

Environmental Degradation and Poverty in Less Industrialized Nations

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ABSTRACT

There is empirical evidence that local environmental problems and low per capita income are geographically correlated. Most of what is written about linkages between environmental degradation and poverty focuses on why the poor use their natural resources in an unsustainable manner. This paper emphasizes first the damage which environmental degradation does to the poor. Next it reviews the standard environmental economics explanation for why the poor accept high levels of pollution, and argues that some notion of power must be added to the standard analysis. Then it examines the role of high discount rates, rapid population growth, incentive structures and institutions in the poverty-environment link. Finally, some general policy conclusions regarding poverty and environmental degradation are drawn.

RESUMEN

Existe evidencia de que los problemas ambientales y el ingreso bajo per cápita están relacionados geográficamente. La mayor parte de lo que ha sido escrito respecto a los vínculos entre la degradación del medio ambiente y la pobreza se centran en descubrir por qué los pobres utilizan sus recursos naturales de manera insostenible. Este trabajo enfatiza principalmente el daño que la degradación del medio ambiente provoca a los sectores pobres de la población. Enseguida, el artículo revisa la explicación de la economía ambiental estándar en cuanto a por qué los pobres aceptan vivir con niveles altos de contaminación, y argumenta que debe agregarse alguna noción de poder al análisis clásico. Por otro lado, también examina el papel que juegan las altas tasas de descuento, el crecimiento acelerado de la población, las estructuras de incentivos e instituciones en el vínculo entre la pobreza y el medio ambiente. Finalmente, se formulan algunas conclusiones en cuanto a la pobreza y la degradación ambiental.

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I. Introduction

THERE is empirical evidence that poverty and environmental degradation are geographically correlated.¹ The evidence indicates that rates of deforestation, soil erosion, water contamination, and air pollution tend to be higher in nations, regions, and localities with low per capita income. Most of what has been written on this geographic coincidence has focused on why the poor use natural resources unsustainably. In this paper we extend the analysis to examine the two-way causal relationship between poverty and environmental degradation. We begin by examining the ways in which environmental degradation exacerbates poverty. In the second section we explore the theoretical explanations for why the poor suffer higher levels of pollution in their immediate surroundings. In the third section we review the most common explanations for unsustainable resource use, high rates of population growth and high discount rates, and the additional explanatory factors of development strategy and institutional context.

II. Effect of Environmental Degradation on the Poor

It is important to recognize that the poor are not only perpetrators of environmental damage, but are also among its most unfortunate victims. Though the direct and indirect welfare losses associated with environmental degradation are not reserved for the poor alone, the poor suffer from them disproportionately. Environmental degradation worsens the plight of the poor primarily through its adverse health effects

and by decreasing the productivity of the resources on which they rely.

Health Effects of Environmental Degradation

In a World Bank study, Mink ranks the most important sources of health problems for the poor.² These include water contamination, indoor air pollution, and outdoor air pollution. The most important of these is contaminated water.³ In fact, the extent of water contamination in the Third World is so great that its effects are not reserved for the poor alone. This is not to imply that the wealthy and the poor suffer equally from this environmental problem. The anecdotal evidence that water and sanitation quality are inferior in poor areas is confirmed by a number of more systematic empirical studies which have shown a strong correlation between per capita income and access to safe water and sanitation.⁴

The primary sources of water contamination are domestic sewage, industrial waste, and agricultural runoff. The nature of the most prevalent water problem typically depends on the stage of development of the economy. Predominantly agricultural economies with a rural base suffer primarily from problems of biological contamination, with fecal waste causing the greatest damage to health. Economies with greater industrial activity and urban based growth tend to suffer more from toxic and hazardous contamination of their waterways.

The second most important source of health problems is indoor air pollution. Indoor air pollution is both more prevalent

1 Alan Durning, "Poverty and the Environment: Reversing the Downward Spiral," Worldwatch Paper No. 92 (1989); Stephen D. Mink, "Poverty, Population, and the Environment", World Bank Discussion Paper No. 189 (Washington, D.C.: the World Bank, 1993); James A. Tobey, "The Impact of Domestic Environmental Policies on International Trade," Ph. D. dissertation, University of Maryland, 1989.

2 Mink, *ibid.*

3 Conference on the Social Dimensions of Environment and Sustainable Development (COSDES), *Development, Environment and People: Report of the Conference on the Social Dimensions of Environment and Sustainable Development* (Geneva, 1992).

4 See Mink, *op. cit.*

among the poor of LDCs and a greater risk to their health than outdoor air pollution. The primary cause of indoor air pollution is the burning of biomass fuels. These fuels emit a great deal of smoke and, depending on the particular fuel, may be toxic. The high rate of respiratory problems among rural women in many cultures has been blamed on the practice of cooking over biomass fires.⁵

The practice of burning biomass fuels varies greatly by culture and climate, but one commonality is that they are burned almost exclusively by the poor. A study of households in South Asia and Brazil has shown that as income increases there is a strong tendency for households to switch from biomass fuels to cleaner-burning sources of energy such as kerosene, propane, and electricity.⁶

The third most important source of health problems is outdoor air pollution.⁷ Outdoor air pollution is caused mainly by industrial manufacturing processes and automobile use. Unlike water and indoor air pollution, exposure to outdoor air pollution does not tend to be restricted mainly to the poor. Since air pollution drifts over large areas, a variety of income groups may be effected.⁸ Nevertheless, the ability of the wealthy to engage in defensive activities makes it extremely likely that the poor are exposed to more air pollution. Defensive activities like relocating to avoid pollution

or purchasing air filters are costly and so are more likely to be undertaken by the wealthy; the wealthy will tend to suffer less exposure because they can afford to opt out of it.

An additional consideration is the unequal health effect a given amount of exposure will have for poor versus wealthy victims. The effect on the poor is greater since they are more likely to work outdoors, exert themselves physically in their labor, and because their generally inferior health status makes them more susceptible to respiratory problems. Thus, although outdoor air pollution drifts, the poor are still likely to suffer more exposure and the exposure they suffer will likely be more damaging.

Productivity Effects of Environmental Degradation

In addition to the direct welfare effects associated with poor health, environmental degradation worsens poverty through its effect on the productivity of the poor.⁹ We can identify two distinct ways in which environmental degradation tends to diminish the productivity of the poor. The first is the aforementioned effect on the health of the poor. Since unhealthy workers are less productive, the inferior environmental quality experienced by the poor implies not only the direct welfare loss of ill health, but also an indirect welfare loss due to the loss of productivity.

5 In *Development, Environment and People: Report of the Conference on the Social Dimensions of Environment and Sustainable Development* (COSDED, op. cit.) it is argued that while the poor bear the brunt of the effects of environmental degradation, within poor households women suffer much more than men. Women are the primary health care providers; they are the procurers of water and fuelwood; they have less opportunity to migrate to escape environmental degradation; and in times of environmentally induced famines their caloric intake drops disproportionately.

6 Mink, op. cit.

7 Sergio Margulis estimates that the annual costs of health damages from pollution in Mexico City alone approach U.S.\$1.07 billion. This estimate includes only costs associated with medical treatment and productivity loss -- it ignores suffering which Margulis terms as "subjective pain" due to the extreme difficulty associated with quantifying it. See Margulis, "Back of the Envelope Estimates of Environmental Damage Costs in Mexico," Policy Research Working Paper No. 824 (Washington, D.C.: Latin America and the Caribbean Regional Office, The World Bank, 1992).

8 Most air quality studies have failed to demonstrate a clear-cut relationship between income level and air pollution level (Mink, op. cit.). However, this failure is due in large part to limitations in the capability to measure airborne contaminants and does not necessarily imply that no correlation exists.

9 Mink, op. cit.

The second is the decreased productivity of degraded natural resources. The reliance of the rural poor on the productivity of natural resources is often very direct. Their lack of man-made or human capital means that decreased soil fertility,¹⁰ deforested land, and polluted, overexploited fisheries dramatically impair their ability to produce enough to meet their basic needs. This decrease in productivity implies that the poor will require more time to reproduce their labor power. Because the poor often rely on the surrounding natural environment for household needs, a degraded, less productive ecosystem will require greater labor inputs to yield the products necessary for survival. Kumar and Hotchkiss carried out a study in Bangladesh in which they categorized different regions into severely or mildly deforested.¹¹ Their study showed that households located in severely deforested regions needed an average of one hour more each day to gather fuelwood than otherwise similar households located in mildly deforested areas. In a region of acute poverty the additional labor time devoted to household tasks is likely to be diverted not from leisure time, but from other productive activities.

III. The Role of the Poor in Environmental Degradation. The Case of Pollution

In examining the role of the poor in environmental degradation we consider first

the case of pollution.¹² In order to understand the role of the poor in the contamination of the environment, we must consider not only their role as polluters, but also as victims of pollution. Environmental quality tends to be bad in poor areas in part because of actions of the poor (e.g., burning biomass fuels), but more importantly because of the actions of others, viz., industrial pollutants are dumped on the poor by manufacturers, and governments fail to provide sufficient water and sanitation infrastructure. Here we consider the standard environmental economics theory of optimal pollution levels as a possible explanation for the high levels of pollution in poor areas. Specifically, we analyze why groups of poor individuals might accept a high level of pollution in their environment. Next we consider how incorporation of power into the optimal externality theory might explain why the poor are so unsuccessful in protecting themselves from the polluting actions or harmful neglect of others.

Standard environmental economics treats pollution like any other externality.¹³ We know from microeconomic theory that the optimal level of any externality will be zero only in the special case for which the marginal external cost exceeds the marginal benefit of externality production at all levels. Optimally, society will produce up to the point where the marginal net benefit (MNB) from production just equals the marginal external cost (MEC). Thus, since externalities are typically generated by productive activity, there is no reason

- 10 Margulis (op. cit.) estimates that annual productivity losses due to soil erosion in Mexico are approximately U.S.\$1 billion. Unfortunately, Margulis does not estimate losses separately for small and large landholders. Regardless, given the large amount of agricultural land owned by smallholders and the relatively high susceptibility of these lands to erosion, it can be assumed that a significant share of these productivity losses are borne by the poor.
- 11 Shubh Kumar and David Hotchkiss, "Consequences of Deforestation for Women's Time Allocation, Agricultural Production, and Nutrition in Hill Areas of Nepal," IFRP Research Report No. 69 (1988).
- 12 If one considers the assimilative capacity of the environment to be a natural resource and defines pollution as the production of waste in excess of the assimilative capacity, then the existence of pollution is not physically distinct from other forms of environmental degradation. Nevertheless, environmental and natural resource economists have found the distinction between pollution and other types of natural resource degradation analytically convenient, and we follow that convention here.
- 13 See, for example, David Pearce and R. Kerry Turner, *Economics of Natural Resources and the Environment* (Baltimore, Md.: John Hopkins University Press, 1990).

to believe that the optimal level of pollution will be zero for any society. The relevant question then is *how much* pollution is optimal for society. Clearly this will depend on the levels of MNB and MEC: higher MNB or lower MEC will increase the optimal level of pollution, while lower MNB or higher MEC will decrease it.

Given this analytical structure it is easy to imagine why poor nations might have higher optimal levels of pollution.¹⁴ First, MEC is to some extent a function of the preferences of the individuals who make up society. Environmental quality is often considered to be a luxury good whose demand decreases by a greater proportion than income as income decreases. As such, the demand for environmental quality will tend to be low in societies where most individuals suffer from low income levels. In addition, since poverty is highly correlated with low levels of education, it may be correlated with low levels of information on the harmful effects of pollution. This lack of recognition of the damages pollution causes tends to decrease further the demand for environmental quality and so lowers the MEC associated with pollution.

It may also be the case that the MNB associated with pollution will be higher in poor societies. In addition to the private MNB enjoyed by the producers of the output which generates the externality, there may exist some additional benefits which accrue to other members of society. In a society with high levels of unemployment/underemployment, the social benefits of the employment creation are likely to be significant. The additional social benefits of productive activity in low in-

come areas tend to increase the optimal level of pollution for poor nations. (See Figure B).

This theoretical result which suggests higher optimal pollution levels in poorer societies is supported by data on levels of industrially produced carbon dioxide. Using correlation analysis to examine the relationship between per capita income and carbon dioxide emissions per dollar of industrial output, we found that there was a Pearson Correlation coefficient of -0.268 which was significantly different from zero at the 5% significance level.¹⁵ This indicates that a strong negative relation exists between carbon dioxide emissions per dollar of industrial output and per capita national income: because of lower MEC and/or higher social MNB, LDCs are willing to tolerate more carbon dioxide pollution per dollar of output.

In addition to a high level of toleration for their own pollution, some LDCs actually accept the dumping of additional waste from developed nations within their borders. From 1985 to 1989 Mexico, Haiti, Guinea, and Zimbabwe accepted waste shipments from the United States, and new dumps for U.S. waste were planned for Panama, the Congo, Guatemala, Sierra Leone, and the Bahamas.¹⁶ (US Congress, 1989) Again, lower MEC and/or higher social MNB lead LDCs to tolerate higher levels of pollution than developed nations.

The Role of Power in Determining Pollution Levels

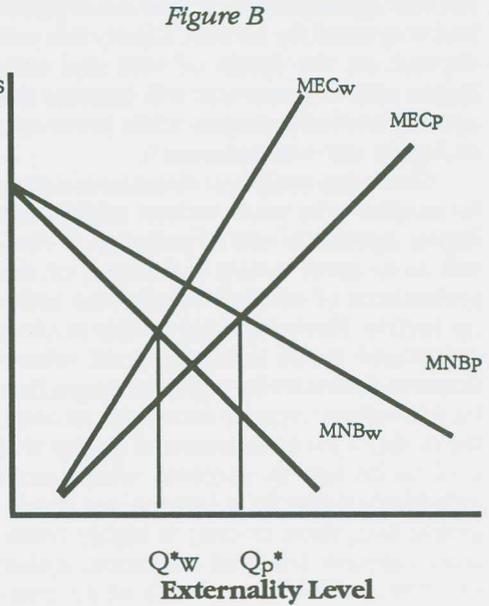
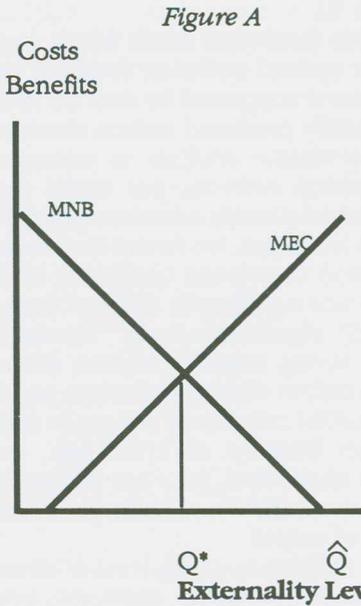
Consideration of why the optimal level of pollution externality varies for different

14 Presumably a government's environmental policy (or lack thereof) will be some reflection on the nation's tolerance for pollution. Tobey (op. cit.) points out that by the mid-1970s most developed nations had instituted pollution control measures and had begun to enforce them actively. In contrast, by the mid-1970s few LDCs had adopted pollution control measures, and of the few who had policies in place, fewer still enforced them. In 1979, Walter and Ugelow (quoted in Tobey, op. cit.) constructed an index for stringency of national environmental controls and used it to regress environmental stringency and per capita income to have a correlation coefficient of .77.

15 The sample consisted of 101 countries and used 1989 data from *World Resources 1992-1993* and the World Development Indicators 1992 database, published by the World Bank.

16 U.S. Congress, "U.S. Waste Exports" (Washington, D.C.: U.S. Government Printing Office, 1989).

Optimal Level of Pollution Externality



A: The optimal level of externality will be at the externality level for which the marginal external cost just equals the marginal net benefit.

B: A lower marginal external cost for the poor (MEC_p) and/or a lower marginal net benefit for the wealthy will imply a higher optimal level of externality production in poor societies (Q_p^*) than in wealthy ones (Q_w^*).

societies gives us some limited insight into why pollution might be worse in LDCs. However, it is not the case that LDCs will typically find themselves with relatively heavy concentrations of pollution spread uniformly throughout their territories, while developed nations suffer only relatively low levels of pollution spread evenly within their borders. Rather, within nations, regions, and localities there is great inequality in the distribution of pollution, with the heaviest concentrations in areas where per capita income is lowest.

Consider the situation in which the producer of some pollution and its victims are members of two distinct groups within the same society. Our simple externality theory indicates that in the absence of regulation (i.e., when MEC are ignored), the

profit -- maximizing producer will generate pollution up to the point where the MNB is equal to zero (\hat{Q} in Figure A). There are a number of possible methods which society could employ to move the production from the unregulated profit maximizing level to the socially optimal level; i.e. from \hat{Q} to Q^* . The most obvious method is some sort of Coasian bargaining arrangement between the victims and beneficiaries of the pollution. Depending on the relevant de facto property rights, either the victim could pay the polluter not to pollute, or the beneficiary could pay the victim for the privilege to pollute. However, the large number of victims associated with most forms of industrial pollution would make the transaction costs of such a bargaining arrange-

ment too high for this solution to be viable in the real world.

Fortunately for the victims, a number of more practical alternatives to the bargaining approach exist. The most commonly suggested alternatives are regulatory standards, emission or input taxes, and marketable emission permits. It is theoretically possible for any of these methods to achieve the socially optimal pollution level. However, the imperfections inherent in any government intervention make it unlikely that any of them will achieve the precise socially optimal level of pollution. Instead, the most likely outcome will be some pollution level between the socially optimal and unregulated profit maximizing levels, i.e. between Q^* and \hat{Q} .

There is a familiar litany of caveats in the literature on the viability of these pollution control techniques: the limited availability of information on environmental damages, the danger of regulatory capture, the difficulty of measuring many types of emissions, and many other problems may explain the failure of these methods to achieve the socially optimal pollution level. However, an important practical consideration which has been neglected is the inequality of power which may exist between the beneficiary and victim of pollution.

In a slightly different context Boyce has argued that this inequality in power implies that more pollution will be produced than would be produced if all agents were equally powerful.¹⁷ Boyce accomplishes this by defining a power-weighted social decision rule and making the assumption that many environmental resources have ill-defined property rights. Boyce begins with the standard benefit-cost approach to evaluating whether a project should be carried out. Projects are carried out when

$$\sum_i b_i > 0,$$

where b_i is the net benefit to each individual in society. In order that his social decision rule more closely resemble what he describes as the "de facto world of social choice," Boyce adds the variable c_i , which represents clout. In his power-weighted decision rule, projects are carried out when

$$\sum_i c_i b_i > 0,$$

In order to demonstrate the importance of the addition of clout we consider a project for which all the economic benefits accrue to one group, while all the negative external effects are suffered by a second group. The benefits to winners are b_w , where $b_w > 0$; and the benefits to the losers are b_l , where $b_l < 0$. Applying the power-weighted social decision rule we have net benefits of $c_w b_w + c_l b_l$, where c_w and c_l represent the clout of the winners and losers. If the group benefiting from the project enjoys more clout than those suffering the external effects, i.e., if $c_w > c_l$, more pollution will be produced than if both groups had equal power, i.e., if $c_w = c_l$. Similarly, if those suffering the external effects enjoy more power, i.e., if $c_w < c_l$, less pollution will be produced than in an equitable society. Boyce argues that the net effect of this inequality will be greater production of pollution because the ill-defined property rights associated with many environmental resources allow less scope for Coasian-type bargaining to prevent the additional pollution which results from having more powerful winners.

Of more importance for our purpose is Boyce's assertion that clout is a function of wealth. In our extension of his power-weighted social decision rule we also assume that clout increases with wealth; thus, $c_i = c(y, z)$ and $\partial c(y, z) / \partial y > 0$, where y is wealth and z is a vector of non-wealth factors. We extend the decision rule by

17 James Boyce, "Inequality, Inefficiency, and the Environment: A Power Theoretic Model," Department of Economics Working Paper 1993-7 (Amherst: University of Massachusetts, 1993).

assuming that the net benefits from any project are a function of the level of exposure to the negative externality. If we let λ represent the level of exposure to the externality, then we have $b_i = b(\lambda)$, and $b'(\lambda) < 0$. Thus we have net benefits equal to: $\sum c_i(y_i, z_i) b_i(\lambda_i)$. Projects which isolate negative externalities where clout is low will tend to have a higher net benefit than projects which spread negative externalities among more powerful groups. Since those projects with the highest social net benefit are most likely to be undertaken, and clout is a positive function of wealth, projects which concentrate exposure to negative environmental externalities in poor communities are more likely to be undertaken.

The Case of Natural Resource Degradation

Most of what has been written on the links between environmental degradation and poverty has focused on why the poor exploit their resources unsustainably. The most common explanations are that the poor have a high rate of population growth and a high discount rate. Here we examine the validity of these explanations and suggest two additional explanatory factors, the choice of development strategy and the institutional environment in which the poor operate.

Rapid Population Growth and Environmental Degradation

Rapid population growth is frequently blamed for environmental degradation in LDCs. Because areas of rapid population growth and rapid environmental degradation often overlap, the conclusion is drawn

that rapid population growth must spur the degradation of environmental resources.

This conclusion is not unreasonable. As mentioned above, the poor tend to rely quite directly on their surrounding natural environment. An increase in the number of poor people implies an increased need for food, construction materials, fuel, and other materials typically obtained from the environment. *Ceteris paribus*, an increase in the poor population will tend to exert stress on the ecosystem on which they rely.

While the above conclusion is not unreasonable, it is superficial in its characterization of the population-environment link. The interrelationship between population growth and the environment is quite complex. Rates of extraction depend not only on population growth, but also on the relative prices of substitute/complement goods, market integration, the effects of culture on economic decisions, technological change, and the robustness of the ecosystem.

In a response to the warnings by Ehrlich and others that population growth will soon overwhelm environmental resources,¹⁸ Griffin argues that a sharp increase in the relative price of scarce natural resources will prevent the extreme case of the human population growing so large as to exceed the earth's carrying capacity and so devastate the environment.¹⁹ Griffin's argument rests on relative price changes, and so rightly shifts the argument over population and environment away from the physical realm (of estimates of carrying capacity, and inches of top soil lost) to the economic realm.

Griffin contends that environmental degradation is due not to population growth, but to the misallocation of resources which results from the failure of prices to reflect true social costs. This failure stems in turn from missing markets,

18 Paul Ehrlich, Gretchen Daily, and Lawrence Goulder, "Population Growth, Economic Growth and Market Economies," *Contention* 1:2 (1991).

19 Keith Griffin, "A Comment on 'Population Growth, Economic Growth and Market Economies'," *Contention* 2:1 (1992).

government failures, and market failure. The true source of environmental degradation must then be these three shortcomings. If these three problems were corrected, population growth would not imply environmental degradation.

But alas, the three problems which Griffin highlights are pervasive. Prices do not always adjust to reflect true social costs for precisely the reasons he states: As demand increases for fuel-wood in Bangladesh, forests are stripped bare, destroying their ability to provide watershed protection -- because of the missing market for watersheds, prices do not reflect the total value of the forest, and it is degraded.²⁰ In response to increasing food demand the government of Indonesia instituted a plan to increase rice production which provided for subsidies on chemical inputs and for price supports.²¹ The overuse of fertilizers and herbicides caused environmental damage, as did the cultivation of previously unprofitable lands in semi-arid regions -- ultimately government failure was the cause of the environmental degradation.²² In Mexico increases in demand for food have led to an increase in intensive agriculture; specifically, the use of irrigation has increased, generating the externalities of soil salinization and freshwater contamination from agricultural runoff -- the market failure associated with these externalities contributed to the environmental degradation.

While price imperfections are critical in the population-degradation link, there are other important factors as well. We must also consider the price response of the resource users. In many cases, natural resources are the only productive re-

sources (besides their own labor) to which poor farmers have access. Thus, their demand for these resources tends to be highly price inelastic: even though the cost of natural resource use soars with increased exploitation, the demand will decrease very little. Consider a rural society with a rapidly growing population and a non-increasing natural capital stock. In order to generate more food and income, the exploitation of the land will likely be intensified: fallow periods will decrease, overgrazing will occur, etc. Though aware that overexploitation of the natural resources will be costly in terms of decreased future productivity, the growing population faces few and unattractive alternatives. There may be some opportunity for rural to urban migration, but this will be limited by the pace of economic growth in the cities. There may also be some chance for extension of the area under cultivation, but this extension will tend to be onto previously ignored marginal lands, which are relatively unproductive and vulnerable to ecological damage.

It is also the case that the response of producers to price signals is not always the most important determinant of their resource use.²³ Cultural and social factors may be more important than price signals. In many regions of Africa, the role of livestock in a variety of cultural traditions does much to determine the size of the herd. The need for cattle to fulfill these cultural obligations often forces pastoralists to maintain herds larger than the profit-maximizing size. For example in the cases of bride wealth and male age group ceremonies, as the number of sons increases, so must the number of cattle, regardless of

20 Durning, *op. cit.*

21 N. Vijay Jagannathan, "Poverty-Environment Linkages: Case Study of West Java," World Bank Environment Department Divisional Paper No. 1990-8.

22 In this context the term "government failure" might be somewhat misleading. The Indonesian government actually succeeded in their professed goal of increasing rice production (Jagannathan, *ibid.*); but of course, the goals of governments are not always the same as the goals of economists.

23 Mwangi Githinji and Charles Perrings, "Social and Ecological Sustainability in the Use of Biotic Resources in Sub Saharan Africa," *AMBIO* 2-3 (May 1993).

the price signals or ecological danger. Unfortunately for the environment, because Homo economicus is not an uncultured brute, overgrazing may result as a direct consequence of population growth.

Thus, although it is not population growth *per se* which threatens the environment, in a world of highly imperfect price adjustments and economic agents who either are not highly responsive to price changes or who respond to non-market incentives, population growth is a proximate (*though not fundamental*) cause of environmental degradation.²⁴

Discount Rates and Environmental Degradation

In explaining the relationship between poverty and environmental degradation the following story is often told: Poor people have high discount rates and so they find it optimal to extract resources at a rapid rate, and they are unlikely to invest in their resources. The logic behind the story is that poor resource users have high discount rates because they have a high rate of time preference, and that the high rate of time preference is caused by their poverty. While this line of reasoning is instructive as a heuristic device, it is bit too neat. We observe neither high discount rates nor high rates of time preference. Rather, we observe economic behavior which we believe is consistent with high discount rates, and we then infer that the high discount rates are caused by high rates of time preference. We also infer that poverty is the cause of this high rate of time preference.

Though reasonable, these inferences do not tell the complete story. High discount rates may be caused by other factors besides the high rate of time preference. As we discuss later, the lack of a social welfare net may also induce behavior consistent with high discount rates. Further, it is not only absolute poverty which causes high rates of time preference. A person's time preference is determined in part by how he compares to his peers. A person who has a low absolute level of income, but a high level of income relative to other members of his society, may not feel poor and may not have a high time preference. This relative aspect of poverty helps to explain why indigenous people of the Amazon who are poor by absolute standards may act in a manner consistent with low discount rates, while migrants into the Amazon who may be materially better off act in a manner consistent with having high discount rates.

Development Strategy and Environmental Degradation

The effect of government policy on the incentives facing the poor is an important determinant of natural resource use. Both broad macro policies, which we might loosely call development strategies, and sector-specific policies and projects affect the incentives that determine how natural resources are used.

We begin with the case of development strategies. Different development strategies will establish different incentives for natural resource use. A development strategy which promotes industrial-led growth creates employment opportunities

24 It is also important to note that the causality between population growth and environmental degradation may also run in the other direction; that is, environmental degradation creates incentives to increase family size (COSDED, op. cit). As the amount of labor time needed to complete basic household tasks increases due to environmental degradation, women may choose to have more children to help with the increasingly arduous tasks like fuelwood collection. The increased labor requirement may also lead to lower educational levels for females, as young girls are required to work at home rather than attend school. As low levels of education are highly correlated with high fertility, this could spur population growth. Finally, the degradation of agricultural land worked by women will decrease their productivity, and so lower the opportunity costs to their labor time devoted to child rearing.

which absorb rural labor and so tend to decrease direct pressure on natural capital. However, at the same time, industrial growth tends to increase demand for raw materials which, depending on the structure of resource markets, may cause environmental degradation. If the policy also involves turning the terms of trade against agriculture, two important changes in the incentives for resource use are likely. First, as the relative prices of agricultural goods decrease, the value of agricultural land tends to fall. As the value of land falls, so too does the cost to degrading it. Second, along with the decrease in income to agricultural producers, there is a multiplier effect for off-farm rural industries. Such industries tend to be labor intensive, and their decline means that the landless face fewer employment opportunities and so there is greater pressure to exploit marginal lands or mine natural resources from common lands.²⁵

Alternatively, a policy of promoting agricultural exports will imply some level of integration into world commodity markets. It is argued that much rural environmental degradation in Africa and Latin America can be attributed to this policy of agro-export development.²⁶ The policy tends to change rural land use from locally oriented, sustainable systems to agricultural enterprises designed to extract the maximum amount of surplus possible in the short run. These agricultural enterprises have tended toward extractive rather than sustainable resource use primarily because of the volatility of world commodity markets. The volatility of world commodity markets generates uncertainty over

the long run profitability of export crops, and so the focus has been on maximizing the short run profits while conditions are favorable.

Specific sectoral policies and investment projects also have an effect on resource use. While this may seem abundantly obvious, it bears emphasizing because the environmental effects may be entirely unanticipated or may be different from what was expected.

Jagannathan, et al, argue that investment in rural infrastructure which has the effect of increasing spatial and market integration may increase environmental degradation.²⁷ Without opportunity to dispose of their surplus, rural populations have little incentive to exploit their natural resources beyond sustainable levels. But if they have access to wider markets for agricultural and forest products, and if they have access to consumer products which may be purchased only with cash,²⁸ they will have an incentive to increase resource exploitation in order to extract a cash surplus. Of course, this does not imply that there will necessarily be an incentive to exploit unsustainably, merely that market integration increases the tendency to do so.²⁹

Institutions and Environmental Degradation

The most important institutional factors contributing to environmental degradation in LDCs are the systems for common property management, security of tenure, and the lack of a social safety net. Much of the environmental degradation in Africa and

25 Jagannathan (op. cit.) emphasizes the importance of the labor absorption of rural industries. His figures indicate that in Indonesia 64 percent of the income of landless laborers comes from off-farm activities.

26 United Nations, "Poverty Alleviation and Sustainable Development: Goals in Conflict?" Views and Recommendations of the Committee for Development Planning (New York: United Nations, 1992).

27 N. Vijay Jagannathan and A.O. Agunbiade, "Poverty-Environment Linkages in Nigeria: Issues for Research," World Bank Environment Department Divisional Working Paper No. 1990-7.

28 The increase in the perceived needs of the rural producers is a critical element in determining their rate of resource exploitation.

29 It is Jagannathan and Agunbiade's (op. cit.) contention that just such a phenomenon of environmental degradation following market integration has occurred in remote areas of Nigeria.

Asia has taken place on common lands.³⁰ The poor have traditionally relied on common areas for building materials, fuelwood, and for food to supplement their diet. These common areas were not owned by individuals, but by the entire group of users. However, despite the lack of private ownership, common lands were managed carefully by the collective owners and were exploited sustainably for generations.

The change from sustainable to extractive use of the common areas began when colonial rulers and newly independent governments interfered with and ultimately destroyed traditional resource management regimes. Colonial governments interfered with the traditional authority structures which controlled resource use, and newly independent governments often nationalized common property resources, removing control to a central authority. The new management schemes were typically unworkable. Because they were stripped of the legal right to the common lands, resource users no longer had the incentive to exploit the common lands in a sustainable manner. Further, the users did not respect the authority of the new resource managers, and the distance to governmental administrative centers and the expense of enforcement made enforcement ineffective. Therefore resource users could neither be excluded from resource use nor forced to exploit the resources sustainably.

A second important institutional factor is the distribution of landholdings and the security of tenure. The presence of an enormous and growing number of landless agricultural workers in LDCs has contributed greatly to environmental degradation. *Prima facie* it may seem somewhat disingenuous to blame those without land for the degradation of the land, but in fact the landless are important degraders of com-

mon areas (because they have no other resources) and of fragile frontier land (because they are forced to cultivate unfamiliar marginal lands without knowledge of the relevant techniques for sustainable exploitation).

Many of the poor occupy land without secure titles or with insecure tenure. This promotes unsustainable resource use because when the poor have access to land without a long-run stake in it, they have an incentive to maximize short run gains at the expense of long-run sustainability. Empirical studies of resource use have demonstrated the strong relationship between security of tenure and sustainable resource use. In a study of forest dwellers in Thailand which examined resource use patterns of landowners, squatters with long-term usufructuary rights, and squatters without usufructuary rights, a clear relationship between security of tenure and sustainability of use was found.³¹ The landowners practiced the most sustainable techniques and the squatters without rights practiced the most extractive.

A third important institutional factor is the lack of a reliable safety net for the poor.³² An often overlooked dimension of poverty is the extreme vulnerability of the poor to unforeseen expenses like illness, crop failure, or natural disaster. Risks are high and insurance markets are absent. When faced with such crises, the poor often must sell off capital in order to pay current expenses, since they typically lack savings and often do not have access to emergency assistance from the community or government. Thus, when the only valuable asset owned by the poor is natural capital, financial emergencies which necessitate liquidation of their capital may well imply environmental degradation.

This lack of a social security net also influences production strategies of poor

30 Durning, op. cit.

31 Jagannathan, op. cit.; Durning, op. cit.

32 Ibid.

agriculturists. Because they cannot afford the risk of a failed harvest, poor farmers are more likely to select a product mix which results in relatively stable yields than a product mix with more variable yields, even if the riskier product mix produces a higher income over the long run. The exigencies of a secure seasonal income trap the poor farmers in a poverty which (for reasons we have seen) threatens the environment. African pastoralists often respond to this lack of a social safety net by maintaining stocks in associative ownership which are so large that they degrade the land.³³ This phenomenon becomes even more acute in cases where the pastoralists have no access to credit to rebuild herds after a natural catastrophe. In such cases they are forced to rely on natural reproduction to rebuild their capital stock, and so there is an incentive to keep stocks which are larger than is ecologically optimal.³⁴

IV. Conclusions

We have examined various links between environmental degradation and poverty. We have shown that environmental degradation is both a contributing factor to poverty and a result of poverty. Our analysis of this two way causality between poverty and environmental degradation leads

to some general policy conclusions. First, contrary to the common assumption that there is a necessary trade off between economic well being and environmental health, the fact that the poor tend to be the principal victims of environmental degradation suggests that actions designed to enhance environmental quality or prevent degradation may actually improve the lot of the poor. Second, the design of any poverty alleviation program will benefit from the inclusion of environmental factors. Third, the vicious cycle of poverty and environmental degradation requires that poverty alleviation form an integral part of any economic program to protect the environment. Fourth, any shift of power to the poor (be it economic or political) will tend to decrease the concentration of environmental degradation in their communities. Fifth, population control programs may help to slow environmental degradation, but they do nothing to address the underlying, fundamental economic problems driving the degradation. Sixth, besides direct poverty alleviation, policies which ensure effective local control of resources by the poor and provide for a social safety net will be the most effective in promoting sustainable resource use by the poor.

33 Githinji and Perrings, *op. cit.*

34 Charles Perrings, "Pastoral Strategies in Sub Saharan Africa: The Economic and Ecological Sustainability of Dryland Range Management" (Riverside: University of California, Riverside, 1992), mimeo.