NATURAL RESOURCES AND ECONOMIC POLICY IN DEVELOPING COUNTRIES

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Abstract

This paper argues for the need to design broad economic policy instruments to reverse the trend in many developing countries toward increasing degradation and destruction of natural resources. The natural resource base, often critical for economic development, is in many cases threatened by a rapid population growth, the effect of which is compounded by inadequately controlled land and water use.

Policy interventions which have a pervasive effect must be established to influence the environmentally-related behavior of countless, relatively small-scale, resource-using activities which take place throughout a nation's economy. Natural resource management should thus become a standard element of macro-economic and sector analysis, and the physical linkages between sectors need to be critically examined.

Governments must overcome major institutional and political obstacles. New approaches, providing incentives and rewards to policy makers, must be developed to increase interagency cooperation while avoiding overlapping jurisdictions and to prevent vested interests from paralyzing new initiatives.

1. INTRODUCTION

1.1 The effects of poor natural resource management are being demonstrated dramatically in many developing countries, in which land and water resources, which are in principle renewable, in fact are declining at rates which threaten the basis upon which already fragile economies rest [11, 14, 15]. The poorest countries, which tend to be heavily dependent upon their natural resource base,

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and whose problems are compounded by relatively high rates of population growth, are the most vulnerable to the problems caused by environmental degradation, in part because shortages of capital and trained manpower severely limit their ability to switch to other economic activities when their natural resources can no longer sustain them. Moreover, it tends to be the poorest people in those countries who suffer most from environmental degradation. There are, of course, innumerable ways in which the problem is manifested, and generalizations are difficult to make. Air and water pollution are of staggering proportions in cities such as Cairo, Bombay, Lagos, Mexico City and Sao Paulo. However, it is clear that in many developing countries the most critical environmental problems are those which relate to a complex network of events involving over-grazing, commercial logging and fuelwood harvesting, land clearance, deforestation, burning of crop residues and dung, soil erosion, sedimentation, flooding, and salinization. Direct economic consequences include severe reductions in domestic energy availability and agricultural productivity, the indirect consequences having profound and far-reaching effects on human well-being. It is also clear that addressing these problems calls for approaches that question some basic assumptions about economic development, and raise generic issues including the relationships between macro-economic planning and sectoral analysis; the handing of externalities; and the welfare of vulnerable groups and future generations.

1.2 The urgency of the problem is increasingly being recognized and attempts are being made to address them. Ambitious projects are underway to plant trees where trees have been cut down; to clear dams that have silted up because of soil erosion upstream; to pump groundwater for irrigation to help stem the advancing desert; to clean up the poisoned ground and the polluted air. However, in many developing countries, the situation is clearly getting worse, and many of the efforts to remedy the situation are failing. In addition to lack of resources--poverty itself sometimes being both a cause and a consequence of environmental damage--there are a number of reasons for this, including political and financial vested interests, institutional overlaps and bureaucratic inefficiencies, and the myopic view of decision makers. But perhaps the most important reason is the sheer difficulty of dealing with a myriad of relatively small-scale natural resource-using activities which together are responsible for the bulk of environmental degradation that is taking place.

1.3 The traditional approach to environmental management is to invest in projects which have primarily environmental objectives, such as reafforestation or sewerage schemes, or to ensure that components of other projects contain elements designed to mitigate adverse environmental impacts. This essentially project-by-project approach is important, and must be continued. Alone, however, it is clearly inadequate, and needs to be supplemented by more comprehensive, wide-ranging policies. By concentrating on curative, piecemeal solutions rather than on the underlying causes, the traditional approach--in industrialized as much as in developing countries--fails to confront the real issues which have much more to do with the way society works, and less with the technical aspects of natural resource degradation. Environmentally related behavior and policy toward it is in fact at the very heart of social, macro-economic and sector policies--relating to agriculture, energy, industry, domestic and foreign investment, fiscal, monetary and trade policy, income distribution, and regional planning.

1.4 It appears, therefore, that the project-by-project approach should be supplemented by one which integrates environmental and natural resource management directly into economic and social policy. This can be done in two ways: (a) through the design of investment programs supporting environmental and natural resource objectives, and (b) through promotion of economic, social and institutional policies and incentives that influence the environmentally related behavior of government agencies, major resource users, and the countless small-scale resource-using activities which occur throughout a nation's economy. While our understanding of technical ameliorative measures is clearly not perfect, and continued efforts are needed to improve it, the foregoing also implies a need to devote much more effort to develop understanding of:

- the nature, dynamics, and severity of natural resource degradation in light of economic and social criteria, including the welfare of vulnerable groups and future generations;
- the underlying causes, both human and naturally-occurring, of natural resource degradation; and
- the range of feasible economic, social and institutional policy interventions that are appropriate to a given situation.

These issues are elaborated on in the remainder of the paper.

2. THE COSTS OF NATURAL RESOURCE DEGRADATION

2.1 National Accounts and Resource Degradation

2.1.1 The problem of inadequate land and water management is acute not only in ecological terms, but also in terms that economists habitually use; indeed the disciplines of economics and ecology should be seen as mutually reinforcing. In developing countries, the effects of high debt burdens and deteriorating terms of trade are being compounded by the severe and escalating economic costs of natural resource degradation. Nevertheless, there are abundant examples of specific environmental protection measures--both policies and projects--which show acceptable rates of return even according to narrowly defined benefit-cost criteria. In general, however, the status of the stock of renewable natural resources is rarely considered in a systematic, comprehensive way at the macro-economic level, where the major strategic planning decisions are made. It is even more rare for explicit linkages to be established between national income accounts and the renewable natural resource base upon which so many economies depend.

2.1.2 It is increasingly being recognized that conventional measures of national income, such as GNP per capita, give misleadingly favorable estimates of economic well-being or economic growth. These measures do not recognize the drawing down of the stock of natural capital (be it renewable or non-renewable), and instead account for the depletion of resources, i.e., the loss of wealth, as net income. Growth built on resource depletion is clearly very different from that obtained from productive efforts, and may be quite unsustainable. Unless net capital formation is larger than natural resource depreciation, the economy's total assets decline as resources are extracted or degraded: this appears to be exactly what is happening in many of the poorer natural resource-based economies.

2.1.3 By definition, while exploitation of non-renewables such as oil or coal involves depletion, land and water use does not necessarily do so. The complexity of the physical linkages between activities, and uncertainty as to the ability of land and water resources to regenerate, have in the past tended to mask what has been happening. Costs of natural resource depletion have not been estimated and, along with all other forms of depletion, have certainly not been reflected in national income accounts. Policy makers, relying upon GNP as a criterion for national well-being, and perhaps being overly preoccupied with short-term considerations may, therefore, have been lulled into a false sense of security. Indeed, the numbers may be large: for example, rough estimates show the economic costs of unsustainable forest depletion in major tropical hardwood exporting countries ranging from 4 to 6 percent of GNP, offsetting any economic growth that may otherwise have been achieved [7, pp. 29-31].

2.1.4 The point of the foregoing is not to suggest reform of national income accounts (although they have a number of serious shortcomings in additions to the one noted here). Rather, it is to emphasize the importance of natural resource depletion in an overall country planning context. That is to say, the macro-economic impact of natural resource utilization and depletion calls for macro-economic policies to regulate it. A critical step in this process is to refine our understanding of relationships between physical events and their economic consequences. Attempts need to be made to quantify the physical nature and extent of the degradation processes to the greatest extent possible, and to express them in monetary terms where feasible. This would help to highlight the consequences of different patterns of resource utilization for future economic growth, and provide a better basis for making strategic decisions concerning resource conservation, augmentation, or further exploitation.

2.2 The Marginal Opportunity Cost of Resource Depletion

2.2.1 A useful tool for conceptualizing and measuring the physical effects of resource depletion in economic terms is the marginal opportunity cost (MOC). This refers to the cost borne by society of depleting a natural resource, and ideally, would be equal to the price that users have to pay for resource-depleting activities. A price less than MOC stimulates over-utilization: a price greater than MOC stifles justifiable consumption. MOC may be described in terms of its three elements [6]:

(a) the direct cost to the user of depleting the resource;
(b) the net benefits foregone by those who might have used the resource in the future (applicable to renewable resources if they are not harvested on a sustainable basis); and
(c) the costs imposed on others, either now or in the future (so-called external costs).

2.2.2 Although the concept has been extensively employed in analyzing the costs of depletable commercial energy resources, calculation of MOC is never easy [6, 7]. This is particularly true of the kind of natural resources discussed in this paper. Nevertheless, several useful efforts have been made, including estimates of the value of agricultural output losses due to deforestation or soil erosion [1], and of foregone electricity output due to dam sedimentation [13]. Of greater importance than the final result itself, however,

is the discipline that is required to painstakingly evaluate all physical interrelationships and analyze each in terms of the effects of resource use. This applies in particular to the importance of making explicit the tradeoffs or value judgments involved regarding impacts which cannot be evaluated in monetary terms. These include decisions about the income distributional consequences of alternative patterns of resource use; the impact on vulnerable groups such as indigenous peoples; the preservation of antiquities; irreversible effects; genetic diversity; and the welfare of future generations. The proportion of MOC that may be estimated unambiguously in monetary terms will sometimes be large, sometimes small; the analytical framework for arriving at the point of decision making appears, however, to be of universal applicability, and MOC may be used effectively as a benchmark to help make judgments about such things as:

- the merits of conservation or protective measures, including investments, regulations and laws;
- taxes, subsidies, and regulated prices of natural resources or their complements or substitutes.

2.3 Discount Rates, Irreversible Effects, and Future Generations

2.3.1 Economic analysis has a critically important role in determining appropriate investments and policies in the environmental area if—and only if—its limitations are recognized. In highlighting the consequences of certain events that cannot themselves be measured in monetary units, and making those consequences explicit in its own narrowly defined terms, economic analysis may be an indispensable aid to good decision making, but it may fail as a discipline if it is pushed too far.

2.3.2 This is illustrated very well in the treatment of equity considerations, of which the welfare of future generations is a special case. It is often claimed that traditional benefit-cost analysis fails in that discount rates used are too high, resulting in inadequate weight being given to the costs of resource depletion or the benefits of conservation measures to future generations. In fact, manipulation of discount rates is not the answer, for it is inconceivable that one could arrive at a discount rate which satisfactorily reflects—all in one number--the various value judgments and technical parameters (e.g., private and social time preferences; welfare of future generations; productivity of capital; economic growth and savings rates) that are involved. It is much too blunt an instrument for that.

2.3.3 There are circumstances in which intertemporal choices can be made quite satisfactorily by the use of discount rates which reflect the returns to capital in alternative uses based upon fairly short-run market criteria. This applies where there is no reason to expect one generation to be very much worse or better off than another, or where irreversible effects are not involved. Gains resulting from projects or activities which pass standard economic tests could, if future societies so choose, be reinvested for the benefit of generations still further in the future. In these circumstances, MOC alone, using market-based discount rates to estimate future costs and benefits, may be used as an adequate benchmark to evaluate investments or policies. However, where irreversible effects (not an unambiguous term, but one which certainly includes elimination of species and any loss of human life, and probably includes desertification) are

involved, or where future societies are expected to be significantly richer or poorer than the present one, MOC must be supplemented by analysis—possibly quantitative, certainly rigorous--of likely physical and income distributional consequences. The massive uncertainties involved in making predictions about events that will take place many years hence should not deter us from taking such analysis at least as seriously as we now take conventional benefit-cost analysis.

2.3.4 The future generations issue is important, not only in itself, but also because it is a good illustration of the role and limitations of economic analysis in natural resource management. In practice, however, we should not allow it to obscure or become an obstacle to the resolution of more immediate environmental concerns. The urgent problems of the Sahel, for example, suggest that priority should be given to resource management, including the treatment of lateral externalities, which have an immediate impact: irreversible effects are already taking place, and the welfare of future generations will largely depend upon measures which improve the well-being of those now living.

3. THE CAUSES OF NATURAL RESOURCE DEGRADATION

3.1 Physical and Behavioral Linkages

3.1.1 The MOC calculation requires a systematic effort to trace through the often highly complex interrelationships between resource-using activities. The underlying causes of environmental degradation may often be related to activities that at first sight are very remotely connected to the observed effects. If project and policy measures are to be viable, they should clearly be based upon a sound understanding not only of the physical linkages between events, but also the equally complex economic, financial, social and institutional linkages which parallel them. Much work needs to be done in this area: in spite of the massive literature on the physical linkages relating to natural resource degradation, relatively little attention has been given specifically to those points in the series of interrelated physical events where institutional or individual behavior plays a key role, and therefore where policy interventions might be feasible.

3.1.2 This requires still further refinement of our understanding of the magnitude and extent of the interdependence between man-made activities and natural resource systems, e.g., between deforestation, land clearance, over-grazing on the one hand, and soil degradation and erosion, watershed destruction, and sedimentation on the other. Efforts should be made to quantify the impacts at each stage of the interlinked ecological and economic system in physical and/or monetary terms in order to determine the points in the system at which it would be most socially profitable to intervene by way of explicit policy measures. One of the essential elements of this exercise would be to separate out the contribution to environmental degradation brought about by naturally occurring events, which, particularly when compounded by human activities, may often dwarf the impact of human activities alone.

3.2 Improvement of Physical Data

3.2.1 Establishment of the link between economic--particularly macro-

economic--analysis and environmental considerations has in the past typically been frustrated by the inadequacy of physical data. This situation is changing rapidly: recent developments in geographic information systgems allow us better than ever before not only to assess current natural resource endowments and trends in use, but also to better project future endowments under various scenarios of economic growth and sectoral output. In particular, in assessing physical linkages and long term trends, remote sensing from space may offer the benefit of a broad synoptic view, repetitive coverage, and uniformity with respect to the way information is collected. Combined with traditional methods of collecting physical data, and by integrating such information with socio-economic data--on population, land tenure systems and so forth--these developments suggest that systematic linking of macro-economic and resource planning can indeed become a reality. Economic planners, therefore, have a major role in helping to ensure that the collection and analysis of technical information is well focussed, and geared to operational or policy requirements.

3.3 Improved Understanding of Behavioral Factors

3.3.1 Along with better understanding of physical data, we also need to develop a better understanding of individual and institutional behavior as it relates to resource use. This requires very much of a multidisciplinary approach, and analysis of causes that are even more fundamental to the way society works than those already discussed. The range of variables that potentially affect environmentally related behavior is awesome. Taxes, prices and subsidies relating to agriculture/forest products, their substitutes and complements; exchange rate policy; income distribution, land tenure and property rights arrangements; the government and private sector institutional structure; population pressure; educational levels in general, and of women in particular; and the political power structure may all play a role in determining the rate of environmental decay [10, 7]. In addition to the range of expertise in the physical sciences, determination of policies, therefore, calls for the involvement of the economist, political scientist, sociologist, and anthropologist, as well as for legal and institutional expertise.

4. POLICY INTERVENTIONS

4.1 Project and Policy Interventions

4.1.1 As noted, the traditional approach to environmental problems is for public authorities to engage in projects such as reafforestation and pollution control, which are aimed at remedying past abuse of the environment, or to prevent degradation by building ameliorative components into industrial projects or irrigation schemes. The kind of technical, economic and social data, and the nature of the value judgments needed to make sensible decisions about such investments is also required in designing policy interventions. The kinds of empirical and conceptual problems encountered in determining appropriate economic incentives parallel very closely those related to the conduct of benefit-cost studies, and estimation of MOC is equally important in project as in policy analysis. In one area, however, the design of policy interventions is more complex than project analysis: while the success of projects rests heavily upon behavioral issues, the success of policy interventions depends even more heavily upon them, and in particular upon the prospects for changing them.

4.1.2 Much work also needs to be done in this area but already considerable evidence exists which gives grounds for optimism as to our ability to make concrete recommendations about policy interventions. Examples abound of instances in which government policies, typically in the form of direct subsidies to environmentally harmful activities, are also unwarranted even in narrowly defined, traditional economic terms. This is particularly true with regard to forestry policies, and to a variety of subsidies used in developing countries to encourage agricultural and forestry activities [8, 10].

4.2 Agricultural Pricing Policies

4.2.1 Governments throughout the world intervene in agricultural pricing markets, primarily in order to keep domestic foods prices low. A variety of direct and indirect interventions are used, most of which tend to reduce agricultural incomes and the ability to invest in conservation measures. The influence on the very poorest farmers may be particularly adverse: extremely low incomes and urgency of short term needs, implying high discount rates, make investment measures required for sustainable output particularly difficult to achieve. Although important examples exist where, because of externalities or adverse income distributional effects, government intervention may be required, in general the freeing up of agricultural markets, permitting prices to approximate international levels, tends to be consistent with environmental objectives as well as with traditional, relatively narrowly defined, economic ones.

4.3 Elimination of Subsidies

4.3.1 Governments, in part to compensate farmers for keeping output prices artificially low, frequently offer a variety of subsidy programs. Many of these are harmful environmentally, and incorrect even in standard economic terms. Thus, encouraged by subsidies, excessive use of pesticides has led not only to increased exposure of individuals to toxic substances, but also to the emergence of more resistant strains of mosquitoes and to a resurgence of malaria in many parts of the world. Resistance of other insects to pesticides is also growing, and net economic losses--even in the short term--may be a direct consequence of subsidies [9]. Returns have frequently been found to be higher when use is made of integrated pest management practices, involving minimal applications of pesticide, combined with more resistant crop varieties and naturally-occurring pesticides. Similarly, subsidies for livestock production in the form of credit at preferential rates, tax holidays, and land concessions, have often resulted in production that is justified neither in economic nor in environmental terms [10].

4.3.2 Governments have also frequently established inappropriate forest revenue systems in which concessionaires do not cover the replacement costs of exploiting forest resources. A variety of subsidies and tax concessions are used, including free provision of infrastructure, such as roads and port facilities; reduced or waived export taxes on processed wood; subsidized credit and export financing; tax holidays and unlimited loss carry-over provisions; and concessional leases [2, 10]. These subsidies encourage over-exploitation, problems being compounded by the existence of short-term leases (sometimes for as little as one year), which encourage concessionaires to exploit forests without concern for

future productivity. In a number of countries, property rights are automatically conferred upon those who clear the land and use it, thus providing further incentive not to leave standing forest untouched [8]

4.3.3 There are many more examples of incentives that lead to natural resource degradation. Typical means of providing irrigation water, for instance, tend to encourage wasteful use. Introduction of user charges covering full economic costs, rather than simply operating costs, may do much to improve the situation [12]. We perhaps accept too readily the argument that the administrative difficulties of charging for irrigation water on the basis of use presents an insuperable hurdle. Pricing of electric power is another interesting and illustrative case: typically, governments require consumers of electricity to pay
charges which cover the financial costs the utility incurs. These costs, however, frequently underestimate economic and social costs; they would be lower than MOC, for example, to the extent that future exploitation of resources costs more than previous schemes (typically true of hydro systems), or that the pollution costs are not fully borne by the utility. Subsidy may be said to exist if the price paid for publicly provided goods or services is less than MOC; it will often be the case that increasing prices beyond those required to meet the financial objectives of power utilities will improve the efficiency of resource utilization and do so in a way that enhances environmental objectives.

4.3.4 The foregoing examples have a common characteristic: they all represent cases in which government policies have perverse effects in both environmental and standard economic terms. They also represent fairly direct incentives for wasteful environmental management. Greater reliance upon natural market forces and removal of the distorting influence of government interventions will in these instances be the appropriate policy stance. Determination of the appropriate policy prescriptions is such cases is, in principle, straightfoward, although, since vested interests are involved, implementation may be more difficult.

4.4 Externalities, the "Commons" Problem and Naturally-Occurring Events

4.4.1 Quite appropriately, the emphasis of policy reform in the agriculture and natural resource sector in recent years has stressed the importance of bringing about greater reliance upon market forces to provide correct signals to producers and consumers. However, the free market is a good servant but a bad master; it is characteristic of environmental problems that they frequently cannot be automatically resolved in an efficient or equitable manner by unregulated market mechanisms, which leaves no alterna-tive to some form of public intervention. Indeed, the subsidies referred to in the preceding paragraphs might justifiably be replaced by taxes.

4.4.2 Central to the natural resource management issue is, of course, the presence of external effects; thus it is frequently in the private interest of individuals to act in such a way that costs are imposed upon others, who are in no position to demand compensation. Examples are legion: the complex physical linkages between various types of resource-using activities referred to earlier typically imply a series of external effects that can only be controlled by government intervention.

4.4.3 Interference with market processes is currently a somewhat unfashionable cause to advocate, but examples of situations calling for it are abundant: for example, the "commons" problem, in which exploitation of a resource—for example grazing land—may continue to appear profitable for additional users, while actually being disastrous for all, frequently warrants public intervention. Common ownership does not necessarily imply inefficiency: tribal ownership of property in regions with stable populations is frequently characterized by sustainable farming methods [7]. The most serious problems tend to be associated with the use of land or other resources for which ownership is not clearly defined. Measures designed to induce prudent management of such communal resources may include physical restrictions, pricing policies, or the introduction of a variety of property rights, land tenure and leasing arrangements. The financial and technical assistance and water rights protection given to private pastoral associations in some Western African countries is an example of public interventions aimed at the "commons" problem.

4.4.4 There are a number of types of incentives to deal with externalities, some of which may involve extremely indirect methods. For example, a tax levied on livestock production might reduce over-grazing, leading to a reduction in land clearance, and by stemming the rate of soil erosion, exert a beneficial influence on agricultural productivity many miles away. Ideally, the tax should be such that the livestock producer faces total input costs equal to the MOC of his activity, which is determined, inter alia, from the effects on soil erosion and consequent impact on agricultural output elsewhere in the system. Export taxes on logs; taxes or subsidies varying by crop, according to their soil conserving characteristics; subsidization of energy-efficient wood stoves or of kerosene; are further examples of possible interventions that call for careful weighing of costs and possible perverse effects against the economic and environmental benefits that might result.

4.4.5 Finally, public intervention may be required to manage or ameliorate the effects of naturally-occurring resource degradation, including both catastrophic and more gradual events. Measures should be designed in light of the costs and benefits (broadly defined) of the ameliorative action. The contribution to damages made, respectively, by natural forces and by human activity, needs to be disentangled, and the set of incentives or other policies designed accordingly. For example, avoidance of flooding caused by naturally-occurring soil erosion and sedimentation might be assisted by incentives to induce industrial or residential location in less damage-prone areas; on the other hand, to the extent that commercial logging is responsible, the focus should be on incentives designed to improve the management of forest resources.

4.5 The Administrative Costs of Incentive Systems

4.5.1 One of the basic arguments in favor of an approach to natural resource management which relies upon pervasive incentive systems is an administrative one. The costs of trying to deal with widespread environmental degradation on a case-by-case basis, relying upon a benefit-cost approach at the conceptual level, and regulation or policing at the practical level, are likely to be excessive. However, the design and implementation of incentive systems is also not costless, for all, to a greater or lesser degree, involve monitoring, policing, and regulation. A system of stumpage fees, for example, may require

extensive monitoring; irrigation water charges may need metering; the bureaucratic and legal costs of administering land reform schemes may be overwhelming. The decision as to whether or not a system of incentives (or indeed, regulations) is worthwhile may be assisted by (and subject to the usual limitations of), a benefit-cost approach. The cost of the incentive system itself, say the cost of measuring water consumption and collecting fees from water users, should be compared with the estimated benefits, i.e., the savings from the change in resource use resulting from the introduction of the incentive scheme. The magnitude of the savings would depend upon the reaction of the users to the price change (price elasticity of demand), and the MOC of the activity to which the incentive scheme is formally applied.

5. THE NEED FOR PARALLEL ACTIONS

5.1 Distribution of Income and Wealth

5.1.1 The types of intervention discussed in the previous section, some quite direct, some less so, could all conceivably be introduced within existing social and institutional systems. Other influences are also of critical importance but represent more fundamental characteristics of the societies concerned, and therefore are likely to be much more difficult to change. One of these is the great inequality in income and wealth that tends to characterize many developing countries. This is often reflected in an extremely skewed distribution of land which in itself may be an obstacle to sound natural resource management.

5.1.2 As population pressure grows, the poor tend to be pushed onto areas with low agricultural potential and which are frequently ecologically sensitive (semi-arid savannas, erosion-prone hillsides, tropical forests). The situation is aggravated where large farmers respond to growing pressures to expand primary commodity exports and thus to enlarge the areas on which cash crops are grown. At the same time, there is evidence that the large landowners--particularly those engaging in monoculture--do not protect the quality of their land and soil as much as do small farmers who own their land [7, pp. 48-56]. Intuition also suggests, although hard evidence is not conclusive, that security of land tenure exerts a positive influence on conservation [3, 7, p. 46]. Having inadequate control over the land they farm, and little political weight, also means that the poor cannot easily obtain the capital and external information and technology by means of which they could reverse their plight.

5.1.3 While the issue of land reform is central to the question of natural resource management, it is also, of course, one of the most difficult to deal with. In developing countries the relevant decisions are frequently made by a small, politically influential group with interests in commercial logging, ranching, plantation cropping, and large-scale irrigated farming operations. As a result, the prevailing systems of investment incentives, tax provisions, credit and land concessions, and agricultural pricing policies tend to favor those in power, causing losses for the economy as a whole, and at the same time damaging the environment and natural resource base.

5.2 Institutional Structures

5.2.1 Another obstacle to improvement in natural resource management

may be the government institutional structure, in which the activities of public agencies may impinge on parties whose welfare is of no concern to them. For example, the costs of a hydroelectric scheme to farmers or indigenous peoples may not be adequately taken into account by a power utility; flooding downstream caused by a river development scheme may not influence a provincial government if the damage occurs outside its borders. Coordination and control of natural resource use in order to handle external effects, in particular to impose systems of incentives which impact on several sectors, may require the creation of new agencies with wide-ranging authority over certain aspects of the operations of functional ministries within a particular region. It also requires incentives to induce public servants to act in a way that is in accordance with the common good, as well as with the goals of their own agencies. The complexity of achieving such changes is obvious, but this represents one of the most important public sector management issues facing developing countries today.

5.3 Population

5.3.1 It is generally accepted that population pressure is one of the root causes of poverty in general and of natural resource degradation in particular. Accordingly, the success of economic and other incentives will depend in large part upon the success of family planning and other population-related policies. For the purposes of the present discussion, there is little to add: virtually all governments recognize the problem of population growth, and major efforts are being made on both the supply side—provisions of family planning facilities--and on the demand side—primarily by education--to address this fundamental issue. Economic considerations, whether we like it or not, play some role in individual decisions about family size and spacing; the role that governments should play in influencing choice by economic incentives or other means is a highly controversial subject, which goes well beyond natural resource management issues.

5.4 The Role of Women

5.4.1 One aspect of the population issue which does concern us directly is the role of women as household and small farm decision makers. In many developing societies, women carry the major burden in supporting the household, and in performing agricultural work [5, 7]. Without their involvement, natural resource related policies are unlikely to succeed. In Africa, about 80 percent of subsistence agriculture is carried out by women; men increasingly are involved in attending to cash crops or have migrated to urban areas. Women normally do not have title to land, nor adequate access to credit. They may, therefore, be in no position to take the steps necessary to protect the quality of the land and water resources within their control. The fact that women generally also have less education than men compounds the problem. Equality of educational opportunity; of land ownership; and of access to credit are, therefore, required if decision makers at the household and small farm level are to be able to respond effectively to incentive systems.

6. CONCLUSION

6.1 Approached from the perspective described in this paper, an agenda for action is emerging; economics has a major role to play in bringing together and

mutually reinforcing environment and development. On the basis of broad natural resource assessments, economic tools may be employed to help determine the desirability of environmentally related projects, and their design and location. Economic analysis is then vital in pinpointing the need for new incentives, or the removal of misguided existing incentive systems. Used properly, economics can identify the policy instruments which are necessary if sustainable development is to be achieved.

6.2 At the same time, the broader policy focus requires that the traditional economic approach be reassessed, and that methodologies be improved and refined. In fact, much could be gained if the tools and concepts already offered by economic theory were to be applied systematically and correctly. Economic analysis must avoid taking a static view, focussing instead on the dynamic nature of the complex environmental and natural resource problems with their multitude of linkages and indirect effects. Many of these effects either show up at far-away locations (e.g., downstream effects), or in the distant future (e.g., gradual depletion of soil nutrients), posing a major challenge to economists who must learn first to understand the many co-evolutionary processes--the physical interactions plus the human impact--and then to apply suitable economic methods.

6.3 Moreover, if economic methods are to be successful, it is crucial that their limitations be understood and continually kept in mind. In particular, it should be recognized that value judgments about distributional and irreversible effects are unavoidable, but quantification in monetary terms of as many variables as possible is important in crystallizing those issues involving implicit value judgments which may otherwise be ignored.

6.4 Economic assessments and projections will necessarily be fraught with massive uncertainty, given the complexity of the various physical and behavioral linkages involved in natural resource management. This makes it imperative that economists recognize the technical limits of their profession and collaborate actively with specialists in many other areas, including: engineers, agricul-turalists, natural and social scientists, lawyers and management experts. This is, above all, an activity that calls for a multi-sectoral and multi-disciplinary approach.

6.5 An agenda for action, to be developed at the individual country level, should consist of work in the following areas:

- assisted by new technologies, assessment of the existing natural resource base, trends and patterns in resource utilization, and prospects for the future under various scenarios of economic growth, by major sector;
- to highlight the magnitude of the problem, estimation of the impact of resource depletion on net national product;
- estimation of the economic and social consequences of major categories of resource use, based upon the MOC framework;
- use of such information to make judgments about the merits of resource conservation, augmentation or further exploitation strategies at the country planning level;
- in light of the foregoing, identification of investment programs,

and areas where widely impacting interventions need to be introduced;

- elimination of those government policies which are clearly perverse, not only in narrow economic terms, but also in terms of their direct environmental impact;
- design and introduction of more complex interventions, calling for incentives--price, tax and subsidy policies--which have an important, but often indirect impact on resource use, and which address externalities and the "commons" problem;
- continued efforts to address major underlying causes, not only of natural resource degradation, but of development problems generally, including: income and land distribution; population growth, education and the status of women; and institutional reform.

6.6 The logic underlying the above agenda is applicable to the handling of environmental problems in general, and is clearly consistent, example, with some of the arguments used to justify the "polluter-pays" principle [4]. The experience of developed countries in trying to get to grips with industrial pollution provides no grounds for complacency about the task that lies ahead: indeed, a massive effort--analytical, empirical, and persuasive--will be needed to implement the agenda. However, there are feasible ways of integrating natural resource issues into economic planning at the national level and, therefore, to give "equal time" to environmental concerns. It has been noted that the case for certain types of intervention is fairly straightforward; their impacts will be direct, and easily justifiable in conventional economic terms as well as being environmentally beneficial. Given progress in these areas, there are grounds for optimism that more ambitious steps, involving the design of more complex, indirect interventions, and even of policies which address the underlying causes of natural resource degradation, will also be successful.

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