WP 091998 September 1998

Environmental Policy Analysis and Instruments for Biodiversity Conservation: A Review of Recent Economic Literature

by
Madhusudan Bhattarai
mbhatta@clemson.edu
and
Michael D. Hammig*
mhammig@clemson.edu

*Graduate Research Assistant and Professor, respectively, Department of Agricultural and Applied Economics, Clemson University, Clemson, SC 29634-0355.

Prepared for presentation at the Ecology and Biological Resource Symposium, Clemson University, September 19, 1998.

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Environmental Policy Analysis and Instruments for Biodiversity Conservation: A Review of Recent Economic Literature

Madhusudan Bhattarai and Michael Hammig[1]

Abstract

This paper provides a synthesis of recent literature dealing with the institutional environment, policy framework, and economic instruments used in policy analysis related to the conservation and sustainable use of biodiversity resources. .The paper analyzes the economic consequences of alternative policy options and summarizes the application of these economic issues in the formulation of biodiversity protection policy. The paper also concludes that the proper understanding of underlying institutions and, if needed, institutional reforming procedures are also required to provide appropriate incentive structures for conservation and sustainable use of biodiversity resources. Illustrations of these principles and examples are taken from published accounts of biodiversity policy debates and policy implementations.

Keywords: biodiversity , conservation, resource management
JEL: Q2, Q3

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1. Introduction

Biological diversity conservation and sustainable development issues are major international concerns. Recently, conservation of biological diversity has been recognized in the international community, including policy makers and scientists, as essential for the very survival of human beings on the planet. In spite of increasing international concern for biodiversity conservation, especially after the United Nation's Rio de Janeiro conference and subsequent Convention on Biological Diversity (CBD) in 1992, it is still not clear what institutional arrangement can effectively promote conservation and sustainable use of biological diversity. Many believe that ambiguous policies and programs focused on the agrarian sector worldwide are at the heart of the present crisis of biodiversity conservation. The impacts of traditional methods of regulation and government intervention in the sector are often conflicting, and frequently adverse with respect of biodiversity protection.

Among ecologists and natural scientists, however, there is at least a general consensus that maintaining a minimum level of biological diversity is of critical importance to the health of ecosystems and maintenance of the food chain for humans (Gowdy, 1997). However, not all analysts and decision-makers give equal value to the preservation of biological diversity, especially while implementing policies and programs for economic development.

At least in principle, it is generally recognized by scientists and policy-makers that failure to properly understand the economic aspects of biodiversity resources and failure to reflect the social value of biodiversity resources in the market arena are some of the major reasons for the present worldwide crisis. Therefore it is useful for experts from all disciplines to be concerned with the economic ramifications of biodiversity preservation.

This paper provides a summary of recent literature dealing with the institutional environment, policy framework, and economic instruments used in policy analysis for the conservation and sustainable use of biodiversity resources. The paper addresses the economic consequences of alternative policy options. The first part of the paper gives a general overview of the problem and summarizes the importance of biodiversity and recent international concerns. The second part of the paper summarizes some of the major economic issues raised in recent literature pertaining to biodiversity. Finally, the third part of the paper presents the major economic policy options for biodiversity programs.

1.1 Background

The term biodiversity denotes biological diversity, which is used to describe the number, variety and variability of living organisms in a given assemblage (Pearce and Dominic, 1994). Biodiversity has several levels: genetic diversity, species diversity, ecosystem diversity, etc. Biodiversity is defined by the Convention on Biological Diversity and also UNEP (1993) as "the variability among living organisms from all sources, including, inter-alia, terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are a part, which includes diversity within species, between species, and of ecosystems" (Barbier, et al. 1995). It is reported that about half of the world's species are contained in just seven percent of the planet's land surface (WRI, 1997a). That means the pressure on terrestrial biodiversity is intense and it increases as human population needs for space grow over time.

Recently, as evidenced by the United Nations' Conference on Environment and Development (UNCED) held in 1992, and the CBD, the concern for biodiversity conservation has been increasing worldwide. This UN conference recommended the integration of conservation and sustainable use of biodiversity into all national and international economic decision-making processes and agreements. As a result, international institutions have begun to design agreements recognizing that biological diversity resources have global significance. The probability of preserving the natural global ecosystem is enhanced if the different levels of biodiversity are recognized and

given due economic value; thus creating adequate economic incentives for the conservation of these natural resources.

Traditional methods of regulation and government intervention are ambiguous. In general, the cost of biodiversity conservation is imposed on local communities, while most of the benefits accrue to a much broader constituency. Therefore, the issue of biodiversity conservation is a problem of managing global environmental resources through applications of local solutions. Considering these facts, the Global Environmental Facility (GEF) was recently created to fund activities to protect biodiversity and natural habitats that would provide cost-effective benefits to the global environment. The GEF, administered by the World Bank, United Nations Development Programme (UNDP), and the United Nations Environment Programme (UNEP), funds projects that otherwise would not be funded by individual nations because of the lower measurable benefits captured by the individual nations (Munasinghe, 1992; CBD, 1996a).

1.2 Recent concerns and causes of biodiversity decline

There is no unanimous agreement among contemporary scientists, economists, and policy analysts on a theory that explains the process and implications of loss of biodiversity. Even among ecologists and natural scientists, there is disagreement about the details of ecological impacts and the role of biodiversity for maintaining co-evolutionary and resilience functions of the ecosystem (Barbier et al., 1995; Swanson, 1995). However, the limited available literature suggests that the main driving forces behind the present level of biodiversity loss arise from human activities which can be further divided into: i) proximate causes such as hunting, fishing, habitat alternation and conversion; and ii) underlying causes such as social and cultural factors that lie behind economic activities (Barbier et al., 1995). These underlying causes of biodiversity loss include the scale and growth of human population, culture and ethics, poverty, economic incentives, and institutions.

2. Economic issues of biodiversity conservation

Economics is concerned with the allocation of resources to meet human needs or to achieve human satisfactions. Therefore, the resource allocation decision in economics is guided by anthropocentric values of resources. Through this anthropocentric view economics can provide an important and useful perspective on biodiversity conservation (Barbier, et al. , 1995; Randall, 1991; McNeely, 1993). In addition, economics can also provide a full range of information on costs and benefits of resource use associated with the provision of resource use choices.

The biodiversity conservation policy of a society is closely linked to the development policy of the nation. Biodiversity conservation programs involve a significant portion of state lands set aside as parks, reserves, protected areas, or as unharvested wild forests. This implies that significant parcels of land remain under-developed from a current time financial point of view. Conservation programs impose significant opportunity costs, in terms of forgone extractive activities, on the surrounding local communities and the nation involved. Successful conservation programs have to resolve this problem. Such programs may have to provide compensation or other incentives to affected communities. Otherwise, there will be pressure for land conversion and depletion of biodiversity resources. Some of the major economic issues involved in conservation and sustainable use of biodiversity resources raised in the recent literature are summarized below.

2.1 Conservation vs. economic development

Norton-Griffin and Southey (1995) reported that national level opportunity costs of biodiversity conservation programs (protected area programs) in Kenya, estimated as forgone net returns from available farming opportunities, was US$ 203 million per year, in 1989 values, which comes close to three percent of annual GDP of Kenya. Reduction of three percent of annual GDP is a substantial loss to Kenyan society. This case study provides a good example illustrating the need of effective international cooperation for the long run success of such biodiversity conservation programs worldwide.

Biodiversity conservation policy of a society is closely associated with sustainable development policy. Development is any process by which welfare of a society is

improved over time (Pearce and Perrings, 1995). The Brundtland Report of the World Commission on Environment and Development (WCED, 1987) defines sustainable development as "development that meets the needs of present generations without compromising the ability of future generations to meet their own needs." In this context sustainable development is then simply any infinite horizon process by which the welfare of a society is non-decreasing (Pezzy, 1992). This provides a linkage between biodiversity conservation policy and sustainable development policy, such that biodiversity protection is viewed as the means of securing ecosystem resilience to ensure sustainable development.

The development of ecological economics as a separate branch in economics has also provided different perspectives on the policy issues of biodiversity conservation. In the literature of ecological economics it is recently recognized that there is a difference between economic growth and economic development, and that the traditional indicators of economic growth alone do not adequately measure the development process. However, we are still at the beginning of the ecological economics learning curve, and there are many aspects of biodiversity for which we do not have satisfactory answers; such as how diversity of genes, genotypes, species, and communities influence ecosystem functioning and its resilience capacity (Pearce and Perrings, 1995). Here, ecological resilience means, in simple terms, the capacity of an ecosystem to recover from and thus absorb external shocks (Barbier, et al. 1995). This implies that we are still far from discovering the optimum level (or minimum level) of biological diversity that is required in an area, or the planet as whole, to guarantee sustainable development.

We can consider biological diversity resources as a part of the aggregate capital stock available for human exploitation. Then, maintaining biodiversity preserves the available "opportunity sets" for future generations. This also ensures that economic growth remains on a sustainable development path. Thus, biodiversity policy is also linked with policies of "intergenerational equity" and "intergenerational transfer" of resources. Obviously, the present rate of decline of biodiversity imposes a debt to this generation in terms of future ecological costs. The weak form of sustainability requires that aggregate capital available to future generations is at least equal to that available to the present generation. Thus, for sustainable development, the opportunity set for future

generations should be maintained at a level comparable to that available to the present generation (Pearce and Perrings, 1995).

Changes in the biological resources base have opportunity costs, due to their complex ecological linkages. Therefore, a conservation strategy would be successful in economic terms when it is able to resolve these underlying opportunity cost issues. Proper understanding of the economic meaning of substitutability of resources (species) and the ecological functions and inter-dependence among species is of crucial importance to the design of appropriate conservation policy (Pearce and Perrings, 1995). However, our understanding of these topics is very limited.

Another problem we observe in this context is that a large proportion of conservation programs are targeted to the preservation of charismatic species, such as the One Horned Rhino, Snow Leopard, Tigers in Asia, Siberian Tiger in Russia, Red Panda in China, or the Bald Eagle in the U.S. Despite the literature that has emphasized the importance of biodiversity to maintain the health, resilience, and the evolutionary function of ecosystems, in reality these considerations do not receive top priority in the planning and design of conservation programs.

Biodiversity conservation issues have close linkages with development policy, and habitats around the world have been changed primarily because of development policies targeted to land use, urbanization, infrastructure development, or food production, to name a few. These economic activities alter the food chain and hydrological cycles associated with affected ecosystems. The opportunities forgone as a result of these activities will depend on the spatial and temporal spread of the effects of biodiversity changes, the degree to which they are reversible, and the potential for species substitution (Pearce and Perings, 1995). Therefore, the quantification of the opportunity costs and benefits of biodiversity conservation programs are critical issues requiring inter-disciplinary efforts of economists, ecologists, and other scientists.

2.2 Valuation issues

Resource valuation is a critical element of resource policy decisions. Valuation depends on the nature of the resource and the institutional context of the use. Therefore, it is natural that there is controversy among professionals as to proper valuation. For

example, the meaning of the word "value" carries different meanings to the ecologist and the economist. In economics, the value of a resource is determined by its marginal use value in the production of goods and services[2]. The ecosystem value of a resource (like biodiversity) is its value in stabilizing the life support systems which make human existence possible (Gowdy, 1997). Thus, the ecosystem concept suggests an infinite value to biodiversity resources when we consider them as a critical factor for the survival of humans. In addition, the ecological concept of use and valuation of biodiversity also involves ethical judgements about duty to future generations and responsibility towards the non-human natural world. Economic valuation efforts struggle to take proper account of these ethical issues.

The market value of resources or commodities is based on their relative use, or the value of other marketed resources or commodities available to consumers. Following this logic, the market value of a resource (including biodiversity) can only be determined by understanding its place within a bundle of alternative choices. Most mainstream economists believe that biodiversity should be considered the same as other resources, and for efficient allocation it should also be placed in the basket of market choices just like any other resource available to human use (Gowdy, 1997). Due to the substitutability of resource use, human society would not be affected much by the depletion of natural resources and species. They feel that market determinations are generally adequate for allocating optimal levels of resources.

The concept of market allocation of resource is rooted in the anthropocentric use value of the resources. Many others do not agree that valuing natural resources like biodiversity with only such anthropocentric measures is adequate. However, the conceptual framework and tools for valuing non-market goods and services are imprecise and subject to theoretical and practical debate among analysts. Therefore, there is a fundamental difference between the conceptual approach and the way by which an economist views the allocation of resources, including biological diversity, and the conceptual approach and the way an ecologist views biodiversity allocation. Such conflicts are also reflected in the policies and programs put forward by different groups.

[2] Non-exploitive uses such as recreation or the option of preserving the resource for future uses are counted among the services that might be "produced".

Economists often fail to understand the meaning and importance of biodiversity resources beyond the economic value as indicated by the relative prices determined by market exchanges. Similarly, many ecologists and natural scientists fail to understand the logic and importance of efficient allocation of resources by market mechanisms, as is done for most other resources, and the requirements of economic development and growth of a human society (Gowdy, 1997).

Ecologists have been arguing for a long time that biological diversity plays a crucial role in maintaining the resilience of ecosystems to environmental shocks. Therefore, the present trend of declining biodiversity is adversely affecting the performance of ecosystems in terms of plant productivity, nutrient retention, water retention, decomposition of materials, gaseous composition and climatic changes (Ehrlich and Ehrlich, 1992; Tilman and Downing, 1994; Gowdy, 1997). In addition, preservation of the evolutionary potential of ecosystems is another significant issue. When species variability within an ecosystem is reduced by habitat destruction or conversion, system modification, and/or genetic erosion of the ecosystem, then the resilience as well as the evolutionary potential of the ecosystem is substantially reduced (Gowdy, 1997). In this circumstance, the ecological value of the biological diversity resources would be infinite, and there is absolutely no substitute of biodiversity resources (Ehrlich and Ehrlich, 1992). Norton (1988, p. 205) summarizes the value of biodiversity resources in philosophical terms as;

> The value of biodiversity is the value of every thing there is. It is the summed value of all the GNPs of all countries from now until the end of the world. If biodiversity is reduced sufficiently, and we do not know the disaster point, there will no longer be any conscious beings. With them go all value -- economic and otherwise.

2.3 Public good nature of biodiversity resources

Benefits of biodiversity can be classified in many ways such as, direct and indirect, material and spiritual, etc. In fact, the benefits accrue to individuals, communities, and societies both national and international. Therefore, the total benefits of biodiversity conservation programs extend beyond the political boundaries of a nation, providing substantial positive global externalities (CBD, 1996b). Though everyone

shares the benefits of biodiversity, few people sense a personal economic stake in its preservation. Therefore, one of the other major reasons identified for the present level of worldwide loss of biodiversity is the public good nature of biodiversity resources.

Public goods are goods that can be supplied to an additional consumer at no extra cost. In economics jargon they are non-exclusionary – benefits are not the exclusive property of any individual or group. Because of the public good nature of biodiversity conservation programs, most of the costs are imposed on the surrounding local community, society or nation involved, but the benefits are shared by the rest of the world. This is the reason for over-exploitation of ecological resources and habitat conversion, species extinction, systems modification, and so on (Barbier, et al. 1995). Thus, one of the major problems of biodiversity conservation programs is the management of international public goods.

The UN Convention on Biodiversity is a reflection of the recognition by the world community that biodiversity is a major concern; and it requires effective international cooperation to resolve the underlying causes of the problem. Establishment of the GEF is a positive step for managing and sustainable use of an international public good like biodiversity. Similarly, the recent meetings of the CBD and Conventions of Parties (COP 3 and 4 in 1997 and 1998), have also recognized that creation of appropriate incentive structures, or compensation to local communities and/or nations is urgently required to save the remaining biodiversity resources on the planet.

Market failure situations

Market failures arise if the existing market fails to reflect the full cost and/or benefit of a good or service. In the case of biodiversity the costs of conservation are a burden upon the local people or communities surrounding the conservation or protected areas; whereas most of the benefits of such programs are shared by larger constituencies. The market failure of biodiversity conservation programs results from policies of open access for natural resource exploitation and public environmental goods (such as forests). Beneficiaries of biodiversity are not isolated, and therefore cannot be made to pay for the benefits they derive. Costs, on the other hand, are paid by the public agency charged with the maintenance of the protection program. The public gaining the benefits and the public bearing the costs are often not the same.

The market failure results in an incomplete or missing market. Market situations of this type arise due to lack of information about resource use, distribution of income, and assets, and imperfect competition, etc. (Barbier, et al., 1995). Thus, the market failure situation is characterized by a divergence between social cost and social benefit of biodiversity resources, and the existing market prices fail to reflect the full social cost and benefit of biodiversity. In an incomplete market, individual decisions for the use of biodiversity may be rational from the individual standpoint, given the institutional structures and information available at that time, but are sub-optimal from the societal standpoint. The wider the divergence between the social value (cost or benefit) and the private value, the more likely we are to destroy biodiversity resources.

Because of the likelihood that market failures are encountered in resource allocation, government interventions are proposed to narrow the gap between private and social values (cost and benefit). The increasing international concern and commitment to further international cooperation, though started only in the recent past, are positive steps in this regard.

Policy and government failures

Policy failures with respect to biodiversity conservation programs are another common problem. Policy or government failure occurs when the policy intervention necessary to correct the underlying market failure problem is inappropriate (Barbier, et al., 1995). Sometimes government policies aimed to correct one kind of market failure cause another, such as a subsidy on farming that increases conversion of land thereby increasing the loss of ecological resources.

The nature and extent of government failures vary across countries. Likewise, policy failure contexts in developing countries are different than those encountered in developed countries. In developing countries, policy making institutions are themselves often in infant stages, and public participation in the decision making process is frequently lacking. These conditions lead to poorly formulated economic and regulatory policies with regard to conservation and use of biodiversity resources. Some of the major problems are excessive subsidies to farming activities, excessive interventions in product markets, low stumpage fees on forestry, inadequate provision of property rights for natural resources, failures to recognize the traditional common property management

institutions in the policy making process, and so on. The situation in developed countries is not much different in the case of biodiversity conservation. The consumption and use of resources are at a much higher level, which further aggravates pressures on the natural resource base worldwide.

2.4 Societal preferences and inadequate information

The underlying preferences of society influence the public policy setting and decision making process. Society preferences are not stable, rather they change over time. The recent increasing awareness of environmental quality and nature preservation agendas in western countries is a reflection of such changing preferences. The decision to preserve biodiversity is fundamentally shaped by the underlying preferences of the society.

Changing preferences limit the scope of economic valuation of biodiversity resources. The utilitarian approach to valuing a resource is based on the continuity of preferences. But, due to ethical or moral issues, or perhaps due to inadequate information available at the individual level, it is possible that lexicographic types of discontinuous preferences may exist for some individuals for environmental goods like biodiversity (Spash and Hanley, 1995). In that case, we cannot exactly value the biodiversity resources from the willingness to accept compensation and willingness to pay framework of neoclassical economics (that is, the contingent valuation method). When some individuals behave as having lexicographic preferences, then they may be unwilling to trade an increase (decrease) in biodiversity against losses (gains) in income. This is possible when some groups of individuals believe that every animal or species on earth has the inalienable right to live. In that case, the normal demand and supply of the market mechanism cannot be used to optimally allocate resources like biodiversity. Similarly, the policy instruments of neoclassical economics then fail to bring optimum solutions. Given the assumption of lexicographic preferences, welfare compensation for preservation or destruction of biodiversity resources is not feasible.

Similarly, inadequate information about the exact role of biodiversity with respect to the present and future needs of human beings is another problem in managing biodiversity resources. The exact characteristics of ecological functions and ecological

resilience capacity of different levels of biodiversity and how it affects humans are unsettled issues among ecologists and natural scientists, let alone for an ordinary individual in the society at large. Thus, providing more information about biodiversity to the public could increase the perception of value of biodiversity and enhance the public willingness to pay for protection.

Spash and Hanley (1995) reported that lack of knowledge about the meaning of biodiversity is prevalent even among university students in the UK. Based on a random sample survey, they reported that the definition and understanding of biodiversity is also low in the general public. Given the lack of understanding prevalent among even the educated public in the developed world, except the scientific community, we are not surprised that the general public in developing countries attach little value to biodiversity and the concern for conserving this international public good. Hence, the lack of information in the general public domain about the role of biodiversity is another major constraint to effective policy and program formulation for biodiversity protection.

2.5 Underlying institutions and incentive structures, biodiversity and institutional failure

Institutions are the constraints that structure political, economic, and social interaction, and they consist of both informal constraints such as, sanctions, taboos, customs, traditions and codes of conduct, and formal rules like constitutions, law, property rights, etc. (North, 1991). Creation of appropriate institutions reduces uncertainty in exchange and reduces transaction and production costs, improves allocative efficiency, and thus increases the feasibility of engaging in economic activities (World Bank, 1991; North, 1991). Hence, institutions are at the heart of the incentive structures of an economy, and as that structure evolves it shapes the direction of economic growth (North, 1991).

Institutional innovations reduce transaction costs which are the source of economic growth because they facilitate wealth-enhancing trade (Bromley, 1995). Property rights regimes and transactions costs are important factors in institutional analysis (North, 1990). In fact, property rights determine who can participate in decision-making and ultimately use resources. For instance, a subsidy or tax cannot be defined

independently of property rights. Hence, efficient resource use follows only after the questions of ownership are answered (Bromley, 1995).

It is argued that ecosystems tend to be localized and existing institutions fail to incorporate (or internalize) the values of biodiversity conservation activities within the decision-making process. This is the cause of the present level of biodiversity decline (Perrings, 1995). The internalization of these externalities may only be achieved through the reform of national and local institutions (Swanson, 1995).

There is increasing recognition within the international community and agencies involved in development of conservation programs (such as OECD, UNEP, IUCN, and the World Bank), that neglect of the institutional factors for designing policy in the past is among the major factors leading to the worldwide crisis in biodiversity today. Hence, an institutional approach to study of biodiversity loss, based on the analysis of transaction costs, could depict a more holistic picture of the current situation and provide realistic policy instruments for better management of biodiversity (CBD, 1996c). Likewise, recently there is greater emphasis on the design and implementation of incentive measures that are based on an institutional approach (OECD, 1997a, Vorhies, 1997a).

Governments' prevailing macroeconomic policies, including monetary and fiscal policies, domestic and international trade policies, etc., that are usually designed for the development of the overall economy also have adverse effects (unintended side effects) on the conservation and use of biodiversity resources in the economy. The limited case study findings across countries so far available indicate that there is a strong linkage between macro policy adopted by a government and environmental deterioration and biodiversity loss (Barbier, et al., 1995). Therefore, to create an effective solution for the sustainable use of biodiversity resources, the policy making body must recognize these economy-wide effects.

It is also argued that biodiversity resources have historically been managed as common pool resources by the community (Bromley, 1995). Therefore, community participation in the management of these resources is required to obtain optimum utilization. Ostrom (1990) defines a common pool resource as having benefits from saving on high exclusion and monitoring costs. Thus, proper understanding of local community institutions is required for conservation and sustainable use of common

property resources like biological diversity. The strengthening of local institutions and active involvement of local communities would also be required to solve the problem of the public good nature of resources like biodiversity.

Bromley and Cernea (1991), based on the review of several World Bank project reports, concluded that natural resource projects that do not incorporate the interests of local users in developing countries ultimately fail. Thus, an essential component of sustainable development programs is to create a system of incentives and sanctions that influence the individual behaviors of those who live in the local area, and who depend upon the natural resource in question. They further state that common property institutions are important in natural resources management, and successful conservation programs in developing countries must be coincident with the local users' interest, and their active participation in the programs. This applies to biodiversity management programs worldwide.

Economic incentives and biodiversity conservation

In the recent meetings of the CBD, the term "incentive measure" is defined as "a specific inducement designed and implemented to influence government bodies, business, non-government organizations, or local people to conserve biological diversity or to use its components in a sustainable manner"(IUCN, 1997). Incentive measures are one of the cross-cutting themes in the Convention on Biodiversity and are now a major part of the focused agendas of the recent meetings of the CBD, as well as other international forums concerned with biodiversity conservation.

Barbier, et al. (1995) stated that the pattern of economic incentives that prevails in society is one of the most important factors influencing the use of biodiversity resources. Hence, the failure to recognize the economic value of biodiversity and to set up appropriate institutions can result in a distortion of economic incentives, which in turn leads to excessive loss of biodiversity. They also reported that most of the benefits from biodiversity conservation and habitat protection are public rather than private, which leads to insufficient private land allocation to conservation from society's point of view.

They also reported that distortion of economic incentives by inherent association of market and policy failures in biodiversity management projects is one of the major underlying factors for the present level of biodiversity loss. Equally, the failure of

prevailing institutional structures to provide needed incentive structures to stakeholders, such as systems of property rights and resource use rights, also lie at the heart of the problem of perverse economic incentives for biodiversity conservation. These may be considered institutional failures. The pattern of economic incentives that exist in a society is often very complex and arises from a combination of important driving forces, such as institutional and legal factors, culture and ethics, and from the specific characteristic of individuals, households and communities (Barbier, et al., 1995).

Conservation and sustainable use of forest resources and biological diversity also depend largely on the political institutions of a nation; how it decides about resource use, allocation, distribution and ownership, and benefits sharing from such natural resources (Perrings, et al., 1992). Moreover, through developing appropriate packages of incentive measures to conserve biodiversity, a government can improve the livelihood of its constituencies, save taxpayers' money, and ensure a better future for future generations (Vorhies, 1996b). Thus, the economic and institutional analysis of biodiversity conservation projects are important for better policy formulation, and to compete for the attention of government and commercial decision makers to support interests in nature conservation and sustainable development (WRI, 1997b).

Similarly, a recent Resources for the Future study reported that biodiversity may be important for any number of commercial, ecological, aesthetic, ethical, or even spiritual reasons. However, when it comes to commercial prospecting among national sources for new products, the value of biodiversity is not as highly rated as other, more tangible, resources. Therefore, in addition to existing market mechanisms, workable incentive measures need to be developed for better conserving biodiversity resources (Simpson, 1997).

3. Biodiversity and economic policy options

As explained above, there is much ambiguity and uncertainty involved with biodiversity programs. This emanates from the incomplete market nature of biodiversity resources, and also from inadequate knowledge and lack of understanding among ecologists and other natural scientists about ecological functioning and ecosystem resilience and their precise relationship with biodiversity. Traditionally, much of the

emphasis of biodiversity programs has been focused on species preservation and controlling or reversing the existing trend of species extinction. But recently the focus of the biodiversity program has shifted from particular organisms to the ecosystem function of a mix of organisms (Perrings, 1995). In this context, some of the major economic policy instruments for biodiversity protection discussed in the recent literature are as follows.

3.1 Precautionary principle

Application of precautionary principles, as the name suggests, implies that some "premium" or reserve fund is allocated to intervene in human developmental activities affecting the natural environment. Here, the burden of scientific proof lies with environmental disrupters such that their actions will not result in unacceptable ecological damage (Barbier, et al., 1995). Similarly, Perrings (1991) related the "precautionary principle" to the notion of reserved rationality, and cautioned policy makers to proceed cautiously with an intervention in the natural environment to safeguard against the possibilities of unexpectedly severe future costs.

This precautionary principle advocates an allocation of a "safeguard allowance," or some "preventive expenditure" that may be required to mitigate any future environmental damage associated with the use of environmental resources. (Perrings, 1991). Later, Costanza and others have proposed an environmental bond, or interest bearing fund, which would later return to the business firm or developer if there were no environment damage. Otherwise, the environmental bond could be used to mitigate the environmental damage done by the developer.

Perrings (1995) advocated the use of insurance for biodiversity conservation, which is basically a premium on managing ecosystem resilience under a given allocation of resources. This is also built on the precautionary principle. However, advocates of strong forms of sustainability are not fully satisfied with the precautionary principle. They argue that there is no perfect substitution between natural and human made capital, so biodiversity loss cannot be compensated by manufactured capital assets.

3.2 Safe minimum standard

Biodiversity conservation in some sense is the act of setting aside sufficient

reserves to satisfy some set of objectives to satisfy the needs of future generations. The needs of future generations are not reflected in the day to day market arena. By the Brundtland definition of sustainability, the welfare of future generations can only be assured if the level of biodiversity they inherit should be no less than that available to present generations. This concept is consistent with maintaining a minimum standard by which to judge the acceptability of change.

The basic notion of safe minimum standard (SMS) rules were first advocated by Ciracy-Wantrup in 1952; to preserve sufficient area of habitat to conserve an ecosystem unless the costs of doing so are intolerably high (Bishop, 1978). Thus, the notion of SMS has a long history. Protected area programs for conservation and sustainable use of biodiversity resources worldwide are based on this notion.

In practice, SMS policy advocates that society should maintain a minimum standard of conservation. The present trend of establishing protected areas can be justified by the economic theory based on SMS policy. By adoption of SMS policy for conservation worldwide we can avoid many shortcomings of cost benefit analysis. However, controversies will still exist about the precise estimation of the minimum standard and definition of the intolerable cost level.

SMS policy imposes a moral premise on the present generation, as it suggests that unless the costs are intolerably high the present generation is obligated to protect biodiversity. Thus, the present trend of irreversible extinction of species must be halted so future generations should not have to forego the benefits that otherwise extinct species would provide. One of the distinctions of SMS policy is that it advocates rules to keep biodiversity beyond the reach of day to day routine market tradeoffs, and its foundation lies somewhere between economic and ethical valuation of resources.

The decision rule of SMS policy is to maximize net benefit of society provided by natural resources, subject to an SMS constraint. In practice, the levels of SMS constraints vary from society to society, and ethical judgements based on several other factors. The available literature on the topic in relation to biodiversity conservation is still not clear as to the determination of intolerable costs. Some authors have recommended a rule to decide natural resource use by benefit-cost criteria, but subject to

SMS constraints of conservation, which may satisfy conservation needs on ethical as well moral grounds (Randall, 1988; Randall, 1991).

Some of the major arguments in support of SMS policy for biodiversity conservation, as explained by Barbier, et al. (1995), Randall (1988), and Bishop (1978) are the following:

- SMS strategy is considered more pragmatic with respect to the attainment of an efficient and sustainable economy, while at the time also taking care of future generations.
- The criterion of "intolerable cost" also implies some limit on how much society should pay for biodiversity conservation.
- A SMS strategy is a pragmatic safeguard for biodiversity conservation until economies move to a sustainable development path, or societal understanding improves.
- SMS based biodiversity conservation strategy keeps biodiversity resources beyond the scope of normal market tradeoffs, which at present are considered to be inadequate to deal with many of the issues of resource use.
- Given the present level of uncertainty associated with the function and use of biodiversity, and future environmental impacts resulting from today's economic activities, SMS provides a practical framework for biodiversity conservation.
- SMS strategy puts limits on economic activities to ensure that they do not impose irreversible environmental costs on future generations.

3.3 Institutional reforms providing appropriate incentive structures

The gap between the social and private values of biodiversity resources explains the need for policy to reconcile the differences. Much of the social value is attributable to the global significance of biodiversity resources, while private values are local in nature. Therefore, better understanding of private as well as social benefits and costs of biodiversity conservation programs is needed to minimize the externalities associated with biodiversity conservation programs. Because of the pervasive market and policy failure situations associated with biodiversity conservation programs, the private costs (benefits) and social costs of such conservation activities diverge widely. Market and

policy failure situations are also associated with existing institutional structures. Therefore, the focus of the biodiversity protection issues has recently shifted to analysis of existing institutions, and to create incentive structures for the individual and society to protect biodiversity resources. Rather than focusing narrowly on the economic instruments, or only token policy reform agendas, the institutional reform process allows changing the entire regime or systems, such as legal system reforms, environmental sanctions, contract enforcement, etc.

The institutional framework of a society has an important influence on individuals' decisions concerning the use of resources and thus incentives for biodiversity conservation. Therefore, institutional failure scenarios on international, national and local levels need to be assessed and corrected if the present worldwide problem of biodiversity loss is to be adequately resolved (CBD, 1996c). However, the success of biodiversity conservation projects in terms of encouraging appropriate economic incentives will require greater understanding of the overall institutional context in which the project is being implemented (Barbier, et al., 1995; CBD, 1996c). Similarly, many aspects of biodiversity require different levels of institutions and incentive measures to various stakeholders for equitable distribution of opportunity costs and benefits of conservation.

Proper analysis and quantification of existing economic incentives and institutions are important for policy recommendations for management of natural resources, and also will influence the political decision making process at the national and international levels (CBD, 1996b). These analyses are also important for appropriate cooperation and involvement of the private sector and local communities. It is increasingly being recognized in the international community that institutional reform processes are important, particularly in developing countries, for the conservation and sustainable use of environmental resources, and ultimately also to help establish markets for environmental goods and services.

Efforts to conserve biodiversity in a low-income country must not be pursued in isolation but must be complementary to overall economic development. Just as efficient and sustainable use of natural resources is essential to economic development, efforts to improve overall economic performance can provide important incentives for increased

conservation. For example, the "nutrient mining" behavior of farmers in the case of frontier agriculture is one of the key factors leading to deforestation and depletion of forest biodiversity. So, in this type of a situation investment to improve agricultural productivity is one of the best solutions to the problem of managing biodiversity (Barbier, et al., 1995). Research at Clemson has revealed that a direct correlation exists between economic growth and expenditures on environmental protection (Yandle and Qin, 1998).

The success of biodiversity conservation programs in protected areas, which are the major focus of biodiversity management programs worldwide, largely depends on the economic and other incentives available to local stakeholders. Hence, conservation projects need to be designed such that they are sensitive to prevailing socioeconomic conditions, and they focus on participation and management by local communities.

In addition, the problems of biodiversity conservation spread across the boundary of one nation or society. Therefore, the solution of biodiversity problems requires national and international understanding, cooperation, and support, and adequate compensation to the individual or nation bearing most of the opportunity costs of such programs. Well-managed compensation schemes would provide adequate incentives to affected individuals and societies to ensure conservation of biodiversity.

The present state of biodiversity profoundly affects many facets of life. Therefore, a multidisciplinary approach is required to effectively tackle the problems. The recent development of ecological economics as a separate discipline, combining the efficiency notion of economics and system perspective of ecology, can be viewed as a positive step in this direction.

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