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Sustainable Biodiversity Management (SBM) Model: An Economic Approach

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ABSTRACT

Biodiversity is the subject matter of scientists especially biologists, who normally study the biological diversity in terms of genetic, species, and ecosystem, and they throw a light on the important services offered by biological diversity. With scientific inquiry, they brought out the information on threatened, endangered, and extinct species caused by human interventions, followed by overpopulation resulted with excessive consumption of biological resources. For instance, industrial, agricultural, and technological revolutions have produced both positive and negative impacts on biological resources. In fact, these resources perform several ecological functions such as: decompose waste products, remove impurities from water, generate oxygen, convert low quality vegetable matter to high quality protein, and pollinate crops; psychological functions such as: aesthetic, psychological, spiritual, and religious benefits; and economic functions such as: food, fodder, fuel for living organisms. The exiting biodiversity management systems have forgotten to express the economic values of biodiversity resources in monetary terms. Environmentalists' deal with assessing the potentials of biodiversity resources, identifying the reasons for degradation, and providing solutions for conversations. Whereas, economists deal with integrating the economics with ecology by adopting the concept "sustainability" and emphasize the need for balancing economic growths with sustainable environmental management (including biodiversity management). In this context, ecological economists play a vital role in biodiversity management by carrying out the impact assessment study, risk analysis, public education, political action, and follow-up. With this background, the authors have propounded a SBM model and it deals with the accounting and auditing, preserving and conserving, reducing and reusing, renewing and replenishing, recycling and recovering the biodiversity resources, in a sustainable way.

Keywords : Biodiversity, Sustainability, and Management.

Introduction

Biodiversity[1] is the variety of life on earth, embracing all species of plants, animals, including humans and micro organism, along with the ecosystems and the ecological process that makes life possible. It renders a myriad of goods and services, essential for subsistence and survival of humans and other species (Santhosh V. et.al, 2005). Biodiversity is broadly defined[2] as the *variety* of the living world — the different plants, animals and microorganisms, the genes they contain and the ecosystems of which they form a part. DeLong (1996)[3] offered a more comprehensive definition:

Biodiversity is an attribute of an area and specifically refers to the variety within and among living organisms, assemblages of living organisms, biotic communities, and biotic processes, whether naturally occurring or modified by humans. Biodiversity can be measured in terms of genetic diversity and the identity and number of different types of species, assemblages of species, biotic communities, and biotic processes, and the amount (e.g., abundance, biomass, cover, rate) and structure of each. It can be observed and measured at any spatial scale ranging from micro sites and habitat patches to the entire biosphere.

Biodiversity can be classified at three levels (Productivity Commission, 2001) — genetic, species and ecosystem: *genetic diversity* occurs within and between populations of species, providing individual characteristics and influencing resilience or adaptability to change; *species diversity* refers to the number of species in an area; and *ecosystem diversity* refers to the variety of interrelated biological communities such as wetlands, rainforests and grasslands, their interactions and resultant ecological processes and ecosystem services.

Contemporary global change is brought about mainly by humans and accordingly the human society poses threats to biological diversity (Goudie et.al, 2002). For millennia, humans have been transporting organisms beyond their natural ranges, wittingly and unwittingly, causing extinctions of native species through competition and predation by introduced species (Andrew S. Goudie, 2002) and the recent Millennium Ecosystem Assessment Report 2005 also stated that: Humans are fundamentally, and to a significant extent irreversibly, changing the diversity of life on earth, and most of these changes represent a loss of biodiversity (Giannis Vardas1 and Anastasios Xepapadeas, 2008). In addition, many factors are usually causing the biodiversity losses, such as: ***physical alteration of habitats*** through processes of conversion (e.g. natural areas are converted to farms, housing subdivisions, shopping malls, marinas, and industrial centres), fragmentation (e.g. the species is endangered due to the fragmentation of its habitation, creating edges that favour the brown-headed cowbird, a nest parasite that can invade the forest and lay its eggs in the nest of the rare warbler), and simplification (e.g. removing fallen logs and dead trees from woodlands for firewood, thus diminishing an important microhabitat on which several species depend); ***the population factor*** – continuing human population growth will bring on continued alteration of natural ecosystems and the inevitable loss of more wild species (e.g. in East Africa, the conversion of savanna and

woodlands to cultivation or intensive grazing has driven most the African elephant population into the existing wildlife reserves, causing a great reduction in their numbers); ***exotic species*** – is a species introduced into an area from somewhere else, often a different continent (e.g. the European colonists bought literally a hundreds of weeds and forage plants to the Americas, so that now most of the common field, lawn, and roadside plant species in eastern North America); and ***overuse*** – is driven by a combination of economic greed, ignorance, and desperation (e.g. Italy holds a record of an astronomical 50 million birds killed and eaten each year) (Richard T.Wright and Bernard J.Nebel, 2002). The whole story of the world designate that biological diversity is declining globally and there is a need to increase efforts to conserve and sustainably use ecosystems and biological resources. Thus, biodiversity loss has become a global concern and emerged as a major issue on both academic and policy grounds.

Biodiversity Management: Conceptual Framework

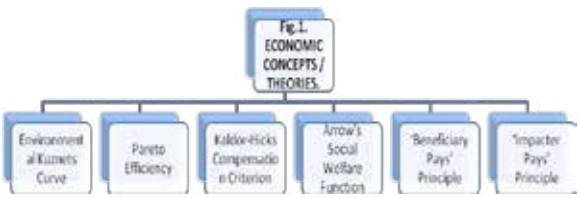
Biodiversity will continue to decline as long as we continue to remove and constrict the natural habitats in which wild species live (Richard T.Wright and Bernard J.Nebel, 2002). This loss is bound to be costly, because biodiversity loss is irreversible; many species — especially the invertebrates, microbes and viruses — have yet to be discovered; Ecosystem diversity exhibits threshold effects; many biodiversity problems cannot be solved by merely proscribing certain behaviour; much biodiversity has no immediate economic value, giving rise to substantial tensions between public and private interests; and the causes of genetic, species and ecosystem losses are extremely diffuse in nature, and involve many different sectors and forms of economic activity (Young et al., 1996). Moreover, it provide vital services to human societies such as *ecological services* - decomposing waste products, removing impurities from water, generates oxygen, converts low quality vegetable matter to high quality protein, and pollinates crops; *psychological services* – disseminates aesthetic, psychological, spiritual, and religious benefits; and *economic services* – fabricates food, fodder, fuel for living organisms. With loss of biodiversity, the Earth's resource base in terms of future food, medicine, and industrial materials will be reduced immeasurably (William M.Marsh and John M.Grossa, Jr., 2002). The seriousness of biodiversity losses has been realized by the international community and they have taken initiatives to promote and implement various management measures, including national land use programmes, international conservation programmes with greatly expanded and integrated systems of preserves, and programmes to repair damaged landscapes that reduce barriers and fragmentation (William M.Marsh and John M.Grossa, Jr., 2002). For instance, aftermath of the Endangered Species Act (ESA) of the United States, the Convention on Illegal Trade and Endangered Species (CITES, 1973) was established – focuses on trade in wildlife and wildlife parts. International institutions like United Nations (UN) finds out that although, CITES provides for some protection of species that might be involved in international trade, it is inadequate to address broader issues pertaining to the loss of biodiversity, and it came out with a proposal of international treaty viz. Convention on Biological Diversity (CBD, 1992) – concern for the intrinsic value of biodiversity, its significance for human welfare, the sovereignty of a nation over its biodiversity, and the nations obligations to protect and conserve biodiversity. Furthermore, the recent one is Critical Ecosystem Partnership Fund (CEPF) – jointly sponsored by the World Bank, Conservation International, and the Global Environment Facility – the ultimate aim is to protect biodiversity 'hot spots' (Richard T.Wright and Bernard J.Nebel, 2002).

Recent experiences from the implementation of the several international treaties, taught that various stakeholders[4] participation is essential in the biodiversity conservation. As a rule, biodiversity conservation has the characteristics of 'public good'[5] - have often been used as the rationale for direct government provision of conservation. However, some of the arguments used to justify public provision of conservation can be weak. There are also some limitations to public provision of conservation. The private sector can complement existing public conservation initiatives and supplement the role of the public sector by reducing the need for public sector involvement in the provision of conservation on both public and private land (Productivity Commission, 2001).

Biodiversity Resources: An Economic Approach

Economists view the natural resources as a luxurious commodity. The perspective of viewing natural resources as luxuries is expressed in the World Bank (1992) report, in which it was suggested that there is an empirical relationship between gross domestic product (GDP) per head and concentrations of industrial pollutions. It was found from the historical experience of Organisation for Economic Cooperation and Development (OECD) countries, the functional relationship between GDP per head and concentrations of industrial pollutants has an inverted U shape. Among economists, this relationship has been christened the "Environmental Kuznets Curve" (EKC). Economists' concern over the natural has been earmarked from the classical to the modern period and continues. For instance, ***Pareto efficiency*** (makes at least one individual better off without making any other individual worse off) helps the ecological economists to find ways to better off the economic development without making any damage to the ecological resources; ***Kaldor-Hicks compensation criterion*** (demonstrates gaining from the policy could offer compensation to those who would lose from the policy. If there is an amount of compensation from gainers to losers that i) would make the losers voluntarily accept the policy and ii) would leave the winners better off with the policy than without, then the policy passes the test) guides the not only economists but also policy makers to balance the ecological losses and economic developments; and the ***Arrow's Social Welfare Function*** *(SWF)* (involves a complete and consistent ranking of policies in terms of desirability (a social welfare ordering) equips the policy makers to give the prior to the preserve and manage the ecological resources, which has been continuously declining in stead of concentrating on economic development which has been majorly focusing on the development in terms of money (Bagnoli et.al, 2008). Economists use distinct value categories to capture these various sources of biodiversity's contribution to human wellbeing, with the most fundamental categories being those of use and non-use values. Taken together, these value categories make up the total economic value (TEV) of biodiversity, *i.e.* the total contribution of biodiversity to humanity (Pearce and Moran, 1994). The concept of the TEV allows us to evaluate the benefits of policies that affect the availability of biodiversity. It does so by assessing the changes in the values within each value category of the TEV that occur as a result of the policy. When a policy sacrifices more benefits of biodiversity than are gained from its loss at the margin, then this policy should not be allowed to proceed. Against the list of benefits identified through TEV, we must compare the costs – monetary and otherwise – of maintaining/procuring these goods and services through biodiversity protection. For policy-makers to decide which policy is the most appropriate, these costs of biodiversity policies also need to be accounted for. The costs of biodiversity policies can be categorised into: *Direct costs* of implementing the policy, *e.g.* budgetary expenses rose through taxation. These costs tend to affect governments and are generally smaller than other costs. *Indirect costs: e.g.* crop losses at the boundaries of protected areas as a result of increased wildlife population levels. Exposure to these costs will be higher for those more reliant on extractive and consumptive activities in, or adjacent to, a conservation area. *Opportunity costs:* the value of lost consumption possibilities previously exercised and no longer possible, or of future consumption possibilities. These opportunity costs are the main costs associated with biodiversity policies. There are two broad cost sharing principles are suggested by the economists (Pigoue A.C, 1932): the ***'impacter pays' principle***, requires individuals causing environmental damage to meet the full costs of their actions — contributing to the costs of activities that ameliorate or prevent biodiversity damage in proportion to their

impacts on biodiversity. As impacters may pass on some of these costs as higher prices, consumers who benefit from activities that adversely impact biodiversity may also meet a portion of the higher costs. The ***'beneficiary pays' principle*** requires anyone who benefits from an activity to contribute to the costs of undertaking it. Under this principle, benefits can accrue to individuals, groups of individuals, or the community more broadly (Aretino, 2001).

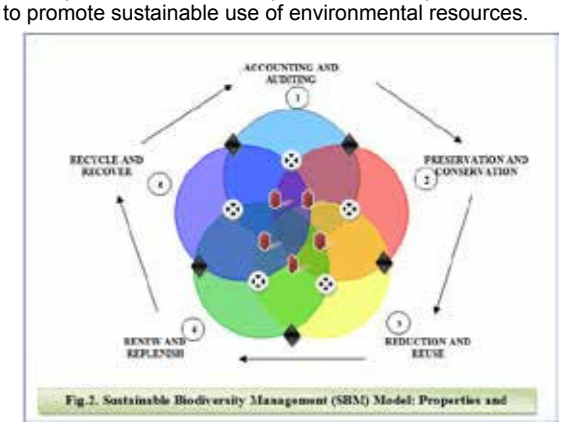


Sustainable Biodiversity Management (SBM) Model: Proposed

A commonly used definition of 'sustainable development' emerged from the World Commission on Environment and Development (1987) (the Brundtland Commission): "...development that meets the needs of the present without compromising the ability of future generations to meet their own needs ... (WCED, 1987). The concept of 'Ecologically Sustainable Development' (ESD) was brought to the fore following growing concern throughout the 1970s and 1980s about the current and future. This inquiry is mainly about processes in place in government to further the implementation of ESD and its activities into six broad themes: quality of life; efficient use of natural resources; protection of the global commons; management of human settlements; waste management; and sustainable economic growth (World Bank 1997).Three core objectives articulated in the ESD are: enhance individual and community wellbeing and welfare by following a path of economic development that safeguards the welfare of future generations; provide for equity within, and between, generations; and protect biological diversity and maintain essential processes and life support systems (Productivity Commission, 1999). Thus, the underlying objective of the ESD is maintenance or improvement of welfare both within, and between, generations. The concept of intergenerational equity requires that actions of the present generation should not compromise the ability of future generations to enjoy at least the same living standards and quality of life as the current generation (refer Pareto efficiency) . Further, ESD attempts to maximize the combined total of economic, social and environmental values of resource use, but to do so may involve trading off some elements that make up these values. Application of ESD, therefore, is about pursuing *optimal* protection of biodiversity rather than *maximum* protection (Bates, 2001). While, pursuing optimal protection and management of biodiversity resources, market failures can occur as a result of: the presence of externalities; inadequate information (for example, about the needs of future generations, the degree of substitutability of natural capital, and why, how, and how much biodiversity should be conserved); the public good characteristics of some components of natural capital; and the existence of 'open access' resources (Productivity Commission, 1999).

The existence of market failures is one of the main reasons for government intervention (although not a sufficient condition because the costs involved in intervention may outweigh the benefits in some instances). Governments can address market failures using a number of approaches, including: encouraging the internalization of externalities using existing markets and price signals by, for example, using environmental taxes and user fees, and removing subsidies on natural resource use; creating markets by establishing property rights (for example, property rights for land and water resources, and tradable pollution permits); using legislation to regulate specific activities and to support market based approaches; and providing information in relation to ESD concerns or problems, including public education, funding R&D and developing performance indicators for monitoring, evaluating and reporting on the implementation of ESD (Productivity Commission, 1999). Although government has a role in ESD implementation, intervention sometimes fails to meet its objectives for a variety of reasons. This results in an inappropriate balance between economic, environmental and social objectives in policy and program formulation. These can lead to regulatory capture, inadequate analytical tools, policy inertia or poor coordination by governments (Productivity Commission, 1999). Further, internationally and ideologically the World Bank (1997) has also concerned on managing the interaction between environment, economy and society and recognized four broad approaches to address ESD related issues through economy wide policies. They are: using markets; creating markets; using environmental regulation; and engaging the public.

Since, the role of commons is becoming increasingly important in promoting sustainable management of the environment, there is a need to fully understand the capability for the management of environmental resources, which can provide the basis for understanding the call for collective action at different platforms, in order to prevent over–exploitation of and to promote sustainable use of environmental resources.



In these contexts, the *SBM model* is propounded for managing the biodiversity

resources in a sustainable manner. The *SBM model* deals with the accounting and auditing, preserving and conserving, reducing and reusing, renewing and replenishing, recycling and recovering the invisible economic value of biodiversity resources. The model is described in three different stages, namely diamond stage, circle stage and positive stage, of biodiversity management. In every stage, it necessitates the collective efforts of players and stakeholders of biodiversity resources. A neutral point analysis on the significant relationships between different properties and elements of biodiversity management is stressed in the diamond stage of the *SBM model*. For instance, a neutral point analysis exhibits the relationships between accounting and auditing, and preservation and conservation at the diamond stage. In the circle stage, by taking an element or property as the platform, the SBM model encourages to evaluate the relative performance of other two specific elements or properties, which may lead the stakeholders and players to understand the direct and inverse performance of different properties and elements of biodiversity management. For instance, by taking the accounting and auditing as a platform, the model necessitates evaluating the relative performance of, preservation and conservation of biodiversity resources and capacity of recycling and recovering the scraps of biodiversity resources. Finally, by taking a neutral point of two elements or properties as the platform, the SBM model insists to assessing the recital of other two specific elements or properties, which may lead the stakeholders and players to understand the ways and means of reaching positive end, in which possible and sustainable management of biodiversity resources could identified. For instance, accounting and auditing, and preservation and conservation as a neutral point of these two elements or properties, the SBM model assesses the recital of reduction level and quantum of resources (used) available for reuse.

Conclusion

As of now, there is no scientific biodiversity management model evolved either by environmentalists, ecologists or by economists. Hence, an attempt has been made to integrate different ecological, environmental and economic variables for sustainable use of biodiversity resources. For instance, environmental accounting has not been properly used for calculating the gross national product (GNP), which must take into account of the debit side of environmental resource use and credit side of economic value of environmental resources. In order to balance the both sides, four 'R's namely reduce, recycle, renew and reuse are essential pre-requisites for sustainable development. More so, private-public participation (PPP) involving the most critical people like indigenous or tribal groups, who have been largely disenfranchised and have no role in management biodiversity resources, and protecting the most valuable flora and fauna, which require constant and frequent accounting and auditing, for quantifying these biological resources. For these, the proposed *SBM Model* could be considered as appropriate tool and instrumental mechanism for managing the biodiversity resources. It emphasizes the role and responsibilities of different stakeholders in protecting and preserving the biodiversity resources through the experiment of participatory management of biodiversity resources. Thus, the *SBM Model* could incorporate the *Input- Output Analysis* (Walras) as an experimental tool for application of economic theory, economic logic, and economic principles, in the ecological and environmental arena.

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