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# Biodiversity institutions and sustainable development

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**Abstract:** It seems that human society needs to come to terms of co-operation at the organizational level of planning as concerns local biological resources, without opting for destructive competitive shared use of natural resources intra-temporarily or inter- temporarily. The conservation of biodiversity and the use of traditional knowledge thus require that the institution of capitalist society change and accommodate co-operation in the management of such resources in the interest of a sustainable development process. The legal and institutional arrangements also need to give due recognition to conservation as well as to equitable benefit-sharing from the use of such resources and the knowledge bases linked with them in the context of modern society. The challenge facing the relevant policies would be to strike a balanced role for local community organization and market to combine efficiency and equity in both the economic and the ecological senses. The interdependence of ecological and social sustainability thus needs to be recognized in both our analytic approach of the concerned scientific disciplines, as well as in the formation of policies for development.

**Resumen:** Parece que la sociedad humana necesita ponerse de acuerdo para la cooperación en el nivel organizativo de la planeación en lo que concierne a los recursos biológicos, sin tener que optar por un uso de los recursos destructivo y basado en la competencia, tanto intratemporalmente como intertemporalmente. Tanto la conservación de la biodiversidad como el uso del conocimiento tradicional requieren que la institución de la sociedad capitalista se modifique de manera que pueda acomodar a la cooperación en el manejo de dichos recursos, en el afán de alcanzar un proceso de desarrollo sostenible. Los arreglos legales e institucionales también necesitan reconocer adecuadamente a la conservación, así como a una repartición equitativa de los beneficios a partir del uso de estos recursos y las bases de conocimiento ligadas a él, en el contexto de la sociedad moderna. El reto que enfrentan las políticas relevantes sería encontrar un papel balanceado para la organización comunitaria local y el mercado, con el fin de combinar la eficiencia y la equidad, tanto en el sentido económico como en el ecológico. Por lo tanto, es necesario reconocer la interdependencia de la sostenibilidad ecológica y la social, tanto desde nuestro enfoque analítico de las disciplinas científicas involucradas, como en la formación de políticas para el desarrollo.

**Resumo:** Parece que a sociedade humana necessita pôr-se de acordo com a cooperação ao nível organizacional do planeamento no que concerne aos recursos biológicos locais, sem optar pelo uso destrutivo, partilhado e competitivo dos recursos naturais intra ou intertemporariamente. A conservação da biodiversidade e o uso do conhecimento tradicional requer, assim, que a instituição da sociedade capitalista, no interesse da sustentabilidade do processo de desenvolvimento, mude e acomode a cooperação na gestão de tais recursos. Os arranjos legais e institucionais também necessitam conferir o devido reconhecimento à conservação assimcomo à partilha equitativa de tais recursos e às bases de conhecimento a eles ligados no contexto da sociedade moderna. Os desafios que as políticas relevantes enfrentam serão os de forçar um papel de balanço para a organização da comunidade local com o mercado de forma a combinar eficiência e equidade quer em termos económicos quer em termos ecológicos. A inter-

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dependência da sustentabilidade ecológica e social necessita assim ser reconhecida, quer na nossa abordagem analítica das disciplinas científicas envolvidas, quer na formação das políticas para o desenvolvimento.

**Key words:** Ecological economics, institutions, sustainable development.

## Introduction

There have been two parallel developments in the realm of the ideology of developmental policies:

(a) The developing countries should be liberalized, opened up and marketized so that the forces of competitive capitalism can ensure a greater efficiency of these.

(b) The objective of development should essentially incorporate the environmental sustainability of the development process among others, so that intergenerational equity is ensured in respect of access to natural and other resources, which are enablers for attaining a state of material well-being on the part of the people.

It is interesting to note that the concern for the environmental sustainability of the development process has drawn our attention to the importance of the conservation of biodiversity and has led us to realize the importance of the role of traditional ecological knowledge in the conservation of biodiversity and in the promotion of a sustainable way of economic life of the people of a society. However, it is a well-known historical fact, on the other hand, that a large part of the traditional ecological knowledge base of various societies was an important asset of most societies in the various stages of pre-capitalist economic formation and that the latter were mostly destroyed by the Western capitalist developments of the eighteenth to twentieth centuries. The colonial expansion of the capitalist market as supported by imperial political expansions of the West European countries led to the destruction of such a knowledge base, as such destruction was often a pre-condition for the successful penetration of commodities and for the required transformation of the way of life of the concerned people. The ways of life of the traditional agrarian as well as tribal societies evolved in a manner which often took due account of the budget constraint of the solar energy flow, particularly in the context of harvesting natural resources and use of technology. The socio-economic system of such societies considered biodiversity to be an important resource and the conservation of the latter influenced the norms and rules of such systems. The expansion of the capitalist market for commodities induced such changes in legal and institutional regimes regarding property rights and other regulations as required to support the functioning of the market. This led to the destruction of the earlier institutions, cultural norms and the fabric of economic life, including its knowledge base. The driving forces behind the scale, composition and technological development of the capitalist market beyond a stage or threshold conflicted with the solar energy budget constraint and carrying capacity of the natural systems. The economic formation of capitalism, therefore, induced neglect of these constraints by attacking and destroying the traditional knowledge base of such societies, which was in a major way related to biodiversity as a resource.

In recent decades, the concern for the environmental sustainability of the development process has led natural and social scientists, as well as policy makers, to pay due regard to the issues of the carrying capacity of the ecosystem as constrained by its physiographic condition, and to ecological processes as driven by the solar energy flow with reference to both the supply of resources and the absorption of wastes (Ayres 1978; d'Arge *et al.* 1970). The value of biodiversity as a resource and its role in a sustainable development process has been increasingly recognized and emphasized in recent times. It is also true that the world economic system is at the same time evolving around the ideology of marketization and liberalization of the developing countries of the South, which are mostly the repositories of biodiversity and particularly of biotic-resources, for the greater integration of the economies of the world. This has been, in

fact, required for the sustainability of effective demand conditions facing the developed industrial nations. We would like to flag, therefore, the issue of internal consistency within the current ideological processes of the world, which needs to be carefully addressed. We shall come back to this in one of the following sections, for this has an important bearing on the policy approach for a sustainable development process in the developing economies. We now digress to elaborate a bit on the interactive relationship of economy and environment in order to situate the problem of the conservation of biodiversity and the traditional knowledge base in the context of sustainable development.

## Economy-environment interaction

The human being is one of the innumerable species inhabiting the earth. Like other species, *Homo sapiens* develop a relationship with their environment comprising both living organisms and non-living substances. However, unlike other species, this relationship between man and nature has vastly changed over time because of the development of human consciousness through the various stages of civilization as represented by science, technology, values and culture. With the help of science and technology, human beings have transformed the resources of nature into products according to their value system for their own consumption, for life support and for the betterment of their own well-being. However, in the phase of capitalist development of human civilization, which began only about three centuries ago, the indefinite accumulation of capital and the generation of surplus became the driving forces behind the growth of economic activities, the institution of the market providing the mechanics of attainment of social well-being. This has caused indefinite growth of demand for natural resources and environmental services in support of such a process of development. Given the size of the human population and the aggregate size of world economic activities, such demand on the biosphere resources was for a long time not considered as a cause of stress or strain on nature's functional system or as a disturbance of the ecological balance, which defines the relative positions and interrelations among various species and material existence (Boulding 1966; Odum 1975). With the population explosion and the pace of industrialization of the world, the situation has vastly changed during the twentieth century. There is ample evidence today of the adverse impacts of the unmindful expansion of economic activities driven by the forces of capitalist accumulation on the ecological balance of the biosphere (e.g. air and water pollution, desertification, climate change, biodiversity loss, etc.). There is apprehension that too much tilting of the balance could cause the ecosystems to flip over to new regimes involving vast uncertainties. The loss of biodiversity due to over-harvesting of natural resources or due to overuse of the 'sink service' of nature by throwing back too much non-biodegradable waste is one of the most critical factors in making ecosystems vulnerable to such instability (Dasgupta & Mäler 1993; Ehrlich 1988). The sustainability of the present global pattern of growth or development process has become an issue of deep concern for everyone today in view of uncertainties regarding man's ability to adapt to changing environmental conditions in the future without involving high costs. In order to arrive at the right policy approach for the sustainable development of any economy, it has, therefore, been imperative to take explicit cognizance of the interactive relation between nature and the economy.

The system of production of material commodities and services in an economy involves directly or indirectly the conversion of natural resources with the help of human labour, and possibly some man-made capital, into a final consumable form. The output of this transformation process may also be a capital good, which would be used as a tool or implement of production in the subsequent periods. The natural resources, which form the material basis of production, would be low-entropy abiotic or biotic ones drawn from the source of nature. After the conversion of these high-value resources into products and full use of the product as consumer or capital goods over their life cycles, the basic elements constituting the inputs of natural resources would emerge in a transformed state and flow back as high-entropy valueless waste to nature. Nature is thus used both as a source and as a sink for the purpose of enhancing human consumption. It is often implicitly assumed that the flow of high-entropy waste would be degraded and further transformed by nature for the regeneration of its low-entropy resources according to the ecological laws and principles (Georgescu-Roegen 1971; Sengupta 2001).

The ecological process of solar energy flow through the food chain and climate system as well as the bio geo-chemical cycles of various nutrients, regenerates most of the biotic and abiotic resources required by the human economic system and degrades the wastes arising in it over time. The regeneration of resources and degradation of the waste compounds, however, require time. For any ecosystem there are upper bounds on the time rate of energy flow and on that of the movement of the basic chemical elements along with the pathways of various nutrient cycles, as well as on the weathering process. There is also a certain indeterminacy in the precise values of these speeds of flow or movements of cycles because of the various degrees of freedom regarding the choice of pathways in the movement of nutrient elements. The rate at which nature can regenerate and supply resources, however, varies from resource to resource and from place to place. The rate at which nature again absorbs a waste would also vary from one waste compound to another. The maximum time rate or speed at which nature can absorb a waste or supply a given resource by regeneration through ecological processes of a region is often far exceeded by the time rates of the same as required by the development process for its sustainability. It is the mismatch between the two time rates of regeneration (supply) of low-entropy resources or of degradation (absorption) of high-entropy wastes as warranted by the ecological process and by the economic developmental process which lies at the root of the environmental crisis, often manifesting in the short-run as a resource crisis. A resource crisis arises if the rate of regeneration of low-entropy resources falls short of the required flow of resources from the ecosystem to the economic system rendering the pre-existing growth process unsustainable. If the rate of augmentation of high-entropy wastes, on the other hand, exceeds the rate of absorption of waste by nature per unit of time, the balance of waste is deposited in the ecosystem as a pollutant. The stock of the latter would accumulate in the ecosystem and such accumulating stock would affect adversely the productivity of the natural system, human health and the regenerative function of nature leading ultimately to the loss of biodiversity and the traditional ecological knowledge linked with it. The very fact that resource crisis and environmental crisis are now real life threats for the sustainability of the development process is indicative of conflicting paradigms of ecological principles and conventional economic principles of development which have driven the behaviour of the systems of nature and economy (Daly 1991; Georgescu-Roegen 1971; Sengupta 2001). The rest of the problem lies, in fact, in the differences between the human timescale as given by the length of time horizon over which human society makes its economic decision of optimal choices, and the geological timescale over which nature acts to effect various important transformations.

## World economic development and limitations of spaceship earth

The world economic development process faces different sets of problems for the mature industrialized economies and the developing economies. In the industrialized countries, the major economic problem has been the instability of levels of income, employment and prices of commodities arising from repeated business cycles of boom and recession among the nations and the world economic order. These have affected the stability of international economic relations. The basic causal factor of such instabilities has been periodic over-accumulation of man-made capital relative to the consumption demand by the people of such economies, due to the maturity of their capitalist process of development. On the other hand, the developing countries have the problems of persistent low income, poverty, unemployment, inflation and debt crisis, which are essentially caused by the lack of man-made capital resources and access to technology, coupled with overpopulation. Besides, there have also been the global problems of the growing gap between the richest and the poorest nations in spite of the respective difficulties they face. The conventional economic approach has been to find a solution for the problems of industrialized countries in ways that expand the home market, introducing new products, restructuring and often raising the level of consumption, even by encouraging waste, and finally, by ensuring the growth of exports. All these are intended to ensure the profitable employment of a capital stock, which is growing continuously out of investment, largely out of reinvestment of the retained profit of corporations earned on capital in an earlier period. For the developing countries, on the other hand, the

solution has been sought in finding ways of mobilizing financial resources from home or abroad and adopting an appropriate strategy for the deployment of these resources in order to remove poverty and unemployment. Besides, it is also believed in the current phase of 'globalization' that the resolution of the problem of the growing gap between the richest and the poorest nations can be found in increasing the mobility of capital across national boundaries and freer trade and foreign investment flows (Sengupta 2001).

The crux of the solution suggested by conventional economics seems to lie in the greater and more profitable employment of the capital stock which would be, or should be, continuously growing, both at national and at global levels, with the normative implication that the productive capacity or the material base of the production economy should be expanding at all levels. The dominant ideology in economics also insists that the expansion of the production base of an economy can only be optimally achieved in a market economy system where price guides investment decisions and ensures efficient allocation of resources through the profit-seeking activities of the firms, except perhaps in situations of obvious market failures.

The long-term vision of economic progress in any part of the world has thus meant the indefinite market-propelled expansion of the production capacity of goods and services of an economy, at least as a necessary condition. In this vision of conventional economics, it is implicitly assumed that nature would pose no constraint to this process of indefinite expansion of the production system driven by the market and the profit motive. The impressive material progress experienced in the western industrialized countries over the last two centuries, and the technological optimism to which the immense technical progress especially in the present century has given rise, seem to provide justification for such a presumption. Economics thus assumes, at least implicitly, that the human being is the dominant species on earth. Through science and technology, mankind will ultimately be able to develop increasing control over the forces of nature so that the function of the latter would be subservient to the requirements of an economy organized on market principles. At the same time, such assumptions tend to contradict some of the basic scientific facts and principles of the natural system when it is subjected to an indefinite growth in production by the economic system. Any regime of steady state economic growth would imply constant proportionate growth in flows of resources from nature to the economy and a similarly increasing throw-back of wastes from the economy to nature, more or less at the same rate, in a scenario of frozen technological efficiency. The rate of growth of flows of resources and waste from or to nature respectively can, however, be less than that of the growth of the social product (GDP), if not also declining due to the reduction of the material resource intensity of the production processes through technical progress. However, since the overall material resource requirement per unit of output cannot be reduced to zero, that is, 'something cannot be produced out of nothing', the required flows of resources as well as waste will grow at a varying higher or lower rate in the development process. This would in any case impose the requirement of increasing support from nature in terms of an indefinitely growing flow of material resources and waste absorption. Thus, in turn, is in conflict with the undesirable fact that our planet is a finite place, like a spaceship endowed with a finite amount of abiotic resources and a finite rate of flow of solar energy from outer space reaching the surface of the earth. Such an energy flow can sustain a finite maximum rate of regeneration of the biotic resources, depending on the size of its stock, but no more! (Boulding 1966; Meadows & Meadows 1972; Meadows *et al.* 1992).

## Policy approach of sustainable development: Technology, biodiversity and institutions

How then can we relax the biophysical limits on economic processes and create space for a sustainable development of economic well-being in the face of growing human numbers in a world where most of the developing economies have not completed the process of demographic transition and where vast unemployment and poverty prevail? Developments in science and technology need to relax the constraints imposed by the ecological principle on the functioning of human economy through appropriate intervention. The development of the knowledge base for such technical change has to take due account of the ecological principle that governs the ecosystems interfacing with the economy. If we keep in mind the limitedness of the resources of our finite planet and the problem of

man-made wastes, our technological concerns should broadly aim at the following:

(a) dematerialization of economic process
(b) decarbonization of energy
(c) increasing substitution of nonrenewable resources by renewables
(d) recycling of waste by converting it into a man-made resource
(e) non-recyclable waste treatment before disposal
(f) enhancement of the primary productivity of biospheric space in ecosystems
(g) biodiversity conservation for the realization of option value in the future use of such resources
(h) facilitation of the redistribution process of income by increasing the productivity of wage goods and creating more employment opportunities.

On the front of the progress of technology and of the knowledge base of human society, a major source of optimism lies in the future developments of biotechnology, which may provide important solutions for resolving resource crises and the problems of absorption of difficult wastes (Erkman 1999; Sengupta 2001). Whatever remains of biodiversity and the traditional knowledge base in the face of the onslaughts of the dominant ideologies promoted by western capitalism are now considered to be important biotic materials and a knowledge resource to be worked on for discovering new solutions to meet the challenge of the sustainability of economic processes. The conservation of biodiversity and that of the traditional knowledge of the use of the biotic resources offered by biodiversity should assume a very important part of our policy thrust for ensuring long-term sustainability. Here, a few important institutional questions arise regarding the recognition of intellectual property rights pertaining to traditional knowledge and benefit-sharing in bioprospecting. The Convention on Biological Diversity has, in fact, established the exclusive right of the local state over its biodiversity. The issue of evolving the right principles of benefit-sharing between the owner of the biotic resource base and the owner of intellectual property based on it is a difficult and challenging problem. In addition, the patenting of the traditional technical knowledge also becomes an important issue of legitimacy and equity, for otherwise many of the developing countries will be illegitimately exploited by the patent-holders of new discoveries who might have taken important clues from the traditional knowledge base, which is unpatented and remains outside the purview of the knowledge market of capitalist technology.

While the legal and institutional regime of intellectual property rights and benefit-sharing from the realized option value of biodiversity in the form of new discoveries needs to accommodate these concerns for equity and distribution in the interest of sustainability of the development process, it is also important to ensure that the market forces of the capitalist development process are regulated so that biodiversity is conserved as a valuable resource by society. One major problem in deciding on the regulation is that biodiversity is often considered as a common property resource of the society regarding which property rights are often ill-defined. One answer to the problem has been institutional change in the form of defining property rights by either privatization of the commons, which are the repositories of biodiversity resources, or community ownership and participatory management (Baland & Platteau 1996; Bardhan & Udry 1999; Chopra *et al.* 1989; Common & Perrings 1992). Privatization of common property resources has its serious adverse distributional implications, as well as a doubtful effect on the conservation of biodiversity due to possible long term preference of the private owner and tradability of property rights. The option of nationalization of such common property, on the other hand, also has limitations in terms of well-known government failure due to inefficiency and corruption. However, a model of co-operation in the management and use of common property with well-defined property rights at the community level (no open access) may be able to resolve the problem of conflicts and ensure the sustainable use of common property resources like biodiversity (Metrick & Weitzman 1998). This is because local-level community management through co-operation places decision-making in the hands of the people who have indigenous knowledge regarding local ecological sustenance, as well as information and motivation that outsiders (private merchants or state bureaucracy) would be lacking.

It seems that human society needs to come to terms of co-operation at the organizational level of planning as concerns local biological resources, without opting for destructive competitive shared use of natural resources intra-temporarily or inter- temporarily. The conservation of biodiversity

and the use of traditional knowledge thus require that the institution of capitalist society change and accommodate co-operation in the management of such resources in the interest of a sustainable development process. The legal and institutional arrangements also need to give due recognition to conservation as well as to equitable benefit-sharing from the use of such resources and the knowledge bases linked with them in the context of modern society. This does not, however, imply the denial of the necessity of the institution of market for matching supply and demand of goods and services and inducing forces of competitive efficiency in each stage of decision-making by the different economic agents. The challenge facing the relevant policies would be to strike a balanced role for local community organization and market to combine efficiency and equity in both the economic and the ecological senses. The interdependence of ecological and social sustainability thus needs to be recognized in both our analytic approach of the concerned scientific disciplines, as well as in the formation of policies for development.

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