ECONOMIC ASPECTS OF MONITORING ENVIRONMENTAL FACTORS: A COST-BENEFIT APPROACH

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Summary

A cost-benefit analysis of the use of environmental resources has some obvious difficulties because of the absence of markets for those goods and the failure of prices to

reflect the true value of those resources. The presence of externality and public good character of those resources make this problem even more complicated. In environmental economics, different methodologies have been identified to incorporate valuation of environmental goods into a formal analysis of costs and benefits for using as well as preserving those resources. The issue of choosing an appropriate discount rate is also very significant for valuing environmental resources because of their potential future use. It leads to the problem of defining an intergenerational preference function. In this context, the importance and effectiveness of various environmental and economic policies have been evaluated in terms of their efficiency.

1. Introduction

1.1. Importance of Cost-Benefit Analysis (CBA) in the Decision Making Process

A rational policy decision is based on some measures of costs and benefits associated with that policy action. In the CBA literature, however, there are several variations in the approaches to compare those costs and benefits. Essentially there are a decision "rule" and an evaluation "framework" that underlie the comparison. Gittinger (1982) identifies various measures of comparing costs and benefits in the context of agricultural development projects. Pearce et al. (1989) suggest four stages of how a decision rule defines as well as measures "gains and losses" in terms of some pre-defined objectives. They are (i) defining costs and benefits, (ii) enumerating gains and losses, (iii) selecting a unit of measurement and (iv) determining weights attached to the units. Bidwell (1986) compares the relative importance of a set of evaluation frameworks which included, among others, (i) cost-benefit analysis (CBA), (ii) cost-effective analysis (CEA), (iii) multi-criteria analysis (MCA), (iv) risk-benefit analysis (RBA), (v) decision analysis (DA) and (vi) environmental impact assessment (EIA).

If an environmental policy 'goal' could be quantitatively set and the 'means' along with their relative 'weights' are defined to achieve the 'goal', then the different characteristics of various evaluation frameworks noted in Pearce et al. (1989) may be combined to evaluate an environmental policy action. This, however, assumes an aggregation of individual preferences and attaching monetary values to non-monetary objects which is often a difficult process. In terms of a predefined 'social welfare function' (SWF) with quantifiable arguments, an environmental policy action can be undertaken and be regarded as beneficial, according to the CBA, as long as it results in positive net social benefits. Other criteria of evaluation frameworks such as relative cost-effectiveness of the CEA, the assignment of individual weights and incorporating probabilities as suggested in the MCA and the RBA, may also be integrated within the framework of the CBA. The EIA, as the name suggests, has been one of the most widely used evaluation criteria in determining the outcome of an environmental policy action. In the United States and also in other parts of the world, "environmental impact assessment is an integral component of decisions made every day on proposed projects, plans and actions" (Marriott, 1997). A comprehensive summary of comparisons among various decision rules may be found in Pearce et al (1981), Cohen (1978), Zeleny (1982), Fischoff et al (1981), Norton (1984) and Andrews (1984).

1.2. A Brief Review of the Use of Economic Instruments for Environmental Policy

Although various project evaluation techniques such as the CBA have been around since late 60's (early references include Little et al (1969), UNIDO (1972a, 1972b), Little et al (1974), Squire et al (1975), Scott et al (1976), Shanner (1979) etc.), it was not until 1989, when an OECD (1989) report was published formalizing the incorporation of economic instruments into the evaluation criteria for an environmental policy analysis. That report underlies the intention of member countries to "seek to introduce more flexibility, efficiency and cost-effectiveness in the consistent application of the Polluter-Pays Principle and more effective use of economic instruments in conjunction with regulations" (ibid). Over the past decades, in spite of occasional lack of interest shown by the economists (Vatn et al. (1995), the field of environmental economics has evolved substantially, particularly in the area of (i) economic techniques for evaluating the costs and benefits of environmental impacts, (ii) developing a pricing mechanism of natural resource and (iii) choosing of appropriate economic and environmental instruments for policy analysis. This has subsequently been formalized more in Pearce et al (1994), Opschoor et al (1994), Smith et al (1997), OECD (2000) etc.

2. Setting Environmental Standards

Environmental standards are set to 'sustain' socio-economic development which has traditionally been a 'victim' of neo-classical economic growth measured in a concept like 'gross domestic product' (GDP) of a nation. In this measure anything that increases the 'production' of goods and services could potentially be growth enhancing. It clearly neglects the non-economic aspects of development. Sustainable development, which incorporates both 'economic growth' and 'environmental improvement', is on the other hand defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs", WCED (1987). In that sense it is concerned both with the 'quality' and 'quantity' of economic growth. In order to ensure such economic growth across countries, efforts are underway to 'quantify' environmental standards which can subsequently be incorporated into the CBA or the EIA of any development project.

2.1. Quantifying Indicators

Environmental policy indicators primarily aim at three areas which are categorized according to the impacts of a policy action. Based on policy relevance, analytical soundness and performance measurement, policy indicators need to be quantified in their respective areas of application for the evaluation of any policy action. The following are the three main areas where environmental indicators for assessing policy measures are generally applied.

2.1.1 Emissions

Environmental problems relating to 'emissions' are wide spread. They include all kinds of pollutions including air, water, noise etc. Standards are primarily set to indicate levels considered necessary to protect public health from any known or anticipated adverse effects of a pollutant. Strict limits of target are set across countries both at international as well as sub-national levels in terms of the amount of polluting gas emissions into the atmosphere, quantity of wastes discharge into the water-systems and urban noise level.

2.1.2 Conservation

"Conservation is, according to Randall et al (1995), the act of setting aside sufficient reserves to satisfy some future-oriented objectives." Despite the difference of opinion as to the intergenerational preference and the process of valuation regarding conservation, there is ample evidence as to the depletion of natural resources which calls for an environmentally sound benefit-cost test for preserving scarce and valuable environmental resources. However, the need for conservation across the various types of resources depends mainly on (i) resource scarcity and (ii) substitution possibility among various factors of production. Based on this, there have been attempts to approach conservation issues within a dynamic CBA where they are examined as a process of generating saving and investment (Randall, A. 1993) in a long timeframe. In addition to Solow (1974) and Hartwick (1977, 1978) who derived the principle of intergenerational equity and efficiency criteria for the use of exhaustible resources, Smith (1987) and Randall (1991), among others, also attempt to incorporate non-use value in the CBA framework.

2.1.3. Bio-diversity

One of the greatest concerns of environmental project evaluation is the loss of biological diversity due to the irreversible outcome of human exploitation of natural resources. The importance of biotic resources both in terms of their commercial and non-commercial potential is enormous. Though most of them are not yet systematically catalogued, following Bishop (1978), it may be concluded that the usefulness of numerous biological species under present level of technological development suggests a positive probability that any known or unknown species will eventually prove useful. Without subscribing to the 'absolutist' arguments of Ehrenfeld (1988) for preserving bio-diversity, an economic case can still be made in favor of protecting those resources. In the benefit-cost analysis of environmental policy, where economic costs (particularly the opportunity costs) may outweigh the benefits, different measures of the valuation of biodiversity are incorporated in a standardized project document.

3. Economic Implications of Adopting Environmental Standards

Environmental standards are usually set to tackle the problem of 'technological' externality which "..occurs whenever the activities of an economic agent affect the activities of another agent in ways that are not reflected in the market transactions" (Nicholson, 1994). In the context of present day economic realities of the world, the problems of externalities may be related to a whole variety of environmental problems. They typically include, among others, acid rain, air pollution, global worming, spill of hazardous waste, ozone depletion, smog, water pollution, overpopulation, and deforestation. Economic implications of these problems are that they are not directly considered in the costs of firms, nor their adverse effects both at individual and social levels are adequately reflected in the market prices faced by the consumers. This results in an inaccurate price structure which subsequently leads to a misallocation of economic resources leading to a further damage of scarce environmental resources. In order to overcome the economic problem of externality, environmental valuation standards are devised which try to place monetary values on environmental impacts by incorporating the benefits and costs of environmental effects into the analysis of alternatives. The need for such special valuation mechanism for environmental goods arises due to the following limitations of the traditional economics of market-mechanism.

3.1. Difficulties with Neo-classical Economic Approach Toward Environmental Valuation

Problems with an economic approach toward environmental valuation may be related to 'markets' and 'prices'. The first theorem of welfare economics (FTWE) is based on competitive markets that are perfectly efficient, usually assumes away many imperfections including externalities, public goods, common property, information asymmetry, policy intervention, transaction costs, monopoly, increasing returns to scale and many other 'market distortions', that come between the costs paid by buyers and the benefits paid by sellers. Due to the presence of these imperfections and similar other limitations related to a market-mechanism, the FTWE might not hold in predicting the efficiency of the system. Many environmental goods are clearly characterized by some of those elements which make the 'markets' for those goods either 'incomplete' or altogether 'absent'. In the presence of 'externality', 'lack of ownership' and 'common property' problems which are endemic in an environmental good, a 'price mechanism' also fails to accurately reflect the true costs of production and consumption. In this context, the following economic problems, which are specific to the valuation of an environmental good, can be identified.

3.1.1. Missing and Incomplete Markets

Efficiency of an economic system depends on the existence of a fully functional market mechanism which coordinates the independent decisions of consumers and firms. The determinants of these decisions include, among others, (i) agents' preference and level of technology, (ii) the property rights that define their endowments, (iii) the set of relative price that determine agents' behavior which reflect those endowments and (iv) the rate at which they discount the future effects of their current actions. In this system agents respond to price signals which equate the demand for and supply of goods and services in a market. All economic decisions are thus coordinated by a market mechanism.

In neo-classical economics, a market failure is defined "..as the inability of the market to lead the economic process towards a social optimum," Opschoor et al. (1994). They also identified that in the context of environmental goods and services, market mechanism fails "..to encapsulates in costs and prices the external effects, or reductions in utility and profits, that agents other than those directly involved in market transactions and the activities associated with those, have to undergo," (ibid). Problems of externality related to environmental pollution, natural resources exploitation and ecosystems' intrusion may cause a failure of the market as an institution rendering it unable to allocate resources in the best use of a society.

In a situation where a market for the adverse effects of an environmental decision fails to emerge, it may be characterized as a 'missing market'. On the other hand, failure of a market may also be due to the 'incompleteness' of a market. An incomplete market situation can arise both internally as well as externally. The OECD (1992) identified the causes of internal market failure, which are related to (i) nature of goods exchanged such as 'collective' or 'club' goods, (ii) non-competitive nature of supply such as monopoly or oligopoly market structures, (iii) instability of exchange, and (iv) lack of information.

The problem of a missing market may be external which is either 'reciprocal' or 'unidirectional' in nature. The use of a common property, where all agents have rights of access, result in reciprocal imposition of costs on all sides whereas deforestation by the users of an upper watershed can impose unidirectional costs on the users of the lower watershed. Both types market problems, which result in 'cost shifting' or 'cost displacement', have been explained in Kapp (1950), Opshcoor (1989) and Pearce et al (1990).

3.1.2. Failure of Price Mechanism

Related to the problems of markets is the inefficiency of pricing mechanism that fails to reflect the true costs of production and consumption of environmental goods. In most cases, it is the problem of 'underpricing' that again arises due to the existence of externality which is characterized by the separation between the affected individual and the source of the effects. So the effects are not built into the market price. Underpricing of environmental goods and services also occurs when all the costs of an input or activity are not included in the price of an output. This is related to the inability of a market which only makes provision for pecuniary costs and not environmental and social costs of production as well as consumption. Pricing problems in environmental costs and benefit analysis may also arise due to the lack of information about the scarcity of good and distorted government policies particularly in agricultural and natural resources sector. An open access and a public good provide another opportunity for the over-exploitation of resources because these goods are generally usable by all without payment. Since such resources are difficult to value, they tend to be overexploited due to their negligible user charges. These problems are extensively dealt in Pearce, et al (1989), Munasinghe (1992), Pearce at al (1992), Pearce (1993) among others.

In order to evaluate an environmental decision, economists try to create surrogate markets and devise pricing mechanism for environmental goods. Without putting a price on a resource be it natural or man-made, nothing can be brought within a CBA or an EIA. This leads to proliferation of a fertile branch of literature in environmental and resource economics which is known as 'environmental valuation'. The process of valuation of environmental resources contributes a lot to the evaluation-mechanism of the CBA which ultimately informs better policy decision.

4. Environmental Valuation

In environmental valuation problem, the concept of 'total economic value' (TEV) is of critical importance since it provides a perspective on the measurement of different sources of benefits associated with an environmental good. Loomies et al. (1991) distinguish five components of the TEV. They are (i) onsite recreation use of resource, (ii) commercial use of resource, (iii) an option demand for the use of resource in future, (iv) an existence value derived from the knowledge of the resource exists in a preserved value and (v) a bequest value derived from the knowledge future generation will be enjoy either 'existence' or 'use' of a resource. In terms of 'user benefits' and 'intrinsic benefits', these five components can be categorized into (i) use value and (ii) non-use value. The former is subject to traditional economic measurement whereas the latter is difficult to quantify in terms of price. In an environmental CBA, total economic value is the principal standard of measurement with which to analyze total benefits of an environmental resource.

If 'valuation' aims at assigning economic values to non-market goods and services, then the principal task related to environmental valuation technique "is to determine how much better or worse off individuals are (or would be) as a result of a change in environmental quality," (Pearce et al. (1994). Theoretically there are two ways one can conceptualize the problem. One is in terms of 'willingness-to-pay' (WTP) which is defined as the value of a change of an environmental quality for which how much of something else an individual is willing to give up. Another is in terms of 'willingness-to-accept' (WTA) which is defined as the value of an environmental change for which how much an individual is ready to accept in order to allow the change to happen. The question is how can one ever know how much an individual would be willing to pay (or accept) for an environmental quality (or damage)? Pearce et al. (1989) identified two techniques of economic measurement of environmental benefits. One is direct valuation techniques based on the measurement of the monetary value of gains derived from environmental improvement. Another technique is indirect which is based on creating surrogate market and specifying a damage function.

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Biographical Sketches

SM Osman Rahman was born in Bangladesh on June 7, 1959. He studied Philosophy and English Literature at Jahangirnagar University, Dhaka, Bangladesh, from where he obtained his first MA degree in English Literature in 1983. After joining the civil service in 1984, he had opportunities of working in different regulatory and development departments under the Government of Bangladesh. In 1993, Osman completed a post-graduate diploma in Development Administration and Project Management from the University of Manchester, UK, under a British Government overseas development scholarship. In 1995, he coordinated a large food policy and rural development project on behalf of the Government of Bangladesh sponsored by the International Food Policy Research Institute, Washington, DC, USA.

Under a US Government scholarship, he pursued graduate studies in Economics from 1996 to 2000 at the School of Economic Studies in the University of Manchester, UK, where he subsequently completed a post-graduate Diploma, an MA and a Ph.D. degree in applied Economics specializing in the resource and environmental issues. In 2001, he worked as a post-doctoral researcher at the University of Idaho, USA where he investigated the economics of the US-Canada softwood lumber industry, and the environmental and resource management issues underlying the historical trade dispute in the lumber industry between these two countries. Since 2002, he has been working as Senior Trade Economist looking after international trade issues related to forestry and resource management, quantitative policy analysis, trade and the environment, coherence in international agreements in trade and other cross-cutting issues, and the economics and politics of dispute settlement mechanism in international trade.

With a wide range of academic training in resource economics, project management and public administration, Osman has extensive research background both in quantitative policy analysis and implementation. He had received several academic awards including the British Government Overseas Development Scholarship, the US AID Scholarship and the School of Economic Studies (University of Manchester, UK) Scholarship for Foreign Students.

Stephen Devadoss completed his undergraduate degree in Agriculture at Tamil Nadu Agricultural University, Coimbatore, India in 1978, Masters degree in Agricultural Economics at Indian Agricultural Research Institute, New Delhi in 1980, and Ph.D. from Iowa State University, Ames, Iowa in 1985. He worked at Center for Agricultural and Rural Development from 1980 to 1991. He joined the Department of Agricultural Economics at the University of Idaho in 1992, where he is currently working as a full professor. His areas of expertise include trade and macroeconomics of agriculture. He has taught at Iowa State University (ISU) and the University of Idaho (UI). The courses he has taught include graduate level Agricultural Policy at ISU, graduate level Microeconomics, Mathematical Economics, Agricultural Trade, and undergraduate Agricultural Trade at the UI. He has published numerous scholarly articles in the area of trade, macroeconomics of agriculture, risk and uncertainty, imperfect competition, agricultural policy, and marketing. He is a recipient of 2004 Research Excellence Award from the University of Idaho.