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Environmental economics

Economic valuation of use and non-use values of environmental goods and services in developing countries

Robert R Hearne

Most of the methodologies for placing economic values on the environment have been developed in the context of developed countries, where high levels of disposable income allow for a high demand for environmental amenities and a willingness to pay for non-use values. Their applicability may be limited in developing countries. A micro-economic model, designed to highlight the different roles of environmental goods and services in developed and developing countries, is presented. In developing countries the values of environmental amenities are relatively less important than those of environmental resources in the production process. The use of the procedures to estimate the value of environmental services in production should be respected, promoted, and refined, particularly in the light of widespread market failure in developing countries.

Keywords: environmental economics; developing countries; project appraisal

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ENVIRONMENTAL ECONOMICS has a growing and extensive literature on rigorous procedures for placing economic values on environmental goods and services. Ideally, development aid organisations would utilise these procedures to undertake an economic appraisal of the costs and benefits of development projects. Since development aid organisations have made explicit efforts to incorporate environmental objectives in development aid programmes the use of these procedures should gain in importance in the process of project appraisal.

Most of these methodologies, including contingent valuation (CVM), travel cost and hedonic pricing, have been developed and refined in the context of developed countries, where high levels of disposable income allow for a high demand for environmental amenities and a willingness to pay (WTP) for non-use values of environmental goods and services. Often these procedures are applied to assess damages under liability rules that are peculiar to the USA: given the extent of potential awards and settlements there, the resources available to estimate economic values are extensive. These resources enable environmental economists to develop the methodology employed. Thus, these methodologies rely on large sets of data and often necessitate the collection of primary data through formalised survey procedures (which are relatively easy in developed countries.)

Because of the popularity of these valuation techniques in the applied economics textbooks and journals, much attention has been concentrated on the

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applicability of these procedures in developing countries. It is often argued that limitations on secondary data or difficulty in collecting survey data would make the cost of these methods prohibitive. Frequently the assumptions used in applying these procedures have been analysed and supported within the context of developed countries but have yet to be tested in developing countries. Also, given the prominence of techniques, especially CVM, that can effectively estimate non-use values, more mundane methods of estimating use values, which might be more important in developing countries, have been neglected.[1]

Yet, despite an increasing academic interest in valuation procedures that is expanding into developing countries (Abdullah, 1993; Echeverría *et al*, 1995), there appears to be continued scepticism among many development aid organisations over their practicality. Concerns about the cost involved in estimating economic values and the contribution of the information provided to decision-makers persist. The failure of environmental economists to gain the confidence of donor agencies in the process of estimating environmental values suggests that their efforts in this field may be misdirected.

This paper will argue that despite the popularity of rigorous valuation methodologies in developed countries, and the prestige awarded to the analysts, the applicability of these methodologies may be limited in developing countries. Although data limitations and difficulties in performing surveys are important, the major restriction on the use of these techniques, especially CVM, is that the type of information provided is designed to answer questions that are not relevant to developing countries, especially in rural areas where environmental goods and services are important inputs into family production functions.

Given poverty levels in developing countries, and limitations on government expenditures, the estimation of non-use values may not be appropriate. Given the different pressures for alternative land, and resource uses that may subtract from environmental quality, as well as the cost involved in presenting an economic appraisal of development projects, it is important to ensure that valuation procedures focus on appropriate issues.

This paper does not argue against the estimation of the value of environmental goods and services. The environment plays an important productive role, especially in rural areas in developing countries, and the loss of environmental services can often be directly linked to productivity losses. The estimation of the changes in productivity in developing countries, or the opportunity cost of the preventive expenditure needed to avert productivity loss, is neither a simple procedure nor a sophisticated use of economic and statistical theory. Yet this information is necessary for informed decision-making.

Furthermore, because many of the alternative resource-use options that are appraised in development projects entail income-generating activities that carry political weight, it may be important to stress the value of productivity changes to a decision-maker as opposed to non-use values. Thus, current efforts to perform economic appraisal of projects and to estimate the value of land-use options (IIED, 1997) should be appreciated for the quality of the information presented and not assessed by the glamour of the methodology employed.

The first section of this paper provides a brief introduction and review of textbook valuation procedures. This is followed by a micro-economic model designed to highlight the different roles of environmental goods and services in developed and developing countries. Then the practice of estimating the value of environmental services in developing countries is reviewed, with a focus on development projects. The conclusion discusses the advantages of closer integration between environmental impact assessment and the economic appraisal of projects.

Textbook valuation procedures

Most undergraduate textbooks in environmental economics introduce the estimation of the value of environmental goods and services as a tool in cost–benefit analysis (Field, 1994; Goodstein, 1995; Pearce and Turner, 1990). Often, after an introduction to some basic welfare economics, these texts provide a review of CVM, the travel cost method (TCM), hedonic pricing (HP), and dose-response estimation (DR).

Without repeating what is presented well in these sources, it is worth noting the most applicable uses of these methodologies:

- TCM is designed to estimate the value of recreational and amenity sites that are not properly rationed by market prices.
- HP is most appropriate to estimate the value of amenity, safety and health benefits that are embedded in the market prices of land, housing and labour.
- CVM analysis does not rely on the presence of complementary market goods and therefore it has the benefit of providing estimates of values that other methodologies cannot. Because of this

latitude it has been refined to estimate non-use values. Indeed much of the recent interest in CVM analysis has revolved around the estimation of 'passive use' values from the *Exxon Valdez* oil spill and the subsequent release of a report from a 'blue chip' panel including two Nobel Prize winners (Arrow *et al*, 1993; Bateman *et al*, 1995).

- DR is less of an economist's tool than an approach to the estimation of material and health damages received in response to doses of pollution.

A simplified model

An important question in the issue of valuation of environmental goods and services in developing countries is whether there is something fundamentally different between developed and developing countries. To demonstrate one possible fundamental difference, a simplified model of consumer choice, production and the rural household will be presented. Thus, in a developed country, a rational consumer with well-behaved preferences would maximise,

$$U(X_1, X_2(E_R), E_m, E_A) \quad (1)$$

subject to,

$$M \geq P_1X_1 + P_2X_2 + P_mE_m \quad (2)$$

or alternatively subject to,

$$M \geq P_1X_1 + P_2X_2 + P_mE_m + WTP_AE_A \quad (3)$$

where

- $U(.)$ = a well behaved, increasing, individual utility function;
- X_1 = a vector of market goods, excluding marketed environmental goods and services;
- X_2 = a market good that is complementary to the consumption of E_R;
- E_R = a non-market environmental service which is used in correlation with X_2 or possibly embedded in the purchase of X_2;
- E_A = a non-market environmental service;
- E_m = a vector of marketed environmental goods and services;
- P_i = exogenously determined prices for X_i and E_m;
- i = 1,2,m;
- M = money income earned or endowed exogenously; and
- WTP_A = individual willingness to pay for non-market environmental good E_R, which is to be realised through some tax, fee, or transfer scheme.

In this model, environmental goods and services are: marketable (E_m) such as private recreation, fish and transferable use permits; embedded or complementary to marketable goods (E_R) such as public recreation, amenities and localised air quality; or are best represented as separate from market goods (E_A) such as non-use benefits and general ambient quality.

This is a simplistic model, in which environmental goods and services are differentiated to highlight different economic valuation procedures. E_M would be valued using market prices. TCM and HP are designed to place economic values on E_R, where, for example, X_2 might be travel costs to visit environmental sites, or land and housing that features access to environmental amenities. CVM has been refined to value E_A, by asking survey respondents to consider the alternative budget constraint presented in (3), and to assess their individual WTP_A. Given the high income levels in developed countries, an assessment of WTP_A is likely to be substantial, especially in aggregation.

Environmental goods and services are also used in production processes, in both the developed and the developing world. Thus, in a simple model, a profit maximising firm would maximise,

$$\Pi = P_Y Y(Z_1, Z_E, E_P) - W_1Z_1 - W_EZ_E \quad (4)$$

where

- Π = firm profits;
- $Y(.)$ = a well-behaved output function;
- P_Y = exogenously determined output price for Y;
- Z_1 = a vector of market inputs, some of which can be substitutes for environmental inputs or abatement inputs;[2]
- Z_E = a vector of market environmental inputs;
- E_P = a non-market environmental service which is available for production use either through usufructuary rights, non-transferable permits or location;
- W_i = xogenously determined input prices for Z_1 and Z_E, i = 1, E.

Again, in the firm's profit maximisation model, environmental services are presented as both market and non-market goods. Market environmental services, Z_E, include land, transferable permits and other production inputs. Non-market environmental services, E_p, can include regulated or unregulated emissions, water, air quality and some amenities.

These two simplified models illustrate the broad range of possible environmental inputs into individual utility or firm production. They also highlight the types of environmental goods and services that attract the attention of economists and applied economics journals, namely E_R and E_A.

Additionally, the model points out the types of environmental services that are not often featured in current research and journals, such as E_M, E_P and Z_E.[3] Of course, the reason that estimating the economic value of these other environmental services is not featured within the discipline of environmental

economics is the perceived lack of need for an economist's input:[4] as long as markets function well, the attitude may be that these values can be safely assessed by accountants, engineers, and ecologists.

In developing countries, the same consumer and producer models are appropriate, but only in a limited sense. The consumer model is most applicable to urban areas where there is a strict differentiation between production and consumption. The producer model is appropriate outside family farms and subsistence production. Often among poorer rural communities, there is less differentiation between consumers and firms, and environmental services affect the rural household directly through household production. In a simplified household production model which neglects home goods,[5] a household would maximise,

$$U(X_1, X_2(E_R), E_M, E_A) \tag{5}$$

subject to,

$$P_Y Y(Z_1, Z_E, E_P) - W_1 Z_1 - W_E Z_E \geq P_1 X_1 + P_2 X_2\ P_m E_m + WTP_A E_A \tag{6}$$

where all terms are defined as previously.

Since environmental amenities are generally considered superior goods, with an increasing relative demand with increasing incomes, WTP_A should be considered to be quite low in poor communities, even in aggregation. However, especially in rural communities, environmental services, Z_E and E_P, can contribute greatly to household production. These services would include locally gathered non-timber forest products, water, water quality, wildlife and soil quality. Furthermore, marketed environmental goods and services, E_M, such as minor forest products, fruits, and fish are expected to be more important in low-income ranges, especially in rural areas.

Thus in poorer communities in developing countries (LDCs), especially rural communities, the most important environmental goods and services, E_M, Z_E and E_P, are the least appropriate for applying the more popular forms of estimating environmental goods and services in developed countries, such as TCM, CVM, and HP. Furthermore, because of incomplete markets in developing countries, the estimation of the economic values of E_M, Z_E and E_P is not, in this case, a straightforward task to be left to accountants and engineers.[6]

In poorer communities in developing countries the most important environmental goods and services are the least appropriate for applying the more popular forms of estimating environmental goods and services in developed countries

Valuation practice in LDCs

In contrast to the textbook reviews of the estimation of the value of environmental services, more general valuation guides present a broader range of valuation techniques (Winpenny, 1991; Munasinghe, 1993; Dixon *et al*, 1994; Abelson; 1996). These additional techniques include estimations of productivity changes, the costs of illness, the use of marketed substitutes for non-market goods, preventive expenditure and shadow projects. These techniques focus on the estimation of use values.

Although the economic analysis involved in these procedures might not be as challenging as in CVM, TCM and HP, the data collection, parameter estimation and calculation of values are not simplistic. As presented in these studies, the less novel approaches to estimating values, such as productivity loss, are the most applicable in developing countries.

A few case studies present the results of TCM studies, for example, in Costa Rica and Kenya (Munasinghe and Lutz, 1993), and of the use of property prices to estimate amenity values (Abelson, 1996). However, these authors seem to accept the limited applicability of CVM in developing countries,[7] and some explicitly point out the costs and difficulties of data collection and the specific problems associated with perceived biases (Ahmad, 1993; Abelson, 1996; Winpenny, 1991). Winpenny also notes the futility of soliciting willingness-to-pay estimates of existence value to poorer citizens in developing countries.[8]

A study of the Ichkeul National Park in Tunisia highlights the relative importance of use and non-use values of land use and biodiversity (Thomas *et al*, 1991). This area was gazetted as a National Park in 1980, primarily as protection for migratory bird species. However, a series of proposed dam projects has threatened the survival of the aquatic plants that provide sustenance for these birds.

Given that agricultural production from irrigation is a priority to the pertinent Tunisian authorities, the potential weight of the arguments in favour of biodiversity conservation and the existence value of wildlife have not been sufficient to ensure the protection of the park's ecosystem. There is, of course, a perceived willingness to pay for the protection of migratory birds in developed countries, but the possibility of any transfer payments for this purpose was considered to be too remote to consider in the study.

However, in this analysis, researchers have estimated the production value of the ecosystem in grazing, fisheries, tourism and wastewater assimilation, and concluded that these use values

were sufficient to justify economically the protection of the park ecosystem. Given these use values, there is little reason to estimate the non-use value of migratory birds.

In order to assess the extent of use of economic procedures to estimate the value of environmental goods and services in development projects, an informal survey of bilateral aid organisations was undertaken; this demonstrated a more pragmatic approach to this type of appraisal and a perceived lack of need to invest in rigorous estimation procedures within the project cycle.[9] Most of these agencies followed a standardised project cycle procedure (Gittinger, 1984), and a few stressed the need to provide decision-makers with qualitative information about environmental impacts.

However, the necessity for operations staff to perform more complex estimations of the value of environmental services, as part of an economic appraisal, was seen as being very infrequent. One reason for this perceived lack of need was a shift away from capital construction projects towards human-resource development projects. Another reason was the cost of the information gathered relative to the accuracy of the estimation obtained, especially in relation to long-term environmental benefits. In general, the process of estimating the value of environmental services was not rejected, but was given a low priority.

One possible solution to the difficulty of estimating the value of environmental services is to use cost-effectiveness analysis instead of cost–benefit analysis. In cost-effectiveness analysis, the benefits of a project are implicitly assumed to be greater than the costs, and therefore only a least-cost solution is determined.[10]

The European Commission Directorate-General for Development, which is overseeing an increasing share of European development aid, appears to favour the use of cost-effectiveness analysis for non-commercial projects with benefits that are not easily valued. This view, if adopted, could imply a rejection of many of the recent developments in the valuation of environmental services, not only the valuation of non-use and existence values but also of changes in productivity.

When the economic benefits from environmental-protection projects are not estimated, decision-makers are left without the comprehensive information needed to allocate resources among different potentially beneficial projects.[11] Also, the failure to estimate benefits may segregate projects that produce environmental services from those that produce marketed goods and services. This segregation could inadvertently put environmental protection projects — even those, such as watershed protection projects, coastal zone protection, soil conservation, and sustainable resource management projects, that have significant productive value — in an unfavourable competitive position for development funds.

Conclusions and observations

This article has presented a simplified micro-economic model to highlight the different ways in which environmental goods and services may enter into the solution of standard consumer and producer optimisation problems in developed and developing countries. Using this model, it was argued that the methodologies that are currently favoured for the estimation of the economic value of environmental goods and services in developed countries may not be appropriate in developing countries. The most popular of these methodologies are designed to answer questions that are less important within the context of development, especially in that of rural poverty. In developing countries the value of environmental amenities are relatively less important then the value of environmental resources in the production process.

However, there is a range of methodologies, perhaps more mundane than the procedures popular in developed countries, that are appropriate for estimating the productive use values of environmental resources. The use of these procedures should be respected, promoted, and refined, particularly in view of widespread market failure in LDCs. The casual dismissal of the validity of the estimation of the economic value of environmental resources should be seen as a challenge to environmental economists to improve both the pertinence and the practicality of the valuation processes they use.

A first step in reducing the costs of the valuation of environmental services is closer co-operation with the physical and natural scientists who perform environmental impact assessments (EIA). Although the two processes of EIA and economic appraisal should remain fairly independent, co-operation in data collection would both reduce costs and stimulate an awareness of relevant environmental and socio-economic issues among the analysts involved.

For instance, an analyst who is measuring erosion and soil loss from a transport project may be able to provide insights into appropriate preventive measures, the use of fertiliser substitutes for lost soil, or productivity losses from damaged soils. As a measure to reduce costs, better communication between the two sets of analysts responsible for EIA and economic appraisal prior to data collection should become a strongly recommended part of project cycle procedures.

Notes

1. For example, a call for papers for a Workshop on Economic Value of Biodiversity in Latin America and the Caribbean held in Santiago, Chile on 6–10 May 1996, specifically requested presentations on the use of CVM, travel cost and hedonic pricing.
2. It is possible to estimate the value of environmental amenities by analysing wage rate differentials. However, presenting this

in the model would distract from this article's argument.
3. An exception would be the agricultural economics literature on soil quality.
4. There is, however, a growing literature on the interface between agricultural production and the environment, especially in developed countries.
5. Household consumption of household-produced goods.
6. Indeed, because of limited markets in rural areas the assumption of exogenous prices is inappropriate, but this does not deter from the analysis.
7. Much attention has been attached to the use of CVM in assessing willingness to pay for water-delivery services (Whittington *et al*, 1990; 1991), but as Dixon points out (1994, page 70) this application of CVM is quite similar to market analysis of private goods as opposed to the evaluation of environmental services.
8. However, it should be noted that in areas where there is a significant middle- and upper-class population, CVM may be appropriate to estimate non-consumptive use values as well as non-use values. The economic valuation of urban air quality, other urban amenities and urban demand for rural amenities may require some form of CVM analysis.
9. Contact was made with the Canadian International Development Agency, the United Kingdom's Overseas Development Agency, the United States Agency for International Development, The Netherlands Ministry of Foreign Affairs, the Swedish International Development Agency, and the Federal Republic of Germany's Kreditanstalt für Wiederaufbau and The European Commission Directorate General for Development.
10. Cost-effectiveness analysis may be appropriate to projects that generate quantifiable environmental benefits that accrue so far into the future as to have a negligible present value using conventional discounting. In circumstances where intergenerational justice is an issue, standard economic analysis may not satisfactorily estimate these benefits.
11. Also, there is a danger that the failure to require a cost–benefit analysis will allow interested parties to lobby for a project that does not have net benefits.

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