BRIEF REPORTS

Measuring Economic Value of Biological Diversity: Concepts, Theories and Methods

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'One basic weakness in a conservation system based wholly on economic motives is that most members of the land community have no economic value' (Leopold 1966).

Introduction

Conservation of biological diversity recently has became a fashionable term, however still, not many understand the real concepts behind this term. State forest management institutions in the Baltic States claim to be concerned with conservation of biological diversity and forest scientists try to assess forest ecosystems in order to indicate abundance of biological diversity and needs for its maintenance and restoration. However, in order to be successful, we should not rely solely on the political commitments and scientific recommendations. The "real life" link among practical forestry operations and scientific knowledge must be found in order to successfully transfer existing information on biological diversity into the practical field of forestry, and enforce consideration of biological diversity while making decisions on forest management activities. The link must allow forestry organisations function according to profit maximisation principles, however, making conservation of biological diversity inherent to this process. Identifying economic value of biological diversity and incorporating it into everyday economic calculations could serve as such connection. Therefore, this paper attempts to shortly examine the value of biological diversity and concepts of existence and intrinsic values, indicates several approaches to measure economic value of biological diversity, and outlines major pros and cons of contingent valuation method.

Non-Use Value and Biological Diversity

Biological diversity is central to the productivity and sustainability of the earth's ecosystems. Organisms, biological structures, and processes are means by which physical elements of the ecosystem are transformed into the goods and services upon which humankind depends (Costanza, 1997; Howe, 1979). The importance of biological diversity - reasons for preserving, promoting, and managing for a rich variety of life forms – can be provided in a form of interrelated utilitarian and ecological categories, as well as some aesthetic and ethical arguments:

- Important products from non-timber species;
- The utility of indicator species;
- Retaining alternative resources for an uncertain future - economic change, climatic change;
- Importance to ecosystem productivity and stability - sustaining productivity, diversity and stability;
- Aesthetic and ethical considerations - anthropocentric values, biocentric values (Barnes and others, 1998; Burton and others, 1992; Christensen, 1996; Gowdy 1997).

Environmental theory and valuation methods facilitate identification of situations in which the value of the environmental improvement is relatively high and situations in which the value of the environmental improvement is relatively low (Blomquist and Whitehead, 1995). For many biologists, the total value of biological diversity is infinite; it is essential to the sustainability of life on Earth including human life. On the other hand, to most economists, even to most environmental economists, biological diversity is just another commodity, subject to trade-offs and substitution, just as any other market good (Gowdy, 1997). Due to so different approaches to the issue and complicity of factors included, the concept of the marginal value of biological diversity, when talking about ecosystems, is problematic (Gowdy, 1997). Removing one species will affect all the other in the system. On the other hand, the fact that precise marginal values

cannot be placed on biological diversity does not mean that substitution and trade-offs are not relevant to public policy regarding biological diversity protection. If policy choices are restricted to market trade-offs, higher-order aspects of biological diversity value will be missed (Gowdy, 1997).

Types of values can be divided into rational values involving standards for truth; moral values - standards for conduct; aesthetic values - standards for appreciation; economic values - standards for choice among goods and services; and spiritual values - standards for meaning (More, Averill, and Stevens, 1996). Well-socialized individual will have acquired the dominant values of the culture and will tend to judge situations, events, goods and services, aesthetic objects and the like in a way consistent with the values of the culture. However, these values may intersect in multiple ways (More, Averill, and Stevens, 1996).

Two categories of non-market economic values have been identified in the literature sources - use values (including option value as a form of possible future use (Krutilla, 1967), applying to the benefits a resource produces for those who actually use it, and non-use values (Krutilla, 1967), concerning benefits received by those who do not use it. The distinction between use and non-use values is not well defined and may not always be clear (More, Averill, and Stevens, 1996; More, 1996). There has not been also an accepted set of definitions for non-use benefits (Smith, 1987). Use values might include recreation, aesthetic appreciation, and spiritual values. Non-use benefits have been subdivided into existence value (the value people receive from simply knowing a resource exists), altruism (the value derived from having other contemporaries use a resource) and bequest value (preserving a resource for future generations) (More, Averill, and Stevens, 1996). In order to avoid confusion in defining use and non-use values, More (1996) distinguishes between on-site benefits (those a person receives from being in close physical proximity to a resource) and off-site benefits.

It is clear both from the above theoretical considerations and overall scientific evidence about the nature of biological diversity, that economists need to broaden their concept of value beyond that determined by market exchange. Several categories of non-market value have been identified for forests: use value, option value, altruism, bequest value, existence value and intrinsic value (More, Averill, and Stevens, 1996). Conservation of biological diversity in forests and maintenance of certain elements of forest ecosystems, supporting biological diversity, usually is carried out as a consequence of existence and intrinsic values. The concepts of existence and intrinsic values will be reviewed in the following section of the paper. Problems involved in distinction of these values will also be shortly described.

Existence and Intrinsic Values

The non-participatory benefit type, which appears to be least understood and to offer the highest order of measurement difficulty is the existence benefit (Bennett, 1984). Formal definitions of existence value require: (a) a specified distinction between what corresponds to the use (or in situ consumption) of a resource as an argument contributing to an individual's utility and some measure of the existence (or state of availability) of the resource as a separate contributor to utility; and (b) the assumption that the level of availability of the resource constrains the level of in situ use that can be selected at all prices for that use (Smith, 1987). As stated in several sources, Krutilla (1967) was the first one to describe existence values indicating, that:

'When the existence of a grand scenic wonder or a unique and fragile ecosystem is involved, its preservation and continued availability are a significant part of the real income of many individuals'.

Since then debates on existence and intrinsic values were ranging from opinions that growing acceptance of and reliance on existence values is misguided (Rosenthal and Nelson, 1992), existence values of the environment are anthropocentric by definition (Blomquist and Whitehead, 1995) and that their role in policy information and analysis should be questioned (More, Averill, and Stevens, 1996), to statements, that non-use value is well-defined and represents nothing more than the value individuals place on a particularly pure form of public good (Kopp, 1992). Larson (1993) argues, that 'pure' existence values may not be as pervasive as is currently believed; if and when they do exist, they may not be large; and, they may be immune to detection by any means, whether conversational or behavioural.

Non-market values arise because natural resources play important roles in furthering human goals. This goal perspective contrasts with intrinsic value - the idea that natural objects have value as ends in themselves regardless of their relationship to man. Because of the lack of precise definitions, elements of intrinsic value are often mixed with existence value, creating confusion in the literature (More, Averill, and Stevens, 1996). These resource values need to be examined on a logical as well as an empirical basis (More, Averill, and Stevens, 1996). Attfield (1998) argues, that intrinsic value and existence values do not overlap at all and that intrinsic value cannot be accommodated for any other purposes within the category of existence-value.

The whole range of problems attempting to indicate existence and intrinsic values in cost-benefit analysis are faced. One of more serious objections to both existence and intrinsic values is that they are essentially static concepts of value - they value the world the way the world is now (More, Averill, and Stevens, 1996). This is especially true of intrinsic value. If everything living (and perhaps non-living things as well) has value and a moral worth of its own, then it must be wrong to allow such things to go out of existence (More, Averill, and Stevens, 1996). But this allows no room for a concept of competition, either in a biological or an economic sense, or for growth, change or development. There also may be little room for creativity. To create is also to destroy (More, Averill, and Stevens, 1996). If existence and intrinsic values actually function to preserve the status quo, this raises a further open question regarding equity: whom do these concepts serve (More, Averill, and Stevens 1996)?

Another major critique of existence values states that it can be construed as a form of use (More, Averill, and Stevens, 1996). The key point is that all these values are human use values and reflect human benefits and costs regardless of where those benefits and costs are applied. People who value the continued existence of ecosystems would be unlikely to value them if most or all of the species interacting in those ecosystems became degenerate, ceased to lead lives in which the generic capacities of their kind were able to develop, and ceased to embody prospects of any revival of flourishing lives or prospects of lives of positive quality in the future (Attfield, 1998).

As can be indicated from above paragraphs, existence and intrinsic values are difficult to define and involve the whole range of uncertainties in receiving monetary expressions. Measuring existence and intrinsic values of biological diversity and forest ecosystem elements, supporting biological diversity, can be a complex process, where many variables must be considered. The following section reviews some attempts made to capture economic value of biological diversity.

Capturing economic value of biological diversity

McInerney (1976) has suggested the classification, which highlights four distinct types of economic decision problem that society faces in the optimal intertemporal use of its resource stocks, and therefore provided a basis for the introductory treatment of natural resource economics. The article states that using resources in the current we are taking away the opportunity to use those resources by future generations. The third class, according to McInerney, includes forests - destructible, renewable stock resources. However, McInerney in his calculations concentrated only on market values of natural resources. Costanza and others (1997) attempted to calculate the total value of ecosystem services (forest included). The study was not based on accurate numbers, due to the lack of monetary valuations of natural ecosystems, however, the results received, as indicated in the source, were close to those of previous two similar studies. The study referred to ecosystem goods and services together as ecosystem services. The article has provided supply and demand curves, showing the definitions of cost, net rent and consumer surplus for some essential ecosystem services. The curve can be applied in calculating monetary values of biological diversity and forest ecosystem elements supporting biological diversity.

Pearce and Moran (1994) expressed total economic value of environmental resource in equation:

$$TEV = UV + NUV = (DUV + IUV + OV) + (XV + BV);$$

where TEV - total economic value of environmental resource; UV - use value; NUV - non-use value; DUV - direct use values (e.g., fishing, timber extraction); IUV - indirect use values (e.g., forest's function in protecting the watershed); OV - optional values (individual's willingness to pay to safeguard an asset for the option of using it at a future date - like an insurance value); BV - bequest value (benefit from the knowledge that others might benefit from a resource in future); XV - existence or 'passive' use value (existence of any particular asset).

The same author also raises a question 'is total economic value really total'? The negative reply has several reasons, the main of which are that economists still have not captured all values, and that there are some underlying functions of ecological systems which are prior to the ecological functions that widely discussed (Pearce and Moran, 1994).

A major issue in conservation of biological diversity is controversy between direct land use and preservation for non-use values. Pearce and Moran (1994) indicated the individual's and society's view on costs and benefits of land use conversion. The decision to converse land or use it sustainably from individual's perspective will be the right one if, benefits of sustainable use of the forests (B(SUB)) after distracting costs of the sustainable use option (C(SUB)) are greater than benefits of traditional development of the land for, e.g., agriculture or forestry, or industry (B(DEV)) after distracting costs of the development option (C(DEV)). Allowing for time and applying discount rate, above needs to be restated in terms of present values to be:

$$PV[B(SUB) - C(SUB)] - PV[B(DEV) - C(DEV)] > 0;$$

where $PV(B) = \sum B_t/(1 + r)^t$, or $\sum B_t/(1 + s)^t$, where r – interest rate, s – social time preference rate (similar equation is provided for costs).

It can be clearly indicated from the above equation, that if the benefits of SUB appear in unmarketed form – i.e. there is no obvious market for them – then the individual landowner has no incentive to take account of them. The problem is even more complicated considering that discounting can make the non-sustainable use preferable to the sustainable use (Pearce and Moran, 1994). A private resource owner would consider the discounted net income stream from the alternative uses and select the use which would hold prospects for the highest present net value (Krutilla, 1967).

Pearce and Moran (1994) also identified two sources of 'economic failure' – the inability of existing markets to capture the 'true' value of natural resources:

- Market failure – distortions due to the 'missing markets' in the external benefits generated by biological diversity conservation;
- Intervention or government failure – distortions due to government action in intervening in the working of the market place.

Within market failure local market failure and global market failure can be distinguished (Pearce and Moran, 1994). The former relates to inability of markets to capture some of the local, national benefits of biological diversity conservation (failure of markets to account for the external costs of biological diversity loss because of land conversion). The latter concept – global market failure – relates to the fact that biological diversity conservation yields external benefits to people outside the boundaries of the nation faced with the development/conservation choice.

In order to receive monetary estimations of non-market values for cost-benefit analysis of biological diversity conservation or sustainable management of forest ecosystem elements supporting biological diversity, valuation techniques had to be developed. Next section reviews currently available economic valuation methods for non-market values and shortly identifies pros and cons of contingent valuation method.

Contingent Valuation Method

Non-use values may be among the most significant, and the most difficult to estimate, of all non-market values (Adamowicz, 1991). There are basically two broad approaches to economic valuation – direct and indirect (Pearce and Moran, 1994). In the direct approach, an attempt is made to elicit preferences by either experiments or questionnaires. The indirect valuation approach includes hedonic price and wage techniques, travel cost method, avertive behaviour, and dose-response and replacement techniques (Pearce and Moran, 1994). Two types of questioning, that can be undertaken under direct estimation of economic value are elicit rankings and elicit values, which is more commonly known as Contingent Valuation Method (Pearce and Moran, 1994). As indicated by several authors, the contingent valuation (CV) technique is currently the only available mechanism for the measurement of non-use values (Adamowicz, 1991; Kopp, 1992). Use of CV method range from applications in protection of forests (Loomis, Lockwood, and DeLacy, 1993) and management of protected areas (Driml, 1997) to estimation of economical benefits of individual species of forest ecosystems, such as wolf (*Canis lupus*) and white-backed woodpecker (*Dendrocopos leucotos*) (Fredman and Boman, 1996).

There are three basic parts to most CV survey instruments – (1) a hypothetical description of the terms under which the good or service is to be offered is presented to the respondent; (2) the respondent is asked questions to determine how much he would value a good or service if confronted with the opportunity to obtain it under the specific terms and conditions (these questions take the form of asking how much an individual is Willing-To-Pay (WTP) or Willing-To-Accept (WTA) for some change in provision); (3) response validity is tested (Pearce and Moran, 1994). Existence values estimated by CV reflect behavioural intentions motivated by a rich set of preferences such as intrinsic worth and altruism.

CV estimates are not random values; they can be internally valid and reliable, however, they can be unreliable as well (Blomquist and Whitehead, 1995). Several authors expressed a concern with reliability of CV applications in measuring non-use values (Adamowicz ,1991; Blomquist and Whitehead 1995; Smith, 1987). Smith (1987) stated, that before the relationship between measures of use and non-use values can be established, it will be necessary to define how individuals perceive the specific terms of availability of the resources involved as well as how these perceptions are influenced by uncertainty.

Reliability issues of CV estimates for environmental policy analysis (Blomquist and Whitehead, 1995) indicated several areas of concern in CV method applications:

- Internal validity - a common result is that willingness to pay increases with income, which is evidence of internal validity;
- Information effects - without consensus, and in terms of contingent market design, additional informa-

tion presented to respondents in some form may be necessary in order to improve the validity of responses;

• Familiarity - in general, respondents who are more familiar with the resource allocation change under consideration are more likely to behave rationally in contingent markets;

• Calibration - since existence values lead to no observable behaviour and have not been measured without CV, it is difficult to ascertain their external validity.

The same authors conclude that despite the conflicting evidence, it might be that existence values do provide information about the preferences of non-users, but at times, the correlation between true willingness to pay, or revealed behaviour, and stated willingness to pay, or behavioural intentions, is not perfect (Blomquist and Whitehead, 1995).

Gowdy (1997) adds onto the doubts on application of CV method in measuring non-use values, indicating that many economists fail to recognise the limitations of basing values entirely on the preferences of isolated individuals acting as consumers at a specific point in time. At the same time Larson (1993) suggests that it should be recognised that it is possible in principle to get substantially the same estimate of existence value from observing behaviour as from asking questions, in many if not all situations.

An attempt to deny several major CV method critique areas was made by Kopp (1992). However, it can be concluded, as indicated by Blomquist and Whitehead (1995), that CV estimates are neither always perfectly reliable nor always perfectly useless. The same holds for the political process in which expression of values for environmental goods is neither always perfectly reliable nor always perfectly useless. Decision-makers should dismiss neither source of information, but should use both contingent market estimates of existence values and demands expressed through the political process. Given the alternative, information provided by contingent valuation can be used (Blomquist and Whitehead, 1995). Whether or not the decision-makers choose to include these particular values in the analysis is the decision made outside the simplistic world of cost-benefit analysis. The important point is that should these decision-makers desire information on these values, economics is perfectly capable of supplying them (Kopp, 1992).

Conclusions

Within this paper the concepts and measuring mechanisms for economic value of biological diversity were shortly reviewed. It is evident that conservation of biological diversity is essential in maintaining sustainable and balanced forest ecosystems. biological diversity values range from market to intrinsic benefits, however, the clear distinction between existence and intrinsic values is missing. The attempts to calculate value of natural ecosystems indicated that non-use values, usually not included into market price, make-up a big share of total economic value of environmental resources. Economic benefits from conserved areas tend to be limited on a local scale, increase at a national level and can be substantial on a global scale. On the other hand, costs, in terms of foregone development benefits, tend to be locally significant and nationally and globally moderate. Contingent valuation method, despite several uncertainties, remains the only tool measuring existence and intrinsic values of biological diversity.

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