Assessment of Methodologies for Valuing Biological Diversity of Forests

Report to the Work Programme on the Conservation and Enhancement of Biological and Landscape Diversity in Forest Ecosystems, 1997–2000 of the Ministerial Conference on the Protection of Forests in Europe (MCPFE)

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European Forest Institute
Internal Report No. 4, 2001

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Editor-in-Chief: Risto Päivinen

FOREWORD

Many of the products and services provided by forests do not have a directly observable market or social value. Improved knowledge on the estimation of the value of all forest goods and services will allow a more informed decision-making, both at the political and the business level, taking into account the economic implications of forest conversion, of degradation, and of alternative forest uses.

The need for methodologies for assessing the value of the various forest goods and services has been recognised in international processes, e.g. in the Pan-European Process (Ministerial Conference on the Protection of Forests in Europe – MCPFE) and Intergovernmental Panel on Forests (IPF). A starting point for international discussion on biodiversity valuation methodologies is to review the state-of-the-art on the existing methods. Dr. Pere Riera (from the Universität Autonoma de Barcelona, Spain, and Director of the EFI Regional Project Centre of Solsona) has compiled this report on behalf of EFI for the Pan-European Process.

Anssi Niskanen
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EXECUTIVE SUMMARY (CONCLUSIONS)

Biological and landscape diversity of forests is a complex, mostly non-market good to value. Economics has developed several methods to estimate non-market values. Some are based on actual markets, like the Travel Cost Method, or the Hedonic Pricing Method. Others simulate a hypothetical market, such as the Contingent Valuation Method, Contingent Rating, Contingent Ranking, Contingent Choice, or Pairwise Choice. Each of them has advantages and disadvantages, and can measure slightly different aspects, but overall they are all reliable methods. Nonetheless, the inherent complexity of forest biodiversity requires valuation methods to be applied according to the state-of-the-art.

Most of the methods are costly to apply and time consuming. However, for most policy purposes, values can be ‘standardized’ and transferred to particular case studies, as is the common practice in other fields.

INTRODUCTION

This report is to respond to the following requirement of Action 1.4. of the Work Programme on the conservation and enhancement of biological and landscape diversity in forest ecosystems, which states:

Many of the products and services provided by forests do not have a real or estimated market and/or social value. Improved knowledge on the estimation of the value of all forest goods and services will allow a more informed decision making both at the political and the business level taking the economic implications of forests conversion of degradation on of alternative forest uses into account.

This issue was addressed in IPF4 in the recommendation for international co-operation in the development of methodologies for the valuation of goods and services (IPF4.102). New valuation methodologies were called for using the following criteria (IPF4.101): neutrality and scientific validity; practical applicability; simplicity and clarity; multidisciplinarity; cost-effectiveness; and orientation towards non-marketable goods and services . The IPF also recommended international organizations to prepare comprehensive documents on the available forest valuation methods (IPF4.104b).

VALUES

Value is a cultural concept, and is related to how human beings perceive things. Something has a value if it contributes to the welfare of someone, and it has more value as it contributes more to welfare. Therefore, 'value' does not exist unrelated to people. Things do not have value *per se*.

Since value is used here as a relative measure or indicator of human welfare, mainstream economics apply. That is, the value of an additional unit (marginal value) of a good can be observed in the competitive price, if the market price is indeed observable. For it to be observable, there has to be a market of this good. To be reliable as a value indicator, the market ought to be perfectly competitive (or close enough to it), with no major failures. Unfortunately, the biological diversity of forests, as a good, does not meet those requirements.

Value is referred to as a change in people's welfare, which comes from a change in the provision or enjoyment of the good. The change could be in the quantity of the good, or in its quality, or in whichever characteristic of it or even of a related good. The changes could be marginal or discrete. Prices reflect marginal changes, but many valuation methods are used to account for discrete changes. Values could be expressed in marginal or discrete terms. As will be explained below, even if discrete changes are to be valued, value estimations may be estimated in marginal terms.

Changes could be positive or negative, expressed in their own magnitudes. When they translate to values, they could reflect an increase or a decrease in welfare. Both can be accounted for. One could expect that a loss of biological diversity would result in a decrease in welfare, and therefore a negative value expressed in monetary terms. Some similar patterns can also be observed for landscapes, although it is not as straight forward, and may vary more from person to person.

Once the physical change is defined, the value should reflect the welfare change in all the individuals whose welfare has been affected by it, or the average welfare change of the individuals of the population. This may be clear in theory, but is not as easy in practice.

First, biological diversity and in particular the preservation of threatened species can affect the welfare of many people, even living far away from the place. In other words, people may get satisfaction out of knowing there is an improvement in biodiversity for present and future generations, even if they would not benefit from it directly. Those welfare gains are usually known as passive or non-use values. Therefore, the relevant population is often not local, but global. The consideration of both use and non-use values gives rise to the notion of total value.

Second, in practice, the definition of the population depends on the intended use of the value estimation. For instance, if it is to enter a regional cost-benefit analysis to support a regional administration decision, it might be considered appropriate to restrict the population considered to the one of the region. But if it is to enter an evaluation of a worldwide policy, a larger population ought to be considered.

Finally, not all valuation methods are usually suitable to measure non-use values. For instance, if a market existed, it could be the case that it failed to capture non-use values. Sometimes, the ability to capture passive use values could be a decisive criterion for choosing one method or another.

METHODS

Provided that a market for the good to be valued does not exist, or that this market has failures, or is not a competitive one, a number of alternative valuation methods are available.

They could be classified into two groups:

1. Actual market based methods
2. Simulated marked methods

ACTUAL MARKET BASED METHODS

The two main methods based on actual markets are the travel cost method (TCM) and the hedonic pricing method (HPM). They can also be combined in the hedonic travel cost method (HTCM).

TCM consists in collecting and analysing data from users of a good located in a place one has to travel to in order to enjoy it. For instance, a local public good such as a particular old-growth forest. The researcher would collect information from visitors or from the population in general. Usually, only visitors are surveyed. Information would typically be obtained through questionnaires. Questions would include the origin of the trip (so the costs of travelling can be estimated), and the number of trips in – say – the last twelve months to the site. If only the former question is used, the method is then called zonal travel cost (ZTCM).

If frequency of trips over time is known for each visitor, then the individual travel cost method (ITCM) can be applied.

A demand function relating frequency of visits and costs can be identified, and the consumer surplus estimated. The procedure used to estimate the function is almost always econometric. Often, a different econometric (and economic) approach is taken, and the frequency of visits over time is modelled using count data models.

Whichever of the two main versions (there are still others) is used, the value estimated by TCM is appropriate to the travel cost estimation; there is no clear consensus as to which items ought to enter the cost calculation. It seems clear that the cost of the fuel (if the visit involves the use of a car, as it usually does) ought to be considered, but other car costs are more controversial. Time is also often counted as a cost. Sometimes accommodation is also considered. The higher the cost considered, the higher the estimated consumer surplus will be.

The other main method based on actual markets is HPM. It is based on the fact that prices of ‘complex’ goods embed information on the implicit prices of the components of the good. For instance, a house overlooking an old-growth forest may be more expensive than an otherwise equivalent house with a less interesting view. The landscape view, as well as the size of the house, its economic distance to services, to amenities (the old-growth), to workplaces, age and shape of the house, and other characteristics conform the final market price of the real estate property.

Attending to this fact, if many transactions of the good (housing, in this instance) could be observed, and the price of the transaction as well as the different relevant characteristics of the good recorded, a regression analysis explaining the price according to the characteristics, would estimate the ‘weight’ or ‘contribution’ of each characteristic to the final market price. This would indicate the value of the landscape view, or the relative accessibility to the old-growth.

In most cases, both TCM and HPM only capture use values, leaving non-use values out of the account. This is not the case, though, with simulated market methods.

SIMULATED MARKET METHODS

Markets can be simulated, and thus ‘prices observed’. The simulation of the market for the good to be valued is achieved through a questionnaire to be passed to the population, or a sample of it. In the simulated market, the supply side is represented by the interviewer, who typically offers to provide a given amount of units of the good at a given price. The respondent, who either accepts or rejects the offer, represents the demand side. One of the most crucial issues in this kind of method is to be precise enough in the description of the market, and yet simple and clear enough for people to understand it. This is important, because biological and landscape diversity are among the goods for which it is difficult to simulate a clear, credible, precise and understandable market in a poll process.

The most widely used method is the contingent valuation method (CVM). In its usual form, a given change in the provision of a good (say a loss of an endangered species) is simulated and the program or policy to achieve it described. The individual is then asked what is the maximum amount of money they would pay for it, or alternatively whether they would pay a given amount of money. In this latter case, the amount of money varies from subsample to subsample, being the proposed physical change constant. In both cases, the mean or median maximum willingness to pay is calculated, either using simple statistical methods or with rather more sophisticated econometric techniques.

The value then refers to the difference of people's welfare between the survival of the species and the disappearance of that species. Obviously, this would capture both use (being able to watch wildlife) and non-use (existence) values.

Sometimes, the interest is in valuing separately several characteristics of biological or landscape diversity of a forest, and not only one. In those cases, repeated applications of CVM could be considered, but it is more practical to rely on other methods that can account for those separate values. Those are often referred to as stated preference (SP) methods – although CVM is a particular form of SP. One of the main differences between CVM and SP is that CVM involves a single physical variation, whereas SP includes a number of variations.

A typical SP method involves general characteristics of the good, usually termed attributes. One of the attributes is a monetary payment (or compensation), and the others are physical. For instance, a forest that has as distinctive number of biological and landscape diversity features under threat by a known risk factor, and that has a program to reduce it, would have the cost of the program as one attribute and the features as the others. Combinations of values for the different attributes yield 'alternatives'. Each alternative is characterized by a combination of physical attributes and a payment. A number of alternatives are chosen following one of the available techniques for doing that, and properly included in the questionnaire. The questionnaire is otherwise very similar to the CVM ones.

Depending on what respondents are asked to state, the SP method varies. When respondents are asked to rate a list of alternatives on a given scale, the method is called contingent rating. If they are asked to rank the alternatives, the method is called contingent ranking. If they are asked to state the most preferred alternative, then the method is called contingent choice method. A very popular variation of the latter is the pairwise choice method, where instead of a list of several alternatives, the respondents face successive pairs of alternatives, and are asked to state which is their preferred alternative (if they have one).

In all cases, the willingness to pay for the reduction of risk in the variation of each physical attribute can be estimated. The way to estimate it is through econometric models of limited dependent variables, such as ordered probit models, multinomial logit models, and alike.

Even if the original variations in the physical values expressed to respondents are discrete (and they usually are), the estimated value is expressed in marginal terms. Therefore, a reduction of a biodiversity index, for instance, would be valued in one unit decrease. If the desired change to be valued is discrete, the value is usually extrapolated accordingly.

One of the main advantages of SP methods over subsequent CVM exercises is that SP can account for cross-effects. For instance, people may consider that an increase in biological diversity without allowing access to forest is worth less than the same increase with some public access. There is a cross-effect between both attributes. If valued separately, the relationship effect on value is missing. If valued together by CVM, the individual values are missing. In general, the value of a forest is not the sum of the values of its attributes. There are often cross-effects, and the value could be higher or lower than the simple sum. SP methods allow for accounting both individual and global values.

RELIABILITY

All the techniques briefly described above have been applied to biological and landscape related aspects involving forests. Each one of them has some advantages over the rest and some disadvantages. The use of one or another depends mainly on the purpose of the valuation exercise and the availability of data and resources. So far, the most popular has been CVM, with SP methods gaining interest within the academic and practitioner worlds.

The reasons for the momentum of SP methods are diverse. They are relatively new, and more researchers get acquainted with them every year. It has a format that respondents tend to find comfortable, thus reducing the proportion of no-answers and protest-answers. SP methods can cope with valuing different attributes of a forest, like biological and landscape diversity aspects, in an integrated manner, therefore being more informative. SP methods tend to cope better with the so-called embedding problem (valuation being rather insensitive to the scale of the physical change) as far as the respondent gets a richer perspective of the scale of the changes proposed.

Both CVM and SP ‘design’ exactly the market as to value the good of interest, whereas with TCM and HPM it is often difficult to isolate the value of the good from other closely related goods. On the other hand, expressing biodiversity changes in simple, accurate, and understandable terms in a questionnaire can prove to be a challenging task.

In order to be able to better transmit the market conditions, researchers often use visual aids, such as simulated landscape changes. This implies that interviews cannot be conducted by telephone, but by mail or face-to-face interviews. In general, the latter is the preferred option, especially when the good to be valued is rather complex. Computer aided interviews are becoming more common.

There tends to be an inverse relationship between familiarity with the good and the ability of respondents to answer meaningfully. The biodiversity related goods tend to be very unfamiliar for a market situation. Therefore, the use of CVM and SP requires state-of-the-art practice to overcome this and other potential problems.

In general, the more specific the change in biodiversity is, the more reliable are the values obtained by all the methods. This is especially the case with CVM and SP.

TCM and HPM tend to be more suitable for *ex post* valuation, since they rely on existing markets, whereas CVM and SP tend to be more adequate for valuing changes *ex ante*. They can also be used in *ex post* valuation, but there might be a lack of incentives to answer.

In summary, even though estimating the economic values of changes in biological and landscape diversity of forests is not a straight forward task, the tools developed by environmental economics makes it possible and, overall, fairly reliable. Provided, of course, that the methods are applied according to the state-of-the-art.

BENEFIT TRANSFER

Values related to the biological or landscape diversity of forests are often to be estimated for policy reasons. Therefore, the valuation becomes part of an evaluation of a policy, program, or a particular investment. In practice, the lack of resources or time to undertake *ad hoc* valuation studies has resulted too often in leaving them aside, and substituting them by qualitative statements only.

However, it is not always necessary to conduct specific and costly studies. If a set of ‘standard’ values were available, they could be used in different situations. ‘Benefit transfer’, as it is called, is used extensively in cost-benefit analysis in different fields. The European Commission, for instance, uses this procedure regularly to evaluate proposed environmental policy.

Also, this would allow easy transition from cost-effectiveness analysis to a full cost-benefit analysis of forest projects, programs, or policies that affect biodiversity and landscapes – which are the vast majority. In that way, decision makers would be aware not only of the least expensive action to meet certain goals (cost-effectiveness), but also how much higher –if at all- the benefits are compared with the costs (cost-benefit analysis).

The transfer of values could be practiced within a given region or at a larger scale. If the latter, equity issues usually arise. Most of the valuation methods described can capture the different willingness to pay for the biodiversity good according to differences in income. Therefore, equity or ‘solidarity’ among countries or regions could be treated explicitly in the evaluation process. Likewise, inter-generational issues could be considered more reliably if such information were available.

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This economic report of the United Nations Environmental Programme *Global Biodiversity Assessment* is particularly well structured. Besides the common revision of use and non-use value concepts, and the methodologies used to estimate the values, this chapter introduces the problem of risk and uncertainty, and devotes specific sections to: valuation of species and habitats; valuation of ecosystem functions; and valuation in the conservation of biodiversity. The length of it (about 90 pages) allows for some depth in selected aspects. For instance, it reports many empirical studies and presents the values found. Even though the report is not particularly focused on forest biological and landscape diversity, the topic is present more or less explicitly in some pages. The list of references is very extensive, although only a portion of it is on biodiversity valuation.

Committee on Noneconomic and Economic Value of Biodiversity, Board on Biology, Commission on Life Sciences and National Research Council. 1999. Perspectives on Biodiversity. Washington D. C.: National Academic Press. 150 p.

This book “responds to a request to the [US] National Research Council from the Deputy Undersecretary of Defense for Environment Security, which recognized that many of the lands it owns or controls have potentially high value for protection and maintenance of biodiversity” (page 1). Chapter 4 reviews the different concepts of value, and Chapter 5 describes some of the valuation methods. The report also includes examples of applications.

Pearce, D.W. and Moran, D. 1994. The Economic Value of Biodiversity. London: Earthscan. 150 p.

This book was published as an expansion of a report of the authors to the International Union for the Conservation of Nature. It reviews most of the topics associated with the economics of biodiversity. Chapter 5 deals specifically with valuation methods, and Chapter 6 reviews some case studies.

Ke Chung Kim and Weaver, R.D. (eds.). 1994. Biodiversity and Landscapes. A paradox of humanity. Cambridge: Cambridge University Press.

This book puts together a collection of 22 papers presented to a 1990 conference on Biodiversity and Landscapes: Human Challenges for Conservation in the Changing World, held in the USA. Two papers are specially linked to valuation. One is authored by Robert D. Weaver, and the other by Allan Randall. They deal with methods and related issues. Randall’s paper concludes that in spite of the difficulties associated with valuation methods, “…in full awareness of the challenges, I believe the effort [to value] could be made and the results should be taken seriously” (page 284.)

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