**André Mayer Research Fellowship**

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# FOREST VALUATION FOR DECISION MAKING

## Lessons of experience and proposals for improvement

**SEBASTIÃO KENGEN**

**Food and Agriculture Organization of the United Nations**

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**Forest Valuation For Decision Making:**

# FOREWORD

The importance of forests for meeting environmental, developmental and social goals is fully recognised. The fate of the world's forests has become a central topic for international policy dialogue, particularly in the context of the Earth Summit and its follow-up. There is a growing desire to combat deforestation and forest degradation and to promote conservation and sustainable forest management (SFM).

Yet there is a feeling that commitment to SFM could be more effective if the full value of forests could be demonstrated. There is a perception that forests are valued mostly as a land bank rather than as valuable resources in their own right. Thus, forests are too easily cut to make room for other land uses. Where forest worth is appreciated, the financial value of commercial timber sales is the sole or predominant element reported. Value estimates often exclude the worth of forest functions in protecting biological diversity, water and soils; in capturing carbon; or in providing livelihood opportunities outside the formal monetary economy. It has been suggested that due to under-valuation of forests, the sector attracts less investment than it deserves. According to these perceptions, better valuation would, by more clearly demonstrating the full importance of forests, attract more investment into the sector.

In the light of this perspective, FAO awarded a one-year André Mayer Research Fellowship to Dr. Sebastiao Kengen of Brazil and the study was carried out between October 1995 and November 1996 at the College of Forest Resources, University of Minnesota, USA. Dr Kengen was to review methodologies for forest valuation and examine the results of their application in preparing investment projects and programmes where forestry is the sole objective or is one of the options or components. The expectation was that a range of tried and proved techniques were already available from which to select the most promising, to develop them further and to format them for inclusion in mainstream forestry investment project preparation procedures.

The research has shown these expectations to have been premature. The outcome of the programme has accordingly been adapted as reflected in this document:

(a) *Firstly*, it is confirmed that many potentially good valuation methodologies exist and the document presents these in summary form. It emphasizes that the issue is not lack of methods but of knowledge of biophysical coefficients of the forest and of production and market factors as it relates to goods and services other than timber (which is often better documented). In the absence of such information, value estimation becomes an exercise in guesswork by analysts.

    Some questions to which answers remain elusive relate to: How much and for how long can particular goods and services of forests be produced? How seasonal are their yields? What is the probability of finding a beneficial species and what would be sustainable yields of usable essence from it? Taking account of research and development costs, production and distribution losses, and market development costs, what would be the cost of capturing the latent benefit? Would the markets observed at local scale truly remain available if production expanded and what would prices be then for the goods or services in question? The lack of a sound knowledge base is among the greatest challenges facing valuation - until it is resolved, the outcomes of many valuation studies will continue to depend inordinately on individual analyst’s attitudes and the breadth (or otherwise) of their experience. The lack of a reference knowledge base also creates risks of some interest groups using valuation for advocacy purposes to boost support for a particular conservation or development cause.

(b) *Secondly*, the document highlights important considerations for analysts and decision-makers, among them being: (i) the need to recognise that there are no absolute values and whatever is presented depends on context and necessarily reflects one or several interest group perspectives or a compromise among many; (ii) positive benefits at one level (local, national or global) may not be so important at another level or may even represent a cost - equity issues arise as to who pays and who benefits; and (iii) absolute or proxy values expressed in monetary terms are only one among many elements for decision.

(c) *Thirdly*, the study has revealed that there is yet to be systematic application of full valuation in forestry, both in investment and other contexts. Of the examples which exist, many have been in academic or environmental interest-group circles. The few practical examples of full valuation have tended to be at a scale which is so large, costly and demanding in terms of skills that they have little chance of entering the mainstream. There is so far not much evidence that full valuation has greatly influenced decisions.

A fundamental factor undermining ability to influence decisions may be the fact that high values are estimated for such benefits as carbon capture, biological diversity conservation etc., for which the possibility of tangible value capture by those most affected by the forest (such as forest dwellers) is often low. Frequent paradoxes arise whereby forests, to which analysts have attributed very high values, are readily cut down by farmers and replaced with land uses which valuation shows to be worth less (but which offer more immediate or tangible gains to the *de facto* "decision-maker" farmers). Thus, the basic issue is the likelihood that those immediately effected can capture the value in tangible terms rather than in vague terms of importance to the broad international community. In its own way, valuation is therefore highly political. High figures from valuation exercises will, if not accompanied by tangible benefits that can be captured, fail to attract the commitment of decision-makers and those directly affected; as a result, they may loose faith in valuation and ignore its findings.

One important message from this research is to draw attention to the limits of what full forest valuation can achieve and to show that there is a distinction between having a high value and being able to capture it. Valuation alone may be important or even necessary for decision making but is not sufficient to attract greater support for sustainable forest management or increased investment. An indication of capture potential (i.e. ability to yield tangible returns) may be a necessary complement. The research also draws attention to the need to improve understanding of how valuation results can be given more weight in decision-making. To improve the likelihood of valuation being influential, the author advocates a cautious approach; a search for better scientific knowledge so that estimates become less dependent on the analyst; development of more rapid, simpler and less costly techniques for valuation which can be integrated into the mainstream; and promoting ways to capture values, so reducing the gap between estimates and reality.

FAO wishes to thank Dr. Sebastiao Kengen for the research work he undertook, which raises the kinds of questions which we hope will challenge other scientists and practitioners into making further efforts. At the University of Minnesota, FAO wishes to record its appreciation to Dr. Alan Ek, Professor and Head of the Department of Forest Resources, and Dr. Alfred Sullivan, Dean, who extended the offer to host the study; to Professor Hans Gregersen who directly guided the study; and to Professor Alan Lundgren who provided many important professional contributions.

Within FAO, this study was supervised by Mafa Chipeta, Senior Forestry Officer (Forest Economics), supported by Linda Ransom of the Forestry Policy and Planning Division. Administrative and financial support was provided through Jean-Marc Meyour and his team in the Fellowships Group.

M. R. de Montalembert
Director

Forestry Policy and Planning Division
Forestry Department

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THIS WORK IS DEDICATED TO MY WIFE

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Sebastiao Kengen
College of Forest Resources
University of Minnesota
St. Paul, USA

November 1996

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# INTRODUCTION

## A. Origins

At a time of many pressing and competing demands for financial resources, the forest sector needs an unchallengeable basis for analysis if forestry investment is effectively to compete with other alternatives. When this study was launched the perception was that proper valuation is an important element in making the case for forestry or for recognizing when alternative land uses are better options. The prospectus of the André Mayer Research Fellowship which funded this study called for research: to document and analyse experiences and results of currently available methods for valuation of forests and trees during investments preparation; to indicate shortcomings of current methodologies in the full valuation of forest products and services; to highlight those which hold most promise for practical application and general adoption; and for the best methods, to suggest how to apply them so as to present the economic contribution of forests and trees at the same level of analytical reliability as that of other land-using options.

The study was to consider (a) land development programmes involving conversion of forests to other land uses and (b) forestry projects proper. Of particular interest was the recommendation of valuation approaches for a range of situations taking account the need for replicability, cost effectiveness and applicability under conditions of poor data availability and where economies are not fully monetized, as in many developing countries. Guidelines included: (a) that methods should be applicable in the context of making funding decisions for specific programmes or projects and capable of integration into the main standard analyses in preparation of investment programmes; and (b) that methods should, within limits imposed by need for scientific rigour, be simple, replicable and have limited dependence on the attitude of the analyst. The report was to be of immediate practical value to investment programme preparation experts in member countries and international lending and technical assistance agencies ranging from development banks to institutions such as the Food and Agriculture Organization of the United Nations (FAO).

A period of nearly a year was spent on an extensive but also in-depth study of information. A programme of attachments was undertaken to the United Nations Environment Programme (UNEP) in Nairobi, Kenya; the Centre for Social and Economic Research on the Global Environment (CSERGE) and International Institute for Environment and Development (IIED), both in London, England; and the World Bank (International Bank for Reconstruction and Development, IBRD), Interamerican Development Bank (IDB), World Resources Institute (WRI) and Resources for the Future, all in Washington, D.C.

It has become apparent that the product envisaged by the André Mayer prospectus is premature relative to the state of the art in forest valuation. The review of literature has shown that, although in recent years numerous forest valuation studies have been carried out in both developed and devolving countries, many have been carried out in isolation from forest policy, management and investment. The following attributes may be noted:

- most studies have been academic;
- those done by funding institutions, e.g. World Bank, have been costly and time-consuming projects;
- there is no evidence of the results influencing decisions. There is some indication that valuation is often undertaken to support decisions already taken, e.g. to establish a conservation area;

- methodologies do not appear to be an issue: they have been applied in the context of both developed and developing countries. The same method can give as divergent a set of results as different methods. All of them lack maturity to such a degree that it is recommended that more than one method be applied to a given situation (see annex 3);

- there is severe site specificity: a “prescription” type of guide for investment preparation, as envisaged by the André Mayer research fellowship, would be difficult to provide at this stage, especially for use internationally;

- production function information is critically short for any one situation, let alone for the diversity of circumstances faced by international development agencies in preparing projects.

In view of the above, the outcome of the André Mayer fellowship has had to be adjusted. It provides not an instruction manual but, rather, a set of principles and a framework for procedures that should be taken into account in any specific context with which the analyst is faced. Indeed, given the variation of circumstance and perceptions, “blueprint” or “cookbook” approaches would be inappropriate.

Unlike other material already available, this work does not present valuation in isolation. Instead, it promotes awareness of the context in which such work is undertaken. Failure to appreciate this carries danger of misuse or even abuse of valuation. For this reason, investment preparation professionals who may be tempted to focus only on the practical elements in Part II of this publication are encouraged to read the first part also.

## B. Overview and purpose

A review of the literature suggests that the exhaustion of forest resources has been a major concern throughout history although usually restricted to a local context or national boundaries. However, with the emergence of the environmentalist movement in recent decades, this concern has been extended beyond national boundaries to international level, particularly with regard to tropical forests. Although a renewable resource, forests can be exhausted if they are not properly managed. Such considerations resulted in forest-related matters received major attention at the 1992 United Nations Conference on Environment and Development (UNCED), commonly referred to as the Rio Summit.

This importance placed on forest resources was reflected in the Forest Principles and in Chapter 11 (Combating Deforestation) of Agenda 21. Chapter 11 listed a series of programme areas aimed at sustainable management including efficient utilization of forests. Measures to ensure the full valuation of the goods and services provided by forests, forest lands and woodlands therefore became essential. It was assumed that inadequate value credited to forests is one of the major causes in the failure of sustainable forest management. Among other things, deforestation and transfer of forests to other land uses were thought to result from inadequate recognition and underestimation of the values of the many goods and services provided by forests at local, national, regional and global levels.

Evidence suggests that many forest valuation studies have been carried out in isolation from forest policy and management. One of the greatest challenges is how to integrate these studies into forest management or forest investment decisions and forestry policy development. Decision-makers are unlikely to seriously take into account values estimated without showing how they can be captured. This is particularly true in developing countries which, in their day-to-day struggle to satisfy the most basic needs of their populations (notably food), cannot take a long-term view.

Valuation *per se* therefore is not a panacea to solve all forest-related problems. Indeed, estimated monetary values, even if high, cannot assure either that forests will be conserved or that forest management will be preferred to alternative land uses. Valuation can be a useful tool, but it is necessary to integrate it into forestry development policy and forest management decisions. It should be remembered that: (i) there are many issues that cannot be addressed through monetary values; (ii) decision-makers often do not require fine-tuned figures, but just orders of magnitude or even no quantitative information at all; (iii) often a decision-maker may need qualitative information only, such as an accurate assessment of the expected outcome, the issues involved and the segments of the population that would be most affected as a consequence of the management decision taken for a particular forest.

This publication aims to provide the decision-maker on investment projects and those involved in forestry investment project preparation with a pragmatic view of forestry valuation. It builds upon preceding FAO Forestry Papers 17 (Gregersen and Contreras, 1979: "Economic analysis of forestry projects" and its supplements "1. Case studies" and "2. Readings"), 106 (Gregersen and Contreras, 1992: "Economic assessment of forestry project impacts")[1] and 114 (Gregersen et al., 1993: "Assessing forestry project impacts: Issues and strategies"). These papers give well developed and well discussed approaches, methodologies and techniques to deal with forestry and related investment projects, as does FAO Conservation Guide 16 (Gregersen et al., 1987: "Guidelines for economic appraisal of watershed management projects"). In FAO Forestry Paper 127 (Gregersen et al., 1995: "Valuing forests: Context, issues and guidelines"), the reader was provided with issues, guidelines and context in which a forestry valuation should take place; its recommendations are essential reading for those who need to decide whether to carry out valuation and how to select the main line of approach.

## C. Audiences

This publication has been prepared primarily to serve two audiences: (a) decision-makers on investment projects, who need exposure to the purpose, limits and context of valuation, and (b) those who prepare forestry investment projects and who want a full briefing on contextual aspects and what it is possible and not possible to do with valuation in their forestry work.

The first audience (decision-makers in government planning agencies, international technical assistance agencies and multilateral development institutions) is offered summary information in the following section and in "Part I: The context in which valuation decisions are taken". Considerable attention is given in this early part of the publication to the function of full valuation, what purposes it can serve in decision-making and its limits, and the context in which it is carried out. The summary information in the early sections can be read independently of Part II which gives technical details on valuation procedures.

The second audience (those who prepare forestry investment projects) are the "practitioners" who need to have key elements of valuation to apply in their work: this is expected to be the main group of users. Material for this group is more detailed and is in "Part II: The valuation process", supported by annexes, many illustrating procedures and outcomes from recent valuation exercises. Users in this category are assumed to have experience in project feasibility analysis and investment preparation in general. They are expected to already know how to use shadow pricing techniques. This publication offers them in one place a convenient reference on how to value a broad range of forest benefits. To do so, there is an extensive bibliography as well as some cross-referencing to other works which practitioners should consult for details on specific techniques.

1 FAO Forestry Paper 106, "Economic assessment of forestry project impacts" (1992), is an updated revision of FAO Forestry Paper 17.

## D. Background

For about the past fifty years it has been repeatedly stated that forests can supply a large range of goods and services of great importance to humankind. However, this realization *per se* does not seem to be able to assure their conservation. On the contrary, figures suggest that the process of deforestation, particularly in tropical areas, is faster than before. Forest degradation is not so well documented, but it can be inferred that it is increasing similarly.

From the 1980s environmental concerns allied to new models, such as sustainable development, caused the increasing rates of deforestation in tropical regions to become a major issue at international level. Various initiatives have ensued. The first one was the launching, in 1985, of the Tropical Forest Action Plan (TFAP) that had as its major aim to save the tropical forests.

However, the apex of this great international interest in forests can be traced to UNCED in 1992 during which special attention was given to forest-related matters. The concepts developed at the Rio Summit were embodied in the Forest Principles and in Chapter 11 (Combating Deforestation) of Agenda 21. Forest resources also received attention in other documents issued during this summit, such as the Convention on Biological Diversity. Since the Rio Summit many intergovernmental initiatives have been taken, such as the Canadian/Malaysian initiative, the Montreal and Helsinki processes, the Centre for International Forestry Research (CIFOR)/Indonesia dialogue and the United Nations Commission on Sustainable Development (UNCSD) - Intergovernmental Panel for Forests among others[2].

This suggests that forest resources have never before received such attention. All of these measures have as their major aim to protect the world's forest resources, particularly the tropical ones, from further depletion or, at least, to slow down the rate of depletion. Unfortunately, however, evidence suggests that deforestation and forest degradation continue at high rates. As pointed out in Agenda 21, "the vast potential of forests and forest lands as a major resource for development has not yet been fully realized". Thus, the need to demonstrate the importance of forest resources remains as strong as ever. Promoting efficient utilization and assessment to recover the full valuation of the goods and services provided by forests, forest lands and woodlands, therefore, has become one of the programme areas according to section C in chapter 11 of Agenda 21.

Inadequate recognition and underestimation of the values of the many goods and services provided by forests at local, regional, national and global level has been assumed to be one of the major causes of failure of sustainable forest management, perhaps even contributing to deforestation, forest degradation and transfer of forests to other land uses. Some authors, such as Richards (1994), argue that the major single cause of deforestation is because forest resources are underpriced and therefore undervalued by society. However, as discussed later (e.g. the Grimes et al. (1994) study on Ecuadorian forests), evidence suggests that valuation *per se* does not seem to be able to halt conversion of forest land to other uses. The need to properly value the goods and services of forests, forest lands and woodlands has long been recognized. The need to value forests can be traced to papers written by German foresters in the last century, e.g. Martin Faustmann (1849) and Max R. Pressler (1860)[3]. One of the earliest references recommending the need for valuing the broad range of forest goods and services occurred at the 5th World Forestry Congress (WFC) held in the United States in 1960.

Proper valuation of forest goods and services is dependent on reliable information on the forest resource, information both quantitative and qualitative including physical as well as socio-economic elements. In this sense, forest resource assessment and, more generally, environmental and social impact assessments are closely related to the valuation of forests even if they are distinct in nature.

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2 For more details on these initiatives, see, for example, CFA (1995).

3 These classical works were reprinted in *Journal of Forest Economics 1(1),* 1995.

The knowledge and understanding of how tropical forests function is still severely limited. There remains considerable uncertainty over the dynamics of the forest ecosystem, particularly as far as tropical forests are concerned. The interactive processes in tropical forests are complex and inadequately understood. Where an alteration or conversion may be irreversible is still uncertain. And knowledge on the relationship between economics and environment is even poorer. Economics has one logic while the environment has another: the challenge is to find the way to make these logics compatible. This lack of information on such basic interaction parameters and values makes it difficult to select the dominant use or combination of uses that could yield the maximum social value for a particular tract of forest. Parallel to this ecological context, there is the "real world" context in which there are forces that influence the fate of forests and pressures for land use changes.

Valuation should be a neutral analytical tool, not an advocacy instrument. However, this does not always happen. Proper valuation of forest resources can provide useful information to all those associated with choices among management options and alternative uses of the forests and lands to meet the needs of the group involved. It can contribute to showing that the sustainable use of the forest has a positive economic value, and that this economic value can be even higher than the value of alternative resource uses which threaten it. However, valuation is unable to be informative about the motivations of people in their use of the forests. Valuation is just a tool that can increase the knowledge of the range of monetary values associated with forests. It is expected that a proper valuation should be able to change government perceptions on forest resources and, consequently, to influence decisions enabling a more judicious use of forest resources; otherwise forest valuation may be a wasted effort.

Despite the importance of forest valuation in the decision-making process, it is not *per se* a solution to all forest-related problems and, consequently, the salvation of the world's forest resources. The valuation process does not ensure that sustainable forest management will be preferred to alternative land uses. Ultimately, valuation is a tool that is expected to provide elements for the decision-making process in the selection of orientations for forest management or in the allocation of land under forests in situations of competition with alternative use options. It can be useful in the sense that it can provide values within an order of magnitude that can help the decision-maker to formulate investment decisions and choose between alternative conservation strategies.

The above points should be understood not as criticism of forest valuation but as the need to recognize its practical limitations. It is important to stress once more that forest valuation is just a tool that, taking into account the context, can contribute to providing a basis for decision. However, as well as economic considerations, there are social and political factors that play an extremely important role in the use of forest resources. Thus, there are several factors that determine a forest's value. Further research is necessary:

(i) to reach better estimates of all goods and services provided by a forest,
(ii) to reinstate appreciation of forests, particularly the tropical ones, as a valuable economic, ecological and social asset, and
(iii) to provide estimated values even though they may not all be captured.

## E. Organization

Following this introduction, which ends with a summary of the suggested steps in forest valuation that are detailed later, the monograph consists of two parts. Part I deals with the context of valuation. The first chapter covers how to define and clarify the decision for which valuation is intended to provide a basis. It is followed by a chapter on clarifying the purpose of the valuation and its context and outputs.

Part II deals with the valuation process itself and is divided into three chapters. Questions of data inadequacy or difficulties of measurement are important in valuation: chapter 3 focuses on this aspect. Chapter 4 deals with choosing and applying valuation methods and techniques to meet information needs.

It should be stressed that valuation methodologies are generic in nature: there are no methods applicable to only one type of project. To carry out valuation for any one project type generally requires the use of several valuation methods which, being tools, are also usable on other types of project as well as being usable for policy-oriented valuation.

Chapter 5 is on uncertainties and how to deal with them. This is a key issue: full forest value comprises many benefits and values, most of which are not measured or measurable; they may be intangible, or not recorded or documented through market or other formal mechanisms; they may accrue to a diffuse global community, or can be reaped only in the distant future. In many instances, their magnitude can be influenced by many factors within and outside the forestry sector and therefore their likely impact is a matter of probability. Thus there are no certainties in valuation: probability assessments are a necessary element of all valuation studies and chapter 5 offers ways to deal with this important aspect. The closing chapter (chapter 6) draws conclusions from what has been discussed and highlights some issues addressed; it also identifies opportunities for further work.

## F. Summary guidelines for forest valuation

What follows is an attempt to provide a guide for practitioners facing the task of developing economic values as part of investment project preparation and/or policy decisions. It is important to stress that the suggested steps constitute guidelines, not “rules” to be followed regardless of context. As emphasized throughout, there is no single rule to be followed. Ultimately, economic values are only one input, often a small one, into decisions concerning forest use. Further, there are many different ways in which to go about deriving and using such values. Within this context, the suggested steps for forest valuation are provided, in the form of a diagram (figure 1) and as a discussion of each step.

*Step 1:* The first step must be a clear definition of the decision to be made.

What answer is required for decision-making? What sort of problem is the analyst confronting? Can valuation of only those aspects amenable to presentation in monetary terms suffice or should there also be supplementary qualitative assessment (such as aesthetic, spiritual or existence values or ethical considerations)? Winpenny (1992) found little scope for applying economic values to these important but non-quantifiable benefits. It is necessary to clearly define what goods and services are going to be valued and in which context spatially and in terms of time scale. The valuation should be site- and time-specific.

*Step 2:* The second step is to clarify the purpose of the valuation, its context and outputs.

What are the objectives to be reached with the study and in what circumstances does the decision have to be made? According to Patton (1986), it is very important to identify who needs what information, under what conditions and for what purposes. Why is valuation important to deal with the problem? What information is required by the decision-maker? It may be qualitative rather than quantitative, or orders of magnitude instead of fine-tuned figures.

**Figure 1. Suggested steps in forest valuation.**

***Step 1:* Clear definition of the decision to be made**

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***Step 2:* Clarify the purpose of the valuation, its context and outputs**

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***Step 3:* Clearly identify and determine the input and output information needs and constraints to meeting those needs**

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***Step 4:* Choose and apply the valuation methods and techniques to meet the information needs**

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***Step 5:* Value uncertainties**

Since a given policy can affect the distribution of benefits and costs, the analyst should ask who will bear the costs and who will get the benefits. In some cases, the major beneficiaries are at global level whereas the costs are borne mainly by the local population (or the reverse). The analyst is dealing with groups of divergent capacity to express themselves or even to understand the issue. Judgement becomes the most critical faculty of the analyst, who must make allowances when local groups have difficulty in formulating their concerns and their particular sets of values. A clear understanding of the context is essential in order to select the correct perspective from which to value forests. Having defined the purpose and context, it becomes possible to say what outputs should be aimed for in the valuation exercise.

*Step 3:* The third step is to clearly identify the input and output needs and to determine information needs and the constraints to meeting those needs.

Data generation is usually costly and time-consuming. As Gregersen et al. (1995) pointed out, it is worth the time and effort to value things only if the values are going to be used effectively to accomplish something, for example, to influence a decision. There is no virtue in collecting more information than the minimum required to make reasonable decisions; the ability to determine just what this level is comes with experience. With regard to data accuracy, it is worthwhile to note that Chambers (1981)[4] suggests that there exists an "optimal ignorance" and "appropriate imprecision", these concepts being a recognition that, although imprecision is not a virtue, saving time and money

4 A substantially revised and updated version of this paper was presented in the International Conference on Rapid Rural Appraisal held at Khon Kaen University in Thailand in 1985 (Chambers, 1987).

is. It is likely that the decision-maker often needs orders of magnitude rather than fine-tuned numbers (see Kumari, 1995b). Thus, fine-tuned figures are not necessarily the best answer.

For example, knowledge is limited on the physical and biological behaviour or capacity of forests to produce the goods and services that give them value. Many interactions and coefficients of productivity as well as the response of forests to husbandry interventions are not yet fully understood, particularly for harvesting of non-wood forest products (NWFPs), biological diversity etc. Similarly, scientific knowledge about production and its cycles or seasonality, about markets for many forest products and services (especially NWFPs) is not well documented, with many results often incomplete or based on dubious estimates about these uncertain and complex issues.

*Step 4:* The fourth step deals with choosing and applying valuation method(s) and technique(s) to meet the information needs according to the problem under consideration.

The analyst's choice of appropriate valuation techniques for a given forestry project calls for judgement and therefore improves with experience. Forestry valuation is not like a construction project, with engineering blueprints which precisely predetermine what should be done. The most appropriate techniques to apply will depend on the context. There has been great emphasis on estimating the total economic value (TEV). Its estimation is not itself a valuation method. Conceptually, it is an aggregate of (i) total use value (TUV) and (ii) total non-use value (TNV). There is a contradiction in the term TEV, in that not all values of goods and services supplied by a forest can be reduced to economic or monetary terms. However, its calculation continues to be appealing.

In all cases, the analyst must assess how much it will cost, and how long it will take to collect, process, analyse and present results relative to the time, funds and human resources available. If an attribute considered vital for a decision cannot be accommodated in the valuation because of cost, skills required or other reasons, the analyst should ask if the valuation should be attempted at all.

*Step 5:* The fifth step is to deal with value uncertainties, the existence of which is often recognized but generally ignored in analysis.

Uncertainty is an inherent part of forestry. This can be attributed to many factors, such as long production periods (from 10 to 100 or more years), during which the goals and objectives of producers change as well as the desires and wants of consumers. Other factors contributing to value uncertainties include basic economic data, physical inputs, costs, physical production response, market structure and prices, technological change and the dynamic of the forest ecosystem, particularly the tropical one (Lundgren and Thompson, 1972). A change of the political party in power may alter goals and value systems of governments, altering social programmes and priorities, and thus affect forest management (Lundgren, 1976).

The analyst needs to clearly identify the problem and the uncertainties allied to it. There is neither an empirical model nor a theoretical one of how the analyst should do this. So, no matter how permanent a particular valuation may appear, it is invariably not the last one. Thus, one strategy of dealing with an uncertain future is to allow room to reconsider and revise the valuation as new information becomes available.

# PART I: THE CONTEXT IN WHICH VALUATION DECISIONS ARE TAKEN

## Chapter 1: DEFINING AND CLARIFYING THE DECISION[5]

### 1.1 General considerations

It has been assumed that the incomplete valuation of forests currently practised[6] has reinforced perceptions that forests have little worth other than for their timber and that this has made governments assign low priority to the forestry sector and thereby contributed to deforestation. Those who hold this opinion expect forest valuation to provide information that can help governments (a) recognize that forests are worth enough to deserve a better share of scarce capital resources among competing land-use activities, and (b) choose and implement investments which appropriately balance natural-resource conservation with development. Munasinghe (1993c) points out that valuation results can also be used in determining or influencing pricing, land use and incentive policies.

In considering the question of defining or clarifying the decision that will require valuation, it is useful to consider the function of valuation which is discussed below. Forest valuation is a tool that can provide decision-makers with useful information for deciding among alternatives or upon preferred combinations of possible interventions.

There is a widespread perception that forests are threatened[7]. In developing countries deforestation and forest degradation have reached levels which society considers unacceptable; in developed countries pollution, the cutting of residual primary forests and human pressure for recreation are putting strains on forests. As a result there is great public interest in forestry and the desire to see greater levels of investments into the sector in order to ensure sustainability. However, forests are complex ecosystems that are not fully understood and, as such, they cannot be fully represented in terms of total area alone. Forests in different locations support different volumes of biomass, different plant and animal species and provide different ecological and social functions. For example, to the people who live in or near forests, they mean a source of different materials, including food, as well as cultural identity. For others, they mean a source of timber and other products. For still others, they have value in terms of recreation, biological conservation and so on (World Bank, 1995). Thus, proper valuation should be intended to provide a rational basis for directing funding into objectives to which society attaches importance.

There have been calls for full valuation as a way to demonstrate the importance of forests and so arrest their displacement by other land uses. Advocates of full valuation argue that forests are undervalued and that consequently people do not realize their importance and, therefore, are unconcerned if there is deforestation, forest degradation or unsustainable use. Guided by this perception, many valuation studies have been carried out to influence policy; others have been done in isolation for research purposes. The closest to valuation in investment preparation has usually been at the pre-investment sectoral review stage. However, valuation principles and methodologies remain the same and the purpose of this work is to show how to apply these general approaches in an investment context.

5 This subject is also discussed in detail in Gregersen et al. (1995).

6 I.e., whereby only the timber element is given much attention: with this approach, the sector's recorded contribution to gross national product (GNP) often appears low.

7 This perception is not new: as early as 1926 the American Forestry Association (AFA) expressed similar concern in its message to the First World Forestry Congress held in Rome (AFA, 1926). For those interested in the role of wood the development of civilization, see, for example, Perlin (1989).

In investment preparation, the function of valuation is to provide a basis for decision or choice among options or to find what combinations of various types of activities give the best benefits. Properly done, valuation can provide useful information to all who are associated with decisions and choices among investment or management options and alternative uses of forests or of the land. It can show whether or not sustainable management and use of the forest has an economic value higher than the value of alternative resource uses which compete with it. Correctly executed, valuation can help to ensure that forestry is not considered in isolation from other sectors; this is especially important when sustainable forest management efforts take place in environments of increasing competition for scarce resources, such as growing needs for agricultural land and for funding. Decision-making by governments, private enterprises, local communities, farmers and conservationist groups on management and utilization of the forest resource is therefore influenced by the value that each of these groups attaches to the forest resource as well as to the relative costs and benefits of alternatives to forests[8].

In the context of valuation for land use decisions, IIED (1994) has stated that, in practice, there is no alternative to presenting the policy-maker with a range of models and indicators. This means offering an array of options from among which the final choice can be made. Thus, valuation can be an important tool for policy analysis: for example the valuation of a native forest can assist in understanding the importance of forest *vis-a-vis* its conversion to other land uses, e.g. land use policy (forestry versus agriculture).

Some benefits of the forest, carbon sequestration among them, can be (or can be perceived to be) more important at global than at national or local levels. Valuation can contribute to setting levels of possible compensation to a country or to a local community that is obliged to conserve forests beyond its own needs or to refrain from using its forests' full production potential. In the case of tropical developing countries, there are often calls for greater conservation of forests for carbon storage or for biological diversity. Such calls, if not backed by funding, imply that the developing country should carry the management costs. Yet the people who derive the satisfaction from that resource conservation may live in developed countries; they do not share the burden and they carry the costs only (and then indirectly) if and when species become extinct or ecosystems disappear. CSERGE (1993) has observed that, under such conditions, where costs fall mainly to the poor and benefits are reaped largely by (possibly wealthy) outsiders, valuation could provide a rational basis for estimating the level of adequate international transfer payments to compensate countries that are conserving forests beyond their own needs for the sake of global gain. Indeed, the concept of a developing country agreeing to the preservation of natural tropical forest without any financial returns to pay for their management is not a very practical one, particularly when large proportions of their populations often rely on the land to supply both food and fuel.

Valuation should always be approached as a tool to answer questions; it should be done not for mere curiosity but to provide those who have to make decisions with the relevant information. Therefore, knowledge of the factors that decision-makers are likely to take into account is necessary before designing the valuation. Investment is one area where prior valuation studies are useful. Investment preparation tends to come after policy decisions on the orientation of the project intervention (sometimes based on formal valuation) have already been taken. In such cases, investment preparation work focuses not so much on valuing the contribution of forests but on comparing the likely outputs with and without the project. However, situations exist where projects are on such a major scale that full valuation of various options is required as an immediate precursor to investment project preparation. It is for such situations that these guidelines are prepared.

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8 It is important to recognize that there is not a single decision-maker, but many decision-makers, and they can vary according to the context.

## 1.2 The meaning of value and of valuation

Value is the worth of a product or service to an individual or a like-minded group in a given context (Brown, 1984). Economic values are anthropocentric by nature, i.e. they are human-oriented and human-assigned. There are, however, non-anthropocentric values, for example, intrinsic values; these essentially deal with the inherent right of life forms to exist, independent of whether they are of use to humans.

Values are of importance not just in the field of economics but also in philosophy in the treatment of ethics. Classifications of value are varied and complex: for the purpose of this work, valuation is understood in its economic sense, i.e. monetary values[9].

The reference to "in a given context" in the above definition of value is of fundamental importance. Even in the "same" situation, people with different values are likely to behave differently. They perceive the situation and organize its constituent elements in different ways. As Jamieson (1987) indicated, even people with identical values do not necessarily behave identically: their values are put into operation under different sets of constraints. In other words, there is not a single value but a wide variety of values for a given resource and the people concerned hold these values for a variety of reasons (McCollum et al., 1992). Hence the results of a valuation should be attributed back only to the group that was studied.

There are many circumstances when the values of forests are not captured and remain only "potential" or "latent". There are other circumstances when values are captured through sale in the market and many other situations when the value is captured by people through direct use (e.g. by subsistence consumption). When value is captured through trade, it is not necessarily equal to that captured through direct use. Kanel (1990), for example, observed that certain non-wood forest products are essential for household food security during drought periods when other foods are scarce. He felt that under such conditions, the *value-in-use*, i.e. the true benefits brought to resource users, is much greater than the *value-in-exchange*, i.e. market value[10].

Economic value associated with forests can be classified in four categories: (A) *direct use values* (including consumptive and non-consumptive use values); (B) *indirect use values*; (C) *option values*; and (D) *existence and bequest values*. Box 1 gives a breakdown of values developed by Gregersen et al. (1995) (after adaptation to include elements from Pearce and Moran, 1994). It should be noted that a forest can have any or all of the values in Box 1 or only some of them. Very often, an analyst has to deal with a combination of values the relative importance of which is different for each forest or project.

## 1.3 Valuation is not a panacea

Full forest valuation is not a panacea for problems of forestry development, including deforestation and forest degradation. In the end, there is a political nature to the decisions made and full valuation provides only some of the information. It is far too simplistic to assume that forest resources have been depleted because of lack of valuation and that they will be conserved or that forest management will be preferred to alternative land uses when valuation takes place. Deforestation is a multisectoral issue and not only a forest sector problem (Ciesla, 1995). Monetary valuation is an attempt to integrate environmental effects into the decision-making process: it is only one form of valuation, has its own limitations and will not always be the most relevant method. There are many socio-economic and political forces that underlie the processes of deforestation, forest degradation and conversion of forest lands to other uses, not all of which can be addressed through

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9 For additional discussion on values, see, for example, Jamieson (1987) and Boulding and Lundstedt (1988).

10 For additional discussion on value-in-use, see, for example, Kvist et al. (1995).

valuation (Commonwealth of Australia, 1995). These forces interact and there is a diversity of needs and concerns which suggests that there is no universally “right” or “wrong” policy path (World Bank, 1995). Valuation is not an end in itself but a tool that can help lead to sound decisions.

**Box 1 - Classification of forest values**

**I. USE VALUES**

**A. Direct use values** *(associated with the following benefits)*

*A.1 Consumptive uses*

A.1.1 commercial/industrial market goods (fuelwood, timber, pulpwood, poles, fruits, animals, fodder, medicines, commercial non-wood products (e.g. rattan) etc.)
A.1.2 indigenous non-market goods and services (fuelwood, non-commercial non-wood products, animals, skins, poles, fruits, nuts, medicinal plants etc.), food security.

*A.2 Non-consumptive uses*

A.2.1 recreation (jungle cruises, wildlife photography, trekking, etc.)
A.2.2 science/education (forest studies of various kinds).

**B. Indirect use values** *(associated with the following benefits)*

*B.1 Watershed protection.*

*B.2 Soil protection, nutrient recycling and soil fertility, agricultural productivity enhancement.*

*B.3 Gas (e.g. carbon dioxide/oxygen) exchange, contribution to climate stabilization and carbon storage.*

*B.4 Habitat and protection of biodiversity and species.*

*B.5 Aesthetic, cultural and spiritual values.*

**II. NON-USE VALUES**

**C. Option values**

*C.1* *People may value the option to use a forest in the future.* Although such values are difficult to measure in economic terms, they should be recognized in value in the contributions of forests to human welfare. This concern can contribute to conservation and preservation of forests.

**D. Existence and bequest values**

*D.1* *People may value a forest or resource complex purely for its existence* and without any intention to directly use the resource in the future. This includes intrinsic value.

*D.2 People may value a forest as a bequest to their successors or others.*

Source: Adapted from Gregersen et al. (1995).

Measuring or estimating values is not the same as capturing them or making them reality and integrating them into forest development policy and management. Values such as those for carbon sequestration may accrue to the global community but no one group can see them reflected in financial flows. For those who live near or in forests, a claim that enormous values are being generated by their forests while they themselves are gaining no cash, employment or other “real” benefits may not be easy to appreciate. Similarly, countries that set aside large areas of forest for environmental benefits (which valuation may show to be quite high) may have difficulty defending their conservation decisions when they have to invest cash in return for the non-cash benefits.

Values will be high enough to stimulate better management of forest resources only if they are perceived to be capable of being realized or capable of being captured, otherwise no attention will be paid to valuation results even if they indicate great value for forests. Thus, for example, Grimes et al. (1994) in their study on the economic value of non-wood forest products in Ecuador calculated a present value of US$2,830 per hectare in upland plots and US$1,257 in alluvial plots for collection of NWFPs. These values were significantly higher than the returns from alternative land uses in this area and yet people persisted in preferring the alternative uses. Clearly, local people preferred actual returns from their other land uses to calculated high “potential” values for NWFPs.

# Chapter 2: CLARIFYING THE PURPOSE OF THE VALUATION AND ITS CONTEXT AND OUTPUTS

## 2.1 Introduction

As recently as 1994 Pearce stated that "the economic valuation of forest functions is still in its infancy" (Pearce, 1994). This statement was made in spite of the fact that the need to properly value forest lands and woodlands has long been recognized. As mentioned previously, two German foresters, Martin Faustmann (1849) and Max R. Pressler (1860), were already concerned about this matter during the last century.

Historically, forest management has dealt mainly with the problem of rotation length as it relates to wood production, i.e. the timing of when to harvest a stand of trees. Economic values have been used in forestry in line with this traditional orientation of forest management focused on wood production. These values have been calculated within the framework of the classical and neo-classical economic theories which do not pay too much attention to environmental problems, viewing them as externalities or side-effects[11]. Thus conventional analysis often fails to adequately capture many forest benefits that either do not enter the market or cannot for other reasons be adequately valued in economic terms.

One of the early references advocating the need to value the broad range of forest goods and services occurred at the 5th World Forestry Congress (WFC) held in the United States in 1960 which had the general theme "Multiple Use of Forest Lands". It was stated at that time that it was "not only through the production of wood but by means of all other 'forest values'" that forests could contribute to national prosperity (WFC, 1960). The 5th WFC, *inter alia,* called for "systematic studies to develop methods for evaluating intangible forest values in quantitative terms". Over the years, timber has been the forest output whose value has dominated valuation, sometimes to near exclusion of all else.

The emphasis on using forests only for wood production has changed in recent decades. A greater emphasis has been put on the forest as supplier also of a wider range of goods (such as non-wood forest products) and services, including environmental roles such as land and water protection, aesthetics, biological diversity, influence on the biosphere and so on. Within this context, managers and planners have faced increased public pressure to take into consideration all uses and to value forest resources for these other goods and services.

To do so, it is necessary to develop and apply methods that will take account of this wide variety of goods and services in the decision-making process. Among services of the forest, recreation received earliest valuation attention, originally in the United States (in the late 1950s and 1960s), followed by Canada and later Europe. Since the 1980s there have been further moves towards measuring other goods and services from the forest and to experiment with fuller forest valuation in developing countries. More recently efforts have been made to value the forest resources of the so-called transition economy countries.

Current thinking, particularly after the United Nations Conference on Environment and Development (the "Rio Summit"), calls for more completely valuing the different goods and services of the forests[12]. A wide range of methodologies[13] has been developed and applied with results that

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11 See, for example, Meyers (1977) and Fearnside (1989) for a discussion on the need for new criteria in evaluating development options in tropical forests.

12 A review of the literature suggests that this call has raised a great interest given the many attempts to value forests in monetary terms; see, for example, Lal (1992), Maudgal and Kakkar (1992), Bawa and Godoy (1993) and Ontario Ministry of Natural Resources (1993). Other examples are referred to and/or quoted throughout this work.

13 This is discussed in more detail in chapter 4.

often fail to agree, sometimes by several orders of magnitude in a given situation. There is a clear need to identify and apply methods the results of which can more easily win the confidence of decision-makers by being less subject to analyst bias or to unwarranted interest-group influence.

In investment project preparation, the emphasis of valuation has generally been on net commercial or financial worth. This has been particularly so for private investments where profitability is the main criterion and attempts to take broader societal gains into account are secondary. Any valuation beyond financial worth is recognition that decision-makers take into account more than money flows. Fuller valuation should attempt to present many additional considerations in monetary terms; nevertheless, analysts should not ignore non-quantifiable political, social and environmental considerations which are often also important.

## 2.2 Forest attributes justifying full valuation

Forests have certain attributes that justify fuller valuation:

- particularly in many developing countries, many forest products such as fuelwood and non-wood forest products (NWFPs) are used mostly on a subsistence basis;
- a particularly significant proportion of environmental services of forests do not enter the market;
- externalities are particularly important in forestry — some important benefits of forests are captured not within or even near the forest but further afield, including at global level; and
- forest benefits that will accrue to future generations rather than be used to meet society's current needs are significant.

Many valuation studies have been carried out with the aim of influencing policy or for research purposes. As far as investment is concerned, these studies have been at the pre-investment sectoral review stage rather than as part of investment project preparation. However, the principles and methodologies of these general approaches would remain the same if they were to be applied in an investment context.

## 2.3 Does valuation give a full picture?

The purpose of valuation is to make the value of each forest use explicit. Michael (1995) suggested that valuation assessment should ensure that economic values incorporate both monetary and non-monetary expressions of preference; they should not be limited to putting a price tag on nature. Given that people attach importance to many things which cannot be expressed in monetary terms, valuation will not on its own provide a full basis for decision; decision-makers will often need to supplement valuation results with "soft" or qualitative considerations of a political, cultural or similar nature.

Because economic valuation is not the sole basis for decision-making, the effort expended on it should be kept in perspective. A decision-maker may need only orders of magnitude and their relative importance to make a decision. A drive for extreme accuracy (which can be time-consuming and costly) may be wasted.

## 2.4 Whose values prevail if there are no absolute values?

As pointed out by Gregersen et al. (1995), there are no absolute economic values other than those based on the perceptions of individuals or groups which, in their turn, are influenced by economic, cultural and social norms. Consequently, forest values are not static: they are dynamic, depending upon the particular context, which may well change over time. Different individuals or groups will often assign different priorities and values to the same forest and their perceptions tend to change with circumstances. There is no universal, objective “truth” or law of value. In the absence of absolutes, forest value varies with the perspective of individuals or groups; values involve relativity to others and, therefore, also involve trade-offs.

The objectives and time preferences of individuals are usually different from those of a community, which, in turn, may differ from those of the society at large. An individual may want to maximize the availability of fuelwood and fodder; a community may want to maximize the availability of a raw material for a popular industry; society at large may want to protect a major watershed. Arnold (1992) felt that for people living in or adjacent to forests, the value lies in the products they derive, in the spiritual and cultural values they attach to the forest environment and in the forest’s role as a land bank. Values of people living in or near forests may differ from those of their national government which may, in turn, differ from those of the international community. The results of valuation should be attributed back only to the group that was studied. Furthermore, values involve costs and benefits whose distribution among interest groups is often political in nature.

The most important attribute of the analyst is not so much the capacity for mechanical manipulation of values but the willingness and ability to discern the perceptions and priorities of various interest groups and to determine what weight to attach to each of them and what other contextual factors to take into account.

## 2.5 Do high values mean anything and can they be captured?

Recently, there has been considerable eagerness to value forests in monetary terms, especially tropical ones, but less or even no emphasis on integrating these values into forestry development policy and improved forest management; this eagerness may explain the high value figures such as those for the Amazon forest in Brazil. Gutierrez and Pearce (1992) (quoted in Michael, 1995) provided the following estimates of contribution to the Brazilian gross national product (GNP): US$15 billion for the direct use of non-timber forest products (NTFPs); US$46 billion for the indirect use value of total carbon storage; US$30 billion for existence value; and US$95 billion for total economic value (TEV) with a net present value of US$1,296 billion. Similarly, high values were found for forests in Mexico in a study by Adger et al. (1995) which attempted to estimate the TEV of the forests[14]. The annual “lower bound” value of the services of the total forest area was approximately US$4 billion. On this basis, the study concludes that there is a strong case for forest conservation in the Mexico.

Although not a valuation issue, a question must be asked of how the country owning the forests can actually capture this value. Bettencourt (1992) reported in a study on economic valuation of forests and woodlands in sub-Saharan Africa that decision-makers there give little weight to arguments in favour of conservation if there is no quantitative proof that short-run economic benefits would be forthcoming. In his review of studies of the value of biodiversity, Aylward (1993) pointed out that the biodiversity value likely to be captured from industrial sources is small compared with the costs of conservation (quoted in Aylward et al., 1995). This suggests that valuation by itself has little interest for the country owning environmental assets if the values cannot be turned into revenue flows to capture some of the value (Michael, 1995). Forested countries among the developing countries lack the mechanisms to capture the global benefits of their forests. Given such high valuation figures and the failure to capture them, it is difficult to see how they can continue to be seriously considered.

[14] Another study on Mexican forests was carried out by CSERGE (1993) for the World Bank; it is summarized in annex 2.

## 2.6 The pursuit of Total Economic Value: can it succeed?

The desire to demonstrate that forests are worth a lot more than is presently perceived by decision-makers may account for the many current efforts at estimating total economic value[15]. The TEV is an attempt to add together all values referred to in box 1 (Classification of forest values). It is an aggregate of total use value and total non-use value. Total use value, in its turn, can be divided into direct use value, indirect use value and option value. Total non-use value includes existence value and bequest value. Different values are estimated, in a particular situation, by applying specific techniques.

However, the literature on forestry valuation shows that there has been a tendency to value particular forest uses as if they exist in isolation, are mutually independent and therefore can be considered additive as TEV implies. This suggests some contradiction in the term TEV in that not all values of forests can be reduced to economic or monetary terms. For example, there are other types of values that must be recognized such as ethical, cultural or religious ones, all of which cannot or should not be assigned a monetary value but must nevertheless be taken into consideration[16]. Winpenny (1992) has appealed to economists wishing to value forests to recognize that economic value is only one yardstick; he has stressed that monetary values fail "to capture all, or even most, of the value of forests". Indeed, for many forest-dwelling tribal people, forests can be worth much more than any monetary value assigned since, as Shukla et al. (1990) said, "their life style is full of customs and traditions where forests play a significant role".

Another complication in trying to calculate the TEV arises from the fact that estimating TEV is not merely a matter of summation of estimated values derived for various forest functions using the methods and techniques available. It does not seem that there is a major problem with calculating TEV, but rather that there may be many "correct" TEVs depending on the combination of complementary outputs chosen. A forest produces outputs that, according to their relationships, can be classified as complementary, independent or competing. Their addition would therefore be meaningless and misleading. There are other values, such as spiritual and cultural values, that cannot be valued in monetary terms. For example, a study carried out by CSERGE on Mexican forests points out that practical applications of TEV are few because of problems of quantification and of elements not being additive (CSERGE, 1993). Therefore, aggregation of values in order to estimate the TEV deserves further research.

Table 1 is a matrix that summarizes different uses of a forest in order to draw attention to the question of their compatibility or incompatibility. It shows that some forest activities or functions can be complementary whereas others are competitive or even mutually incompatible.

A key consideration for the analyst is to recognize that, although each activity or output may, on its own, be valuable, when considered in a multiple-purpose forestry context, some benefits can be captured only if others are suppressed or cancelled. For example, the level of timber harvesting may affect the forest value for watershed protection, and/or biological diversity, and/or recreation. Or the setting aside of part of a forest to protect biological diversity may affect the value of the forest for timber production. Wherever any of the uses compete in any way with any other use, then there is a different kind of problem. With competing uses the problem becomes one of deciding on the

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15 For examples of estimating TEV, see Ayres and Dixon (1995) and Kumari (1995b).

16 For more discussion of values that cannot be reduced to monetary terms, see, for example: Clay (1988); Shukla et al. (1990); Bettencourt (1992); Bengston (1994); Tacconi (1995); Tacconi and Bennett (1995); Lescuyer (1996).

appropriate level or combination of uses a given forest can support. It is a problem of allocating use levels.

**Table 1. Forest management for multiple use: compatibility matrix.**

| IMPACT ON<br>IMPACT OF | Timber and commercial logging | Fuelwood production | Non-wood forest products | Recreation | Soil & Watershed protection | Hunting | Biological conservation |
|---|---|---|---|---|---|---|---|
| **Timber and commercial logging** | - there are trade-offs and complementarity between high-quality and general-purpose timber | - encroachment<br>- thinnings find an outlet<br>- short-term income<br>- trade-offs, but generally compatible | - encroachment<br>- additional income<br>- biological interdependence<br>- canopy opening may suppress production of some NWFPs<br>- local vs national and export market<br>- trade-offs, but generally compatible | - suppression of recreation activities during logging operations<br>-aesthetic damage especially if clear felling<br>- some complementarity is possible depending on location of both activities | - if properly managed impacts can be minimal<br>- potential impacts on water flows, quality and quantity as well as on soils | - impacts can be minimal, except for rare species that require isolation<br>- can be positive because of opening up of areas for browse, etc. | - interactions are similar to recreation, although the negative impacts can be even greater depending on location, logging and harvest methods used<br>- generally incompatible except for:<br>(a) generalized species;<br>(b) corridors;<br>(c) very select harvest of high-value species |
| **Fuelwood production** | - additional income<br>- possible damage to standing timber<br>- utilization of non-commercial species<br>- likely compatibility | | - generally compatible in natural forests and multi-species plantations<br>- additional income<br>- can lead to some constraint on fuelwood species | - some complementarity is possible depending on how both activities take place | - compatible if properly managed<br>- additional value<br>- trade-offs | - possible complementarity depending on how and where both activities take place | - interactions are similar to soil and watershed protection<br>- generally incompatible |
| **Non-wood forest products** | - can be compatible: however, there is possibility of damage to standing timber<br>- generally compatible in natural forests and multi-species plantations<br>- additional income<br>- trade-offs, but generally compatible | - additional income<br>- generally compatible in natural forests and multi-species plantations<br>- trade-offs, but generally compatible | | - some complementarity is possible depending on how both activities take place | - compatible if properly managed<br>- additional value<br>- trade-offs | - possible complementarity depending on how and where both activities take place | - generally incompatible |
| **Recreation** | - restricts location of timber activities<br>- may create conflicts in terms of road usage<br>- direct conflicts if land is set aside for wilderness to | - restricts location of timber activities<br>- direct conflicts if land is set aside for wilderness to the exclusion of other | - can be generally compatible depending how and where both activities take place | | - can have impact depending on magnitude of recreation activities, so they may or may not be | - some conflicts, for example, those due to potential risk of injury<br>- timing will determine extent of conflicts; | - can have impact depending on magnitude of recreation activities, so they may or may not be compatible |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | the exclusion of other uses | uses | | | compatible | - can impose limitations on hunters | |

**Table 1** *continued***.**

| IMPACT ON<br>IPACT OF | Timber and commercial logging | Fuelwood Production | NWFP | Recreation | Soil & Watershed protection | Hunting | Biological conservation |
|---|---|---|---|---|---|---|---|
| **Soil & Watershed protection** | - can impose restrictions on logging activities<br>- can impose higher logging and management costs | - can deny free access to the forest<br>- can be compatible if properly managed | - can deny free access to the forest<br>- can be compatible if properly managed | - can impose restrictions on the use of the area<br>- can be compatible depending on how and where recreation activities take place | | - can be generally compatible, but also depends on how and where hunting takes place | - none (positive complementarities)<br>- additional value |
| **Hunting** | - no impacts likely, unless restrictions on logging cause them<br>- conflicts can arise due to danger of injury from hunting accidents | - compatibility regarding use, but conflicts can arise because of danger of injury from hunting accidents | - compatibility regarding use, but conflicts can arise because of danger of injury from hunting accidents | - compatibility regarding use, but conflicts can arise because of danger of injury from hunting accidents<br>- negative impacts on recreation are possible if heavy hunting pressure takes place and reduces animal population | - can be generally compatible, depending on how and where hunting takes place | | - incompatible |
| **Biological conservation** | - generally incompatible since land is set aside for preservation to the exclusion of all other uses | - generally incompatible since land is set aside for preservation to the exclusion of all other uses | - generally incompatible since land is set aside for preservation to the exclusion of all other uses<br>- imposes constraints on the collection of plants and animals except for collection of species samples for research | - can be compatible depending on how and where recreation activities take place | - none (positive complementarities ) | | |

Source: Adapted from Panayotou and Ashton (1992) and Gregersen (1996).

It is not always clear from the examples in the literature why TEV has been sought since, sometimes, partial valuation focused on the most critical forest functions for a given case could yield a perfectly adequate result. TEV is of particular relevance for policy analysis, whereas in the context of investment it may often not be necessary. Nevertheless, TEV continues to be appealing and investment preparation experts may be required to derive it. In complex multiple-purpose projects such as those on protected areas, wetlands management or watershed conservation, TEV (or a near approximation) may be desirable. Many investment projects involve interventions where a choice has to be made between uses of the land. In some instances, forest valuation could be limited to a comparative approach[17], especially if, after valuing one or a few key forest functions, superiority (or inferiority) of the forest option is already amply demonstrated so that further effort seems pointless. TEV should be pursued where there is no clear superiority of one or another option.

Good sense suggests that a complex process such as TEV determination should not be embarked upon lightly. Quick estimation should first be done on partial valuation. Only if partial valuation methods prove inadequate in giving a convincing basis for judging the relative merits of options should a full-blown TEV exercise be contemplated. Experience shows that to calculate complete and total economic value is difficult, that it may be unnecessary for the decision required and may often even be meaningless. In many cases, it is more realistic to focus on the most dominant elements of value in a given context rather than also attempting valuation of more minor considerations, to the point of diminishing returns for additional effort.

In other investment situations the impacts of the project will be of more concern: valuation should then focus on comparing net values with or without the project. Such cases could include afforestation of degraded land, forest industries or major recreation developments.

It is also important to take into account the problems related to double-counting and possible trade-offs between various direct and indirect use values. Recognizing that it is necessary to dis-aggregate the goods, services and attributes of an ecosystem for valuation purposes, Barbier (1994) warns that complementarity and substitutability of the goods and services must be accounted for in arriving at total use values to avoid their being possibly grossly overstated.

Another problem in estimating TEV is related to the fact that in a forest there are thousands of different animal and plant species. Hence, it is likely that an aggregation of individual estimates would lead to unreasonable total sums. Existence value studies, for example, have been carried out in Europe and the United States to value the “willingness to pay” (WTP) to protect endangered species; examples of some of these studies are presented in table 2[18]. These values should be perceived as a clue to people’s WTP for a policy that saves that particular endangered species. Such studies fail to take into account that a particular species does not exist in isolation in nature; on the contrary, it is part of a larger dynamic process that represents the context within which it functions (Dailey Jr and Norton, 1994). This suggests that these studies cannot be understood as representing the total existence value of forests. According to Wibe (1995), it is impossible to estimate in a single study the total existence value of a forest.

The process of arriving at an approximation of TEV also involves careful identification of “stock” and “flow” aspects of forests. Forests have both a stock and flow of resources. There are values that are intrinsic to the existence of the forest (e.g. biological diversity), whereas others are related to the conversion of part of that stock (e.g. harvesting) into a flow of timber and other forest products. There are many methods and techniques available that allow the estimation of both.

**Table 2. Examples of existence value studies.**

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17 For example, in converting forest to farmland or the reverse; in choosing whether bare land should be afforested or converted to rangeland; in deciding whether a forest area should be reserved for recreation or industrial exploitation should be included in the investment package.

18 See annex 3 for some more examples of estimated economic values for different forest uses.

| Object | Value per year and per household (1990 US$) |
|---|---|
| Fragile forests | 10-25 |
| Endangered species | 17 |
| Spotted owl | 40 |
| Bald eagle | 22 |
| Bald eagle | 20 |
| Wild turkey | 12 |
| Wild turkey | 12 |
| Coyote control | 4 |
| Coyote preservation | 5 |
| Wilderness | 61-106 |
| Recreation forests | 62 |

Source: Wibe (1995): table 3, p. 15.

Thus, given real world competition among forest uses, the TEV of the forest depends upon the particular combination of uses one wishes to consider. For example, in a given context, the particular type and level of direct use value (DUV) may affect the type and level of indirect use value (IUV) that can be sustained; these, in turn, may affect the option value (OV). This implies that one cannot independently determine, for example, DUV without considering IUV and OV involved, the levels of which affect the value of DUV. But one cannot estimate IUV without knowing DUV and OV, etc. The analyst is then faced with determining a simultaneous solution to a series of interdependent equations. Box 2 summarizes the points discussed above that should be considered in calculating TEV.

## 2.7 Considerations of usefulness and credibility of valuation

It is important that valuation findings are perceived to be useful and believable. In considering criteria for acceptance and use of forest valuation results, Gregersen et al. (1995) subdivided factors into (a) “usefulness” and (b) “credibility”. Usefulness factors include relevance and timeliness of the results. Credibility factors include perceived accuracy, reputation of analysts, breadth of interest groups considered, ease of understanding, level of uncertainty and controversy, agreement with information from other sources and acceptability by advisers.

Recent results of some attempted full valuations of forests have given cause for concern. Problems include: (i) analysts producing widely divergent results for any given situation; (ii) attaching high weight and therefore value to forest contributions on which there is so far no scientific consensus, e.g. level of contribution of NWFPs, carbon sequestration and probability of finding species of high medicinal value in conservation areas; (iii) a tendency to present all values in monetary terms or to imply that all values can be reduced to monetary terms; (iv) attaching weights to the value of various forest goods and services on the basis of the views of external people (particularly the wealthy) who inflate values; and (v) deriving total economic value by simple summation.

**Box 2. - Calculating total economic value (TEV)**

- First ask if TEV is necessary;

- Not all values can or should be assigned a monetary value, e.g. ethical, cultural or religious values; they must, nevertheless, be taken into consideration;

- Forests produce outputs that can be complementary, independent or competing. Thus, TEV cannot be an exercise of simple addition of estimated values for each one of these components. Attempting to calculate TEV can lead to double-counting and possible trade-offs between competing or mutually exclusive uses, both direct and indirect;

- There may be many “correct” TEVs depending on the combination of outputs chosen;

- Existence value studies, for example, aim to value the willingness to pay (WTP) to protect endangered species. These values should be perceived as a clue to people’s WTP for a policy that saves a particular endangered species: however, such species do not exist in isolation in nature; on the contrary, they are part of a larger system that represents the context within which they function. This suggests that these studies cannot be understood as representing the total existence value of the forest. Indeed, it is unlikely that a single study can estimate the total existence value of a forest;

- Forests have both a “stock” and “flow” of resources. There are values that are intrinsic to the existence of the forest (e.g. biological diversity), whereas others are related to conversion of part of that stock (e.g. harvesting) into a flow of timber and other forest products. The process of estimating TEV requires a careful identification of stock and flow aspects of forests;

- Because of the above factors, estimated TEV may not represent an accurate total value. TEV estimation deserves further research.

### 2.7.1 Divergence of results

There is a problem of proliferation of methodologies for full valuation of forests but also of lack of a uniform basis for estimating parameters even in applying one method; thus in applying them, analysts have often ended up with widely divergent results even when applying methods to the same site. For example, when Aylward (1993) reviewed studies of the value of biodiversity in a particular industrial area (as an input in the pharmaceutical research and development process) he found a range of values from $15.00 per species to $24 million per species on an annual basis (quoted in Aylward et al., 1995). This divergence in results can be attributed to factors such as economic diversity among different study sites sampled and a difference in the methods and assumptions used as well as products studied. For example, a contingent valuation survey could be carried out using a different approach and divergent estimate values reached for the same good or service (Elsasser, 1994).

Forests can supply different goods and the quantity of them can be measured on the basis of (i) the inventory, i.e. the quantity in the forest and (ii) the flow, i.e. the quantity used by people. Some researchers carry out valuation on the basis of the inventory, others on the basis of the flow, whereas still others use both quantities (Godoy and Lubowski, 1992). Given that the difference in values between the flow and the inventory can be large, diverse results will be reached.

The use of different methods can lead to different results in the same area, e.g. the people’s estimated WTP annually for setting aside plots of old-growth forest in Sweden varied between SEK50 and SEK125 per household (Naskali, 1995).

Evidence also suggests that people from developed countries reveal a higher WTP for the conservation of tropical forests than people from the regions where these forests are located. For people living in or near a forest its value lies in the products that they can collect from it as well as spiritual and cultural values attached to it. Studies of the same area may therefore present divergent results depending on the database employed.

An example of these differences is summarized in table 3 which shows a range of estimates on the value per tonne of releasing $CO_2$ into the atmosphere over time according to different studies[19].

**Table 3. Estimates of the value of $CO_2$ release into the atmosphere over time ($/t C).**

| Study | 1991-2000 | 2001-2010 | 2011-2020 | 2021-2030 |
|---|---|---|---|---|
| Nordhaus (1991) | - | - | 7.3 | - |
| Ayres and Walter (1991) | - | - | 30-35 | - |
| Nordhaus (1992) | 5.3 | 6.8 | 8.6 | 10.0 |
| Fankhauser (1993) | 20.4 | 22.9 | 25.4 | 27.8 |

Source: CSERGE (1993): table A.3.4, p. 81 (annex 3).

According to CSERGE (1993: p. 80, annex 3): "the estimates of Ayres and Walter (1991) are of greater magnitude than those of Nordhaus, though using the same methodology." It is beyond of the scope of this study to discuss which estimate is better or more reliable. Rather, these estimates support the claim elsewhere in this paper that there is no universal value. It should also be pointed out that the interactions between economy and ecology, as well as the carbon cycle, are not fully understood. So some assumptions are made on the basis of the analyst's own experience or perception. Differences in estimates are not restricted to monetary values such as those shown in table 3, but can also be found in other measures, for example, carbon storage estimates per hectare (t C/ha).

### 2.7.2 Very high values calculated and publicized

A second element relating to credibility is the very high forest values that have been calculated and publicized. In several developing country exercises the values given for forests are out of all proportion to the size of the national economies. If they were financial, the forest values calculated would in some instances dwarf the national economies of those countries or at least be large enough for the forest sector to cover the national external debts.

It is probably the over-zealous attempts to present all values in monetary terms that have generated estimates that have been far from credible and, therefore, have reduced the confidence of decision-makers. It may be speculated that this problem reflects "advocacy valuation", i.e. that it has arisen from analysts setting out to prove a position they already have in mind, such as to promote conservation or environmental forestry at the expense of utilization.

High values are attached to ecological functions of forests where scientific consensus unfortunately remains weak (such as carbon sequestration). High values have been derived for tropical forests, examples being the economic values of the Amazon forest (e.g. Gutierrez and Pearce, 1992, quoted in Michael, 1995) and Mexico (CSERGE, 1993; Adger et al., 1995). The values estimated are such that, just from selling NWFPs from the Amazon region, Brazil would probably solve all its economic problems; carbon storage would make this even more certain. This sort of study seems to disregard that most of the NWFPs are marketed locally and may be unknown even elsewhere in Brazil: to extrapolate the local market characteristics to a global scale can lead to serious errors. It would appear that underlying the Amazon study are assumptions that (i) there are constant returns to scale in the harvest, collection and distribution of these forest products, and (ii) the demand for them is elastic (at the given price, any amount of them can be sold).

[19] See annex 3 for some more examples of estimated economic values for different forest uses.

A third example is a 1995 Malaysian study (table 4) in which at base scenario[20] Kumari apportioned 69 percent of forest value to its carbon stock alone and nearly 99 percent at scenario B3. When there is a move from the base option to option B1, the TEV rises by M$396/ha while carbon stock value increases by M$969/ha, i.e. 2.4 times more than TEV, because in this instance the reduction in timber value is more than compensated for by increased carbon and other values (Kumari, 1995b).

**Table 4. Summary of results for a Malaysian study[a].**

| Good/Service | Base option | | Change from base option to sustainable option (M$/ha) | | |
|---|---|---|---|---|---|
| | (Unsustainable, A) (M$/ha) | % of TEV | B1 | B2 | B3 |
| Timber | 2,149 | 21.3 | -696 | -399 | -873 |
| Agro-hydrological | 319 | 3.1 | 0 | 411 | 680 |
| Endangered species | 454 | 4.4 | 35 | 20 | 44 |
| Carbon stock | 7,080 | 69.2 | 969 | 1597 | 1597 |
| Rattan | 22 | 0.2 | 88 | 172 | 192 |
| Bamboo | 98 | 1.0 | 0 | -20 | -20 |
| Recreation | 57 | 0.6 | 0 | 0 | 0 |
| Domestic water | 30 | 0.3 | 0 | 0 | 0 |
| Fish | 29 | 0.3 | 0 | 0 | 0 |
| TEV | 10,238 | 100.0 | 396 | 1782 | 1620 |

Source: Kumari, 1995b: table 12, p. 28. (1990 prices, 8% discount rate.)

Medicinal plants are another element whose value is often inflated. The temptation is to assume that in any tropical forest conservation area, some plant with a "miracle cure" substance will be found equivalent to the *Rosy periwinkle* (with its anti-cancer properties) found in Madagascar. No effort is made to apply sensitivity analysis to forest value according to the level of probability of such discovery, thus implying certainty where none is justified.

Some concern is beginning to be expressed by serious professionals that this eagerness to find monetary values may, by generating unrealistic numbers, eventually undermine the credibility of full forest valuation in general. For example, Andersson and Bojö (1992) felt that the case for sustainable use of forest resources was not well served by resort to improper use of the replacement cost method. They considered it better to undertake the difficult search for realistic values which could sustain long-term credibility.

### 2.7.3 Apparent over-use of monetary proxies for all forest values

A third source of weakness undermining usefulness and credibility of valuation results relates to apparent over-use of monetary proxies for all forest values. There is no clear consensus about whether all forest values can be expressed in monetary terms[21]. Gregersen et al. (1995) pointed to certain conditions, e.g. "irreversibilities" or uncertainty and uniqueness of certain species, that cannot be adequately addressed in economic terms; Mäler (1991) comes to similar conclusions. Many other social, cultural and ecological benefits cannot be valued in monetary terms; some practitioners feel it is time to call a halt. Michael (1995) reports Ehrenfeld's (1988) argument that "if we persist in this crusade to determine value where value ought to be evident, we will be left with nothing but our

[20] The base scenario is considered equivalent to current practice and is labelled "unsustainable". Alternatives B1 to B3 are "sustainable" management options.

[21] See Bengston (1994): in this article the author addresses and discusses key issues related to this question as well as other questions within the context of what he calls the "new environmental paradigm".

greed when the dust finally settles". Between these two extremes there are authors, such as Folke (1995), who suggest that ecologists and economists can find common ground. There are also authors, such as Peterson et al. (1988), who go further and argue that economics should be integrated with other disciplines.

Nevertheless, the assumed correlation between lack of monetary values and destruction or misuse of forests has led to eagerness in attempting to value, in monetary terms, each good and service in every forest. The attempt to express most, if not all, values in monetary terms for ease of comparison is appealing, but can lead to gross miscalculations and, ultimately, wrong decisions.

### 2.7.4 Dependence on the views of outsiders in establishing forest values

The fourth credibility problem is the heavy dependence on the views or perceptions of often wealthy "outsiders" as a basis for attaching weights to the value of goods and services of forests. Estimated values are likely to reflect the WTP for the moral satisfaction of contributing to public goods, not the actual economic value of these goods.

In the Amazon example referred to earlier, the US$95 billion for TEV with a net present value of US$1,296 billion was derived from surveys of WTP among the relatively wealthy adult population in countries of the Organization for Economic Cooperation and Development (OECD): surveys among Brazilians would probably have resulted in lower values. Given that values depend on the level at which they are assessed and according to the perspective of each interest group, the utmost efforts are necessary to consult and agree upon who should be involved and at what levels and what weights should be accorded to the levels and interest groups' perspectives.

Questions on WTP for the existence of forests as a whole can lead to meaningless answers. How can an individual correctly evaluate the utility difference between an actual situation (i.e. forests exist) to a hypothetical situation (i.e. no forests at all)? For specific sites it is possible to compare, for example, the use value of the site for a park or reserve to its value for timber exploitation and this can contribute to planning the land use (Wibe, 1995).

It is also important to bear in mind that there may be a great gap between survey responses and the real world. It is one thing for a person to tell an interviewer how much he/she is willing to pay to save a forest, a species and so on: it is quite a different matter when the same person is asked to write out a cheque. Lack of knowledge of the socio-economic, political and ecological conditions in which a forest is located can lead the analyst to wrong interpretations and, consequently, false and meaningless values.

### 2.7.5 Use of additive methods for estimating TEV

A fifth problem is the use of additive methods for estimating total economic value (TEV) of a forest. In some studies TEV may have been derived by mere summation, so giving higher values than if internal incompatibilities were corrected for. As discussed earlier, there are conceptual problems in that the sum of the parts is not the same as the overall worth of the forest because some of the values are mutually exclusive and some are interdependent.

# PART II: THE VALUATION PROCESS

## Chapter 3: IDENTIFYING AND DETERMINING INPUT AND OUTPUT INFORMATION NEEDS AND CONSTRAINTS TO MEETING THOSE NEEDS[22]

### 3.1 General considerations

Much has been written about economic, social and environmental losses caused by deforestation and forest degradation. Population growth has been frequently pointed out as a major cause. However, although this may be true of some regions, there has been also some exaggeration. Indeed, deforestation and forest degradation are the result not of a single cause but of a complex relationship of different factors. So, the first step is to identify and quantify real impacts and their causes. This is a critical and difficult step. For example, estimates of some outputs, such as fuelwood, timber or fodder, can be dealt with in a straightforward fashion, whereas environmental outputs are not so easy to deal with. Environmental outputs can usually be dealt with only in a qualitative sense, e.g. aesthetic benefits (Gregersen and Contreras, 1992). It is also important to bear in mind that some forestry projects are designed to produce multiple outputs (e.g. sawnwood and plywood) or joint products and services (e.g. timber, wildlife habitat and watershed or soil protection).

The inputs of a project can be direct or indirect. Indirect inputs are those which already exist in the project site, e.g. infrastructure such as roads or community facilities. Direct inputs are paid for by the project. If raw material, such as wood, is produced as part of the project, then the component input requirements are listed rather than the raw material such as roundwood. According to Gregersen and Contreras (1992), the direct inputs can be categorized as shown in table 5.

**Table 5. Categories of direct inputs.**

| Inputs category | Comments |
|---|---|
| 1. Human resources | Distinctions should be made between male, female and child labour, unskilled and skilled labour, staff, consultants and seasonally available workers. |
| 2. Land | Land can be broken down into categories to reflect different uses and values. |
| 3. Equipment | Working tables will be needed with detailed listing of equipment required and timing of such requirements. In the final tables, some major subcategories can be used as derived from the detailed tables. Replacement requirements have to be included. |
| 4. Raw materials and supplies | Items such as utilities (energy, fuels, etc.), wood raw material (if purchased), chemicals, seedlings, tools and other purchased inputs, and water can be listed separately. |
| 5. Structures and civil works | If structures and civil works (housing, roads, other facilities such as dock and harbour services) are purchased or rented, they appear as separate inputs. However, if the project involves construction of such works, they should not be listed as inputs as such. Rather, the component labour, land, equipment and raw material requirements for constructing them are listed. |

Source: Adapted from Gregersen and Contreras (1992): table 4.1, p. 47.

[22] This subject has been discussed in great detail in FAO Forestry Papers 106, 114 and 127 as well as FAO Conservation Guide 16.

A forestry investment project can provide direct or indirect outputs which are specific to both the site and the situation. This is in accordance with one of the arguments of this report on the importance of the context in the design, analysis and results of a forestry valuation study. The classification as direct or indirect output follows. As can be seen, most of the outputs might or might not be traded in any given situation[23].

*Direct outputs that may or may not be traded in markets in a given project situation*

Outputs that are consumed:
- timber products (commercial/non-commercial)
- fuelwood and other biomass fuels
- fruits, nuts, leaves, etc.
- laboratory animals, genetic materials, skins, etc.

Outputs that are not consumed, but often are paid for in financial terms:
- scenery/recreation use (jungle cruises, trekking, wildlife photography, etc.)
- soil protection/watershed protection (downstream land/water users paying upstream populations for services to protect soil)
- existence values (people valuing a forest just because it is there).

*Indirect outputs which so far are not paid for through market transactions*

- socio-cultural services, i.e. living environment, for indigenous peoples
- protection of biodiversity (which may eventually lead to marketed outputs)
- gas exchange and carbon storage.

Gregersen and Contreras (1992) suggest that, as a general rule:

(i) using the various technical studies available for the project, identify direct inputs and outputs. To the extent that separable project components have been identified, divide up the direct inputs and outputs by components. These can be listed in separate physical flow tables for components and added together at a later, summary stage in the analysis;

(ii) identify the indirect effects due to the project. List these by separable components, if possible, as indirect positive effects if they add to the aggregate quantity/quality of goods and services available for consumption, or as indirect negative effects if they involve reduction in the quantity/quality of goods and services available.

Both direct and indirect effects should be distinguished on the basis of how the resulting information will be used in succeeding stages in the analysis. They should be divided into categories that make sense from the point of view of valuation and in terms of the types of sensitivity tests that will be included in the analysis. Many of the indirect effects cannot be assigned meaningful values in monetary terms. However, they should still be identified in quantitative physical terms, if possible, and otherwise at least specified in descriptive terms. Regardless of whether or not they have an identifiable monetary value, they may be important in the broader decision-making context. It is not just monetary values that are important to a decision-maker: on the contrary, there are many other considerations that may be much more important. The analyst should also be aware that, generally, an indirect positive effect can have an associated indirect negative effect (cost), e.g. pollution or negative environmental effects.

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23 This list is adapted from Gregersen and Contreras (1992): p. 45.

Technical experts can help the analyst identify the likely magnitudes of the effects (both positive and negative). These can be listed in a separate table or tables. In those instances where it is not possible to estimate magnitudes (quantities involved), the analyst should still develop a statement describing the nature of the effect expected in terms as specific as possible. Note that in any change there will be always someone who gains and someone else who loses. Most of time they are very different people. Evidence suggests that the establishment of a park or reserve generally imposes losses on local people who depend on the forest resource whereas its benefits go to outsiders. This is a very important aspect to be taken into account.

The “with and without” concept should be used to develop technical relationships to relate system inputs[24] and outputs with and without the project. It is important to stress that with and without a proposed change is different from “before and after” the change (Gregersen et al., 1995). This rule is not specific to a particular type of investment project.

The existing situation or “without project” condition over time must first be defined and quantified using the available information, such as inventory, monitoring and survey data. Often, this information is neither easily available nor sufficient to characterize all the important relationships. Thus, experience and expertise of professionals are needed to compensate for the absence of data and to focus energies on those relationships having the greatest impacts.

The next step is to define the “with project” conditions; for example the effectiveness of different rehabilitation and management practices should be quantified. As in the “without project” situation, the analyst may be faced with lack of data. Again, input and output values should be estimated and, to do so, professionals with experience and expertise are required. It should be stressed that output will vary according to the combination of inputs (i.e. technical relationships) and that the great challenge is to develop these biophysical relationships.

Not all benefits attributed to a forestry project have a close relationship to market products, e.g. high environmental quality can contribute to better health of people. In such cases values can be estimated by proxy using one of the methods discussed in more detail in the next chapter. However, there are some benefits that cannot be quantified, such as those involving ethical issues of human life. In such cases information should be descriptive. These aspects will influence the kind of information required and will vary not just as a function of the project type but also as a function of the context in which the project has been proposed. The main sources of information are statistical records, surveys, inventories and so on. The analyst can also rely on information provided by professionals with experience and expertise on the investment project type or on the area where the project is located or, preferably, on both.

Valuation should be case specific: each case has its own specificities and data requirements. There is no model nor a list of what information is needed. The information demanded will be a function of the objective of the valuation, the context in which the valuation is being carried out[25], availability, time and cost to collect[26] and technique/method used. One of the greatest challenges is not just to produce the information, but how to get it used. The expertise and experience of the analyst will be of extreme importance in this definition of what information is needed. It is also important to bear in mind that one type of project can have more than one function, e.g. a project can have as its major aim watershed management, but at same time contribute to biological conservation (protected area). For each of the four major categories of investment project discussed, the types of information needed are outlined. It does not constitute an exhaustive and conclusive list of the

[24] Inputs are generally land, labour and capital.

[25] Socio-economic, physical resources and ecological situations differ from one place to another, even within the same country or region. This should be taken into account in order to provide an overall direction and purpose of the valuation.

[26] See, Chambers (1987) for an interesting discussion on this matter.

information required because each case has its own particularities which should be taken into account. However, as an example, the watershed is discussed in detail.

## 3.2 Where forests are competing with alternative land uses

In such cases it is advisable first of all to define clearly both the forest scenario and the non-forest scenario, i.e. what will be the use to which the land will be put after conversion from forest. Then identify the inputs and outputs for both. The issue of who benefits and who loses is particularly important in this case because often very different people and economic sectors of society are involved. Frequently the decision to convert forest land to agricultural land, including pasture, is based on a political decision rather than an economic one. One of the best examples was the process of colonization in the Amazon region[27]. Among other factors, pressure for increasing food production and even questions of national security can have much more influence than economic factors in the final decision on converting forest land to other uses.

## 3.3 Afforestation or reforestation

Arguments in favour of afforestation or reforestation projects have often been in response to specific aims such as to offset deforestation, meet industrial needs or supply fuelwood. However, this sort of project can also contribute to watershed protection. In recent decades a major emphasis has been put on projects in which social aspects are the major goal, such as community forestry projects. In such cases the focus should be much more on the role of these plantations in satisfying people's needs rather than on trees *per se* as has traditionally been done in large-scale industrial forest plantations.

The traditional inputs linked to land, labour and capital should be identified and quantified. Given the emphasis on social forestry projects, the analyst should be aware of the land tenure where the project is going to be established. The property ownership mode can be individual, family, village, government or even free access. These forms can occur in isolation as well as coexist. Each project will have different combinations of these inputs and for each one there will be a different output. Each afforestation or reforestation project is to some extent distinct and site specific. Therefore, although some principles may be common and known, their application to particular situations requires interpretation of local needs and adaptation to fit those needs.

## 3.4 Establishment of protected areas

Given the emphasis on environmental matters, the establishment of protected areas has become a major concern. As in the previous project types, the major inputs usually will be land, labour and capital. However, in these projects the analyst should be very careful since evidence suggests that the establishment of protected areas may be much more important to outsiders than to local people. The establishment of protected areas to promote biological conservation seems to have imposed heavy opportunity costs on local people. It is also important to bear in mind that, for example, establishment of protected areas may conflict with the aim of becoming self-sufficient in wood products.

## 3.5 Watershed management[28]

Deforestation is one of the causes usually blamed for upland degradation and for downstream impacts, such as flooding and reservoir sedimentation: although this is true in part, there has been also some exaggeration (see box 3). So, the first step is to identify and quantify real impacts and their

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27 For more specific details on this subject, see, for example: Hecht (1985); Browder (1988, 1992); Repetto and Gillis (1988); Schneider (1995).

28 Economic appraisal of watershed management projects is covered in greater detail in Gregersen et al.( 1987).

causes. Any project involves a set of new or altered activities directed at reaching its objective. In the case of watershed management projects these activities primarily involve upland use and management. The inputs are largely those derived from additional use of factors of production (land, labour and capital) over and above the level of use in the "without project" condition. These inputs are "costs" and occur on site whereas outputs are divided between upland on-site and downstream off-site effects and are "benefits". A list of examples of inputs needed for a watershed project is presented in table 6. Once the inputs have been listed, they should be quantified in terms of costs; a physical flow table by each category and for the years of the project should be developed since the inputs are not going to be used at the same time.

**Table 6. Examples of inputs needed for watershed projects.**

| Category of inputs | Examples |
|---|---|
| 1. Human resources | - Resource Managers (forest, range, watershed managers and planners)<br>- Engineers and hydrologists (design of erosion control structures, flood plain analyses, water yield estimate, etc.)<br>- Skilled labour (construction)<br>- Unskilled labour<br>- Training/extension specialists to facilitate adoption of project |
| 2. Equipment | - Detailed listing of equipment needed for construction and maintenance<br>- Schedule of needs, i.e. timing |
| 3. Land | - Land classified according to suitability for various uses<br>- Designated sensitive areas to be protected (benefits forgone)<br>- Areas to receive treatments followed by management |
| 4. Raw materials and supplies | - Utilities (energy, fuels, etc.)<br>- Wood (construction, fence posts, etc.)<br>- Other construction material (concrete)<br>- Water |
| 5. Structures and civil works | - Housing, roads, other facilities needed for project that are not part of project itself; if part of project, they are included in human resources and materials. |

Source: Adapted from Gregersen et al. (1987): table 3.1, p. 22.

Once the inputs are listed the next step is to identify the outputs produced. Technical studies are needed to derive relationships that link outputs for a given watershed condition "without project" and outputs associated "with project". All outputs should be considered. Using the "with and without" concept, technical relationships can be developed as presented in table 7. It should be stressed that it is the incremental relationships between the independent and dependent variables that is important.

However, people do not put value on soil losses avoided, but rather on what those avoided losses mean in terms of, for example, food losses avoided. Thus, the input-output relationship is only complete when it has reached the relationship between inputs and the goods and services that are consumed or used by people and therefore take on value to society.

**Table 7. Examples of technical relationships needed to perform economic analysis of watershed management projects under "with and without" project conditions.**

| Dependent variables "Y" | Independent variables "X" |
|---|---|
| **Uplands** | |
| 1. Annual erosion rates (t/ha) | - Land use/watershed practices; e.g. as characterized by Universal Soil Loss Equation (USLE) |
| 2. Crop production (kg /ha)<br>Wool production (kg /ha)<br>Meat production (kg /ha)<br>Wood production ($m^3$/ha) | - Annual erosion rates (t/ha) for each land-use/watershed practice |
| 3. Annual water yield ($m^3$/ha)<br>Avg. minimum 5-day flow ($m^3$/sec)<br>Avg. annual peak discharge ($m^3$/sec)<br>Frequency of landslides[a] | - Change in forest cover, as % of watershed |
| 4. Wildlife habitat diversity or numbers of species present | - % Watershed forested, rangelands and cultivated; and amount of edge |
| **Downstream** | |
| 5. Sedimentation rates at reservoir or channel ($m^3$/yr) | - Annual erosion rates (t/ha) from above |
| 6. Annual loss of hydropower generation capacity, loss of irrigation capacity, etc. | - Sedimentation rates ($m^3$/yr) |
| 7. Frequency of flooding[a] | - Stormflow-stream stage relationships under different channel conditions |
| 8. Fisheries production in reservoirs/lakes (kg/yr) | - Nutrient loading from upland watersheds (kg/yr) |
| 9. Average annual losses ($) due to flooding | - Frequency of flooding[a] and sedimentation of channels |

Source: Gregersen et al. (1987): table 3.2, p. 23.

Notes: [a] Technical relationships for determining land use impacts on landslides and flood frequency and associated damages require involved and complex analyses. According to Gregersen et al. (1987), methods of performing hazard analysis for such events are presented by Petak and Atkisson (1982).

## 3.6 Final remarks

Proper valuation of forest goods and services depends on reliable information, both quantitative and qualitative, and including physical as well as socio-economic elements. However, information on biophysical relationships between inputs and outputs is often inadequate. A shortage of basic and reliable scientific information on many aspects of forest production other than timber is among the most fundamental barriers to reliable forest valuation at present. The absence of solid information and knowledge may explain the heavy reliance on "guesstimates". It may also explain the temptation facing analysts to adopt assumptions for a given valuation that may tend to favour the outcomes they want to see.

On the physical side, sound information on the nature of the forest and ecosystem interactions as determined by forest resource assessments is a prerequisite for valuation of forests. This information should go beyond timber to encompass non-wood products and the potential to provide services. It should cover both “stock” and “flow” elements; for example, it is necessary to know not only total quantities of wood and non-wood products but also productivity under various management regimes. Furthermore, it is necessary to know how the system interacts internally: how does harvest of timber affect non-wood resource productivity? how does either of them affect water and soil protection potentials? what cyclic (including seasonal) patterns exist in productivity? Specific areas of information weakness include:

- There is still considerable uncertainty over the dynamics of the forest ecosystem, processes which (particularly in tropical forests) are complex and inadequately understood. Even knowledge on what may be irreversible after forest alteration and conversion is still inadequate, as is that on the relationship between economics and environment;

- According to Andersson and Bojö (1990), “our knowledge of environmental processes, such as land degradation, is rather limited, especially regarding long-run effects”. This can lead to wrong assumptions which, in turn, can drastically affect valuation results. Box 3 gives an example of the implications of poor knowledge on the perception of value in a watershed forestry project.

**Box 3. When does sedimentation control start?**

Control of sedimentation has been a major consideration and source of value for forests in watershed management projects. In the absence of unassailable scientific evidence, it is assumed in some valuation studies that sedimentation will be reduced as early as the first year after watershed forestry interventions. This boosts early returns and therefore the net present value (NPV) is increased, sometimes sharply. In real life, however, many soil stabilization benefits take place only after many years and could be spread over decades, thus reducing NPV to very small or even negligible levels.

See: Chomitz and Kumari (1996).

One result of lack of reliable knowledge is that analysts have on occasion succumbed to the temptation of attaching high weights (and consequently high values) to forest functions or goods for which there is no reliable or agreed scientific information on the biophysical relationships between inputs and outputs. Take non-wood forest products as an example:

- *High values based on what foundation?*

  There is frequent attribution of high values to hitherto little-commercialized tropical NWFPs for which there is no information on yields, productivity, markets, seasonality and management regimes.

- *Predictability*

  Data are also insufficient on potential yield of NWFPs. These products usually occur at extremely low densities and produce low yield per unit area. Information is lacking or is weak on the reliability of crop yields, periodicity or seasonality: this clearly makes marketing problematic. Box 4 gives an example of unpredictable NWFP yields.

**Box 4. - Unpredictability of forest yields: a factor in valuation**[29]

An example of lack of predictability in data on non-wood forest products (NWFPs) is the production of the *illipe* nut that produces an oil similar to cocoa butter: the *illipe* fruit is produced by about 20 different species of *Shorea* trees. According to Peters (1994), in 1987, over 13,000 tonnes valued at over US$5 million were exported from West Kalimantan (Indonesia) alone. In the following year less than 50 tonnes were collected. In carrying out valuation, it is important to bear in mind this lack of predictability of production. In the absence of solid records or basic knowledge, a cautious approach should be used to avoid overestimation of value of NWFPs.

- *Weak knowledge of cultural dimensions*

  Within the same country, the cultural milieux varies in every region and even locality: consequently, the peoples' perceptions and uses of the forest are also different. Padoch (1987), referring to Peruvian conditions, points out that there is no "typical village" or "typical marketing pattern". A study by Lescuyer (1996) of two neighbouring villages with different commercial outlets showed that the institution of monetary value for each product gathered led to change in the modes of use of the resource. This once more suggests that forest valuation should be type- and site-specific and any generalized approach would have only limited validity (Leslie, 1987).

The following chapter deals with choosing and applying valuation measures and techniques in order to value inputs and outputs. It is assumed that the inputs and outputs have been explicitly identified and quantified as discussed in this chapter.

[29] This subject is also referred to in Panayotou & Ashton (1992).

# Chapter 4: CHOOSING AND APPLYING MEASURES OF VALUE AND TECHNIQUES TO MEET THE INFORMATION NEEDS[30]

## 4.1 General considerations

In the previous chapter biophysical input and output were put together. They are associated with the changes that are under review in the decision context being studied. This chapter reviews a range of methods and techniques available for estimating values for the inputs and outputs. A "cookbook" approach will not do: situations are too site-specific within the decision context to allow this. There are some general guidelines that can be suggested, but they are not fixed rules. Box 5 highlights a few.

## 4.2 Measures of value in forest valuation

### 4.2.1 Main types of value measure

With the elements of box 5 in mind, and while recognizing that adaptations may be needed to suit each circumstance, the main value measures presented fall into three categories:

(a) direct market prices;

(b) indirect market prices (value inferred from other market prices), e.g. residual values, value of production increases, surrogate prices and replacement cost or cost avoided, opportunity cost, hedonic price and travel cost;

(c) non-market prices.

There has been remarkable growth in the academic literature on valuation methods for the different forest goods and services[31]. What follows is a quick overview of the main methods which are also summarized in table 8. A key point is that in any given analysis, a number of different techniques may be used. Indeed, this seems to be the trend according to evidence from the literature. Each category is discussed briefly below.

Figure 2 indicates the general categories of economic value measures commonly used. More specific examples of different techniques and their applications are summarized in table 8. Each measure presented in this table is discussed in more detail in the following sections[32].

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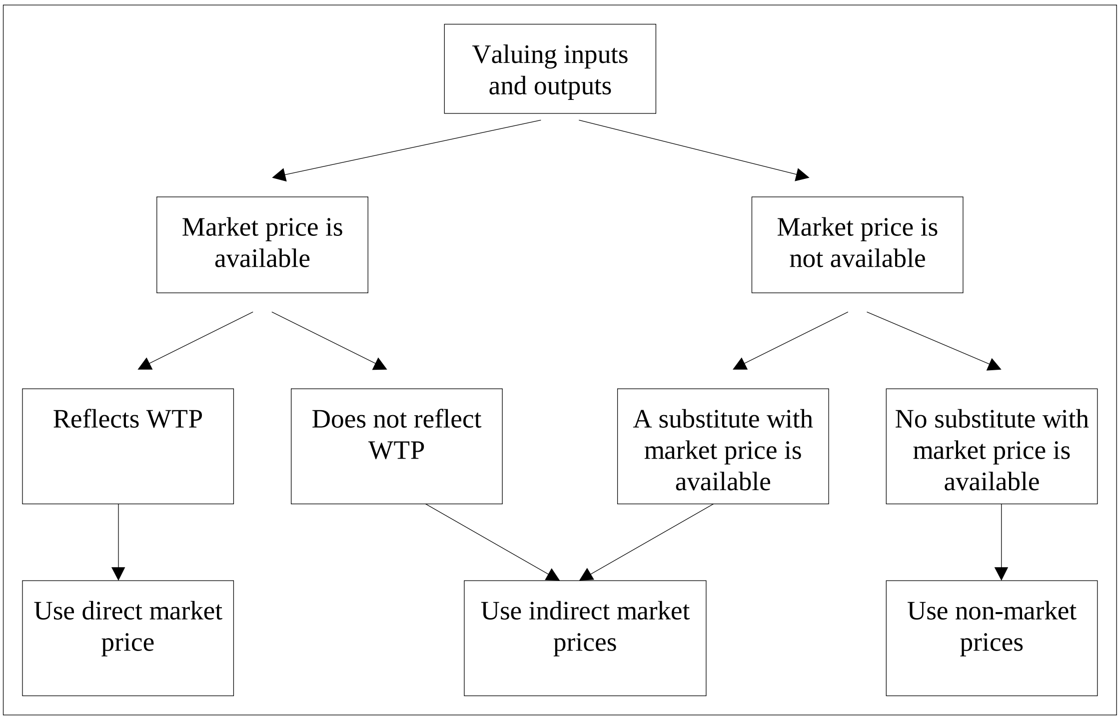
30 See annex 1 for a more detailed discussion on values, benefits and costs to consider in forest valuation. Annex 2 presents a series of examples of recent estimates of forest values illustrating the application of the methods discussed in this chapter. Examples are not restricted to the use of a single method and/or technique; on the contrary, methods are used jointly.

31 For some of the reviews of methods, see, for example: Dixon and Hufschmidt (1986); Dixon et al. (1988a, 1988b); Folmer and Van Ierland (1989); Dixon and Sherman (1990, 1991); Bateman (1991a, 1991b); Winpenny (1991); Kramer et al. (1992); Panayotou and Ashton (1992); Redclift (1992); Sharma (1992); Barbier (1993); Costanza et al. (1993); Godoy et al. (1993); Munasinghe (1993a, 1993b); IIED (1994); Langner (1994); Lutz and Munasinghe (1994); Pearce and Moran (1994); Commonwealth of Australia (1995); Gregersen et al. (1995); Gregersen (1996): Lewis (1995).

32 This general approach can be used for all four major types of investment projects and this has been already discussed in considerable detail in FAO Forestry Papers 106, 114 and 127 as well as in FAO Conservation Guide 16.

**Figure 2. Valuation conditions and approaches.**




Source: Adapted from Gregersen et. al (1987): fig. 6.1, p. 59.
Notes: WTP = willingness to pay.

## 4.3 Direct market price measures of value

### 4.3.1. On what conceptual foundation do direct market price methods depend?

#### *4.3.1.1 When market prices are correct*

Market prices are the result of interaction between consumers and producers through demand and supply of goods and services. The direct market price methods value the different forest goods and services that are exchanged in the marketplace with the implicit assumption that market prices correctly reflect economic scarcity and hence are economic-efficiency prices. Market prices can be used either in financial or economic analysis to compare the costs and benefits of alternative forest use options.

The first step is identify which goods and services are traded in the market. The second is to collect the empirical data, whether based on an original survey and/or secondary sources (e.g. published economic statistics). For forest goods and services that are freely traded in an open manner, market prices are available and reliable; the market prices exist and correspond to the intersection of supply and demand curves[33].

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[33] Demand curves reflect consumers' willingness to pay (WTP) whereas supply curves reflect producers' willingness to sell (WTS). Market prices reflect the intersection of supply and demand curves.

**Box 5. Suggested guidelines in choosing forest valuation techniques.**

The analyst should be open to all techniques and not develop such a strong preference for one that he/she forces its application to all situations (i.e., the analyst should avoid being like a person with a hammer to whom everything looks like a nail);

The analyst should, instead, carefully consider the task, evaluate the ability of existing tools to handle the job, select the appropriate one;

Where no existing tools suffice, the analyst may have to adapt one or several of them or even design new tools. Whether using established or new techniques, full transparency regarding assumptions and their basis should be ensured;

Since full forest valuation occurs in an environment of uncertainty, it is prudent to try deriving value estimates by more than one technique so as to have some kind of cross-check;

Irrespective of technique chosen, the manipulation of information at the ecological-economics frontier may influence the appointment of costs and benefits to various interest groups. This raises ethical questions. It is not an analyst’s job to make ethical judgements among existing groups or between present and future generations. It is the analyst’s obligation, however, to indicate how proposed interventions (such as investment projects) affect the costs and benefits;

Always include financial valuation since decision-makers find this a familiar point of reference;

For valuation aspects beyond financial valuation based on market prices, first carry out the easiest. If this gives large enough values on which to base the required decision, there is no point in spending much more time on valuing other functions;

Collecting and generating quantitative information can be a costly activity; to incur such costs is worthwhile only if the data are able to influence decisions. Therefore data collection should be in response to specific demands and guided by the type of decisions for which the results are to be used;

Extrapolation of results from one country to another, although it may be appealing, should be minimized or avoided. The value assigned to a forest resource by a person or a group depends, among other things, on the context of the valuation and varies in time and space (Brown, 1984; Brown and Slovic, 1988; Mäler, 1991). Risks are even greater in attempting to extrapolate value of forest resources from developed countries to tropical developing countries. For example, given that forest resources are currently the subject of massive public attention in developed countries and that people there have higher incomes, the results of such surveys give higher value estimates for conservation of tropical forests than if the people living in or near those forests were surveyed.

**Table 8. Valuation approaches in relation to type of forest goods and services.**

| MEASURES | TECHNIQUE INVOLVING | EXAMPLES |
|---|---|---|
| **DIRECT MARKET PRICES** | | |
| | Market surveys, use of statistics;<br>Direct observation;<br>Experimental markets. | This is used to value all market goods and services from the forest, unless there are market distortions. The most common cases when one encounters distortions are when there exist imposed minimum prices or price ceilings on goods and/or services. In such cases, the techniques below are used. |
| **INDIRECT MARKET PRICES** (i.e., value inferred from market prices for other goods or services) | | |
| Residual values | Use of market prices for final goods and intermediate inputs, plus some measure of profit, to arrive at residual value. | Stumpage value for timber is derived by looking at market prices for finished lumber and subtracting out costs from stump through processing to lumber sale. |
| Value of production increases as a measurement of minimum value of some input | Use of market value of increased production to provide proxy measure of the value of an input or set of inputs. | Increased market value of crop production with a windbreak over what it would have been without a windbreak provides a proxy minimum gross value for the windbreak. From that is subtracted associated costs to arrive at net value. |
| Surrogate prices and replacement cost or avoided costs | Use of market prices for close substitute as a proxy measure of value for the unpriced good or service being valued. Both are converted to some common denominator, e.g. heating value, protection value. | The maximum value of fuelwood in a new market is estimated on the basis of the value of alternative fuels, e.g. kerosene, in that market, after adjusting for calorific value of the two fuels;<br>The maximum value of a watershed management programme focused only on containing sediment in a downstream reservoir is made equal to the alternative market cost of dredging the reservoir of the additional sediment that would occur without the watershed management programme. |
| Opportunity cost | Use of market prices for the best alternative forgone provides some measure of minimum value for a good or service. This is essentially a cost measure that is used to provide minimum value for a benefit. | The minimum value of a wilderness park is estimated on the basis of market priced value of the goods and/or services forgone, e.g. timber, mineral, grazing, etc. |
| Hedonic prices | Use of market value differences for two similar goods or services that differ only in terms of one characteristic as a measure of the value of that characteristic. | The market value differences for similar forest properties are used to reflect the value of some environmental service or cost that varies across the properties. |
| Differences in travel costs as measure of value of an area, facility or activity | Per capita measures of participation from different distance zones are used to derive estimates of the value of an area, facility or activity. | Differences in market-priced costs of trips by different users to a reserve are used to value nature-based tourism based on differences in use rates in relation to differences in trip costs. |
| **NON-MARKET VALUE ESTIMATES** (willingness to pay) | | |
| | Contingent valuation, or surveys of stakeholders' willingness to pay (WTP) for a given event, area, facility, activity (this is a measure of value in use). | Value of a certain wildlife population is inferred from a survey of environmentalists' willingness to pay to save the population. |

Source: Adapted from Gregersen (1996): pp. 9-14 (table 9.2).

*4.3.1.2 When market prices are distorted and therefore misleading*

Prices can be distorted because of market and/or policy failures[34], in which case the prices do not reflect true scarcity and shadow prices are required. Distortions are generally because of taxes, subsidies, administratively set exchange rates or mandated wage or interest rates. Examples include incentives given by the Brazilian government for settlement in the Amazon region and subsidies given to farmers in many OECD countries which encourage production of crops, meat and dairy products outside environmentally suitable areas. Another example, reported by McNeely and Dobias (1992), is of subsidies provided by the Government of Thailand to tapioca farmers to increase export earnings: these led to widespread loss of Thailand's forests and were directly contrary to other policies favouring forest preservation. To correct such distortions, appropriately adjusted market prices, commonly called "shadow prices"[35], should be estimated.

Adjustments to use shadow prices or some other multiplier instead of market prices is a complex process that requires additional work and expertise. It is also the subject of some debate; for example, Gregersen et al. (1987) recommend caution in the use of shadow prices in place of market prices, arguing that market prices:

- are often more readily accepted by decision-makers than are artificial values derived by the analyst;
- are generally easy to observe, both at a single point and over time;
- reflect the decision of many buyers, whereas calculating shadow prices may often rely just on the judgement of the analyst.

Gregersen et al. (1987) also point out that the procedures for calculating shadow prices are rather complex for a field person and, if improperly followed, can introduce larger discrepancies than the simple use of even imperfect market prices.

*4.3.1.3 Sources of market information*

A variety of sources can yield appropriate market prices, e.g. official statistics, socio-economic surveys, commercial market intelligence sources, or, in the case of rural products, consultation with extension officers. When determining market prices, it is important to take into account the seasonal variations that lead to price fluctuations due to changing supply/demand balance. Points to consider in the use of direct market price measures of value are summarized in box 6.

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[34] Market failures refer to the inability of market prices, under certain conditions (e.g. presence of open access resource exploitation and public goods, externalities, incomplete information and imperfect markets) to reflect accurately the value of environmental goods and services, e.g. non-marketed environmental services, such as carbon sequestration. Policy failures refer to instances when government policies have unintended, perverse side-effects or cause inappropriate resource-use behaviour from a societal perspective: e.g. reported subsidies for beef in Botswana, compounded by preferential tariffs in the European Community, are claimed to be causing cattle-raising in numbers beyond environmental support capacity (a case of irrational behaviour from the environmental perspective).

[35] Shadow prices are adjusted market prices which reflect the true benefit or cost to the economy, e.g. the difference between the market (subsidized) price of fertilizer and the world price a government must pay. A detailed discussion on practical considerations on shadow prices can be found in FAO Forestry Papers 17 and 106.

**Box 6. - Considerations when using direct prices**

- Direct prices are relatively easy to obtain. There have been many surveys of market prices from different goods and services provided by the forest. However, (i) not all forest goods and services are traded, including most environmental ones, (ii) there are markets where there is bargaining between traders and sellers, and hence no fixed publicly stated price exists, and (iii) observed prices may be of past transactions and outdated and may or may not reflect current or future conditions, whereas for most projects, prices are needed for future situations.

- They do not reflect willingness to pay (WTP), as it is usually understood; they reflect only what people actually do pay in exchanges (they do not tell what the WTP demand curve looks like; they give only one point on that curve);

- Market and/or policy failures may distort market prices, in which case they cannot reflect the true economic value. Allied to these failures there are seasonal variations and other effects on prices that can lead to a distortion of the market price as a good measure of value.

### 4.3.2 Example of application of market price

Peters et al. (1989) carried out a study on non-timber products and forest management in Peru and relied mainly on market and official prices, actual expenditure and the opportunity cost of labour (minimum wage). Initially, a physical inventory of one hectare of natural forest land was performed at Mishana, Rio Nanay, Peru. After this inventory, monthly surveys were carried out of local markets on the prices of fruit; timber prices were obtained by interviewing local mill operators. Interviews and observation of local forest users enabled the authors to obtain estimates of fruit yields for seven other tree species and of the labour inputs required to harvest fruit and latex. These primary data were supplemented with selected published information, e.g. minimum wage in Peru in 1987, logging and transport costs for timber (estimated at 30-50 percent of the total market value of delivered timber) and so on.

Then, based on the array of information referred to above, the following secondary data were generated:

- tree population, annual yield per tree, market price and total production value for 11 fruit tree species and one latex-producing species occurring in one hectare of forest;

- tree population, merchantable volume, unit price at the mill and stumpage value for 60 species of commercial timber (grouped under 23 commercial names) in the same hectare of forest;

- maximum sustainable timber yield (estimated at 30 cubic metres per hectare every 20 years).

These data were used to estimate gross and net revenues derived from fruit, latex and timber production on natural forest land. It was concluded that sustainable multiple use of natural forest generates higher economic value than timber alone. This can be seen in table 9.

**Table 9. - Financial returns to non-timber products and other forest uses in 1 hectare of natural forest at Mishana, Rio Nanay, Peru.**

| | (Net present value, US$/ha, 1989, 5% discount rate) |
|---|---|
| 1. Non-timber harvesting | |
| Fruit and latex | 6,330 |
| 2. Sustainable timber harvesting | |
| Periodic selective cutting | 490 |
| **Total natural forest value (1 + 2)** | **6,820** |
| 3. Clear-cut timber harvesting | 1,001 |
| 4. Plantation harvesting | |
| Timber and pulpwood[a] | 3,184 |
| 5. Cattle ranching[b] | 2,960 |

Source: Reproduced from IIED (1994).
Notes: a 1.0 ha plantation of *Gmelina arborea* in the Brazilian Amazon.
b Gross revenues per hectare of fully stocked cattle pastures in the Brazilian Amazon (costs of weeding and fencing and animal care not deducted).

## 4.4 Indirect (surrogate) market price measures

### 4.4.1 General considerations

The indirect market price valuation approach uses information about surrogate markets to input or infer the value of a related, non-marketed good or service. In other words, it attempts to draw inferences from observed market-based information. There are different techniques and methods to do so. They are indirect because they do not depend on people's direct responses to prices for the good or service being valued. To illustrate, some are discussed briefly below.

Among examples of surrogate price methods are (a) residual value, (b) value of production increases as minimum measure of value of some input, (c) surrogate prices and replacement cost or cost avoided, (d) opportunity cost, (e) hedonic pricing and (f) travel cost.

### 4.4.2 Residual value method

#### *4.4.2.1 Approach to application*

The residual value of particular goods or services is estimated from the prices of goods or services established later in the production-distribution process. It assumes that the value of the good or service at the forest roadside[36] is at least equal to the residual value left after subtracting from market prices the costs of further transport to mill, processing at mill, marketing and distribution. These conversion return methods have traditionally been used in appraisal of "stumpage value" (the value of standing timber). Although stumpage fees may account for a relatively small percentage of the total costs to forest products companies, methods to determine how much money may be charged for standing timber continue to be questioned by some authors. For example, Luckert and Bernard (1993) argue that such traditional residual value methods for assessing "stumpage", although consistent with economic theory, are not appropriate for forestry in Canada. They point out that such methods do not adequately represent stumpage values because of complications posed by imperfect competition, dynamic residual values and the forest tenure system.

[36] The equivalent of "logs at roadside" can be adopted in the process for any forest goods.

Bettencourt (1992) suggested that the residual value of standing wood reflects the price that buyers are willing to pay for it whereas sellers consider this stumpage value as the minimum price they would be willing to accept, taking into account their production costs. Bettencourt states further that "while traditionally the residual stumpage value has been estimated from the buyers' side, this procedure is only correct in cases where the production costs of the wood (prior to felling) are zero from the sellers' perspective. This happens, for example, when wood is gathered from open-access forests." Such an assumption would not occur in the case of plantation wood where real production costs are incurred by the seller.

This method can be used also in cases where a market price for a non-wood forest product does not exist, but the product is used to manufacture other products for which market prices do exist. In this situation, the market price of the end product is the point of departure from which costs incurred in transformation of the product, costs of supplementary inputs and all other production, transportation and marketing costs are subtracted to arrive at the residual value. The residual value method can also be applied to economic valuation of fuelwood. Points to consider when using the residual value method are summarized in box 7.

**Box 7. - Considerations when using residual value method**

- Provides only a minimum value for the good or service in question;
- Does not take into account environmental and social impacts;
- Prevailing market prices used may be distorted.

*4.4.2.2 Examples of application of residual value method*[37]

Evidence suggests that many countries, particularly developing ones, are becoming increasingly concerned about their forest revenue systems. For many of these countries a primary objective in designing a forest revenue system is to maximize forest revenues collected. To do so, forest charges must closely reflect the stumpage values of the timber cut. The US Forest Service and the British Columbia Forest Service in Canada have developed sophisticated stumpage appraisal systems using residual value approaches. However, most developing countries are likely to rely on more basic and simpler appraisal methods. Tables 10 and 11 illustrate two examples of the derivation of stumpage values: the first is based on log prices and the second on prices of manufactured forest products.

[37] These examples were reproduced from Gray (1983).

**Table 10. - Derivation of stumpage values based on log prices**

| | Illustrative prices and average costs ($/m$^3$) | |
|---|---|---|
| **EXPORT PRICE OF LOGS** | | **100** |
| *Less* port handling charges | | |
| Log transportation costs: | | |
| Road construction | 7 | |
| Transportation overhead | 3 | |
| Truck hauling, loading, dumping | 18 | |
| Normal profit on capital | 4 | |
| *Less* total transportation costs | | 32 |
| **LOG VALUE AT ROADSIDE** (maximum WTP) | | **58** |
| Log production costs: | | |
| Logging overhead | 6 | |
| Felling and yarding | 16 | |
| Normal profit on capital | 6 | |
| *Less* total production costs | | 28 |
| **DERIVED STUMPAGE VALUE** | | **30** |

Source: Gray (1983): table 4.1, p. 35.

Note: WTP = willingness to pay.

Caution should be taken in analysing such derived values. The analyst must have experience and knowledge of the context. These derived values can hide some important facts if the analyst lacks experience and local knowledge. For example, Bettencourt (1992) prepared a typical valuation of charcoal, a traded item, in Rwanda using the residual stumpage approach. The retail price of charcoal in Kigali (the main market) was used as the starting point of the analysis, and the stumpage value was derived by taking into consideration retailer profit margins, transportation and labour costs and transformation losses. The calculated residual value was less than RF100/stere which was far below actual plantation costs[38]. This suggests that, among other reasons, most sellers collect the wood illegally from public forests, thus failing to internalize costs involved in growing the wood.

[38] The costs of production of plantation wood were estimated at RF1,321/stere, RF335/stere and RF321/stere for, respectively, state, communal and private plantations producing an annual yield of 12 m$^3$/ha (Bettencourt, 1992).

**Table 11. - Derivation of stumpage values based on forest product prices**

| | Illustrative prices and average costs ($/m$^3$) | |
|---|---|---|
| Selling price of plywood x recovery factor ($440/m$^3$ x 0.50 m$^3$ plywood/m$^3$ logs) | | 220 |
| Selling price of pulp chips x recovery factor ($50/m$^3$ x 0.30 m$^3$ chips/m$^3$ logs) | | 15 |
| **VALUE OF PRODUCTS RECOVERED PER m$^3$ OF LOGS USED** | | **235** |
| Plywood manufacturing costs (converted to log input basis: costs/m$^3$ of plywood x recovery factor) | | |
| Overhead ($34/m$^3$ x 0.50) | 17 | |
| Depreciation ($24/m$^3$ x 0.50) | 12 | |
| Operational costs (labour, glue, etc.) ($170/m$^3$ x 0.50) | 85 | |
| Normal profit on capital ($22 x 0.50) | 11 | |
| Truck hauling, loading, dumping | 18 | |
| Normal profit on capital | 4 | |
| *Less* total plywood manufacturing costs | | 125 |
| **VALUE OF LOGS ENTERING PLANT** (maximum WTP) | | **110** |
| Log transportation costs: | | |
| Road construction | 7 | |
| Transportation overhead | 3 | |
| Truck hauling, loading, dumping | 18 | |
| Normal profit on capital | 4 | |
| *Less* total transportation costs | | 32 |
| **VALUE OF LOGS AT ROADSIDE** (maximum WTP) | | **78** |
| Log production costs: | | |
| Logging overhead | 6 | |
| Felling and yarding | 16 | |
| Normal profit on capital | 6 | |
| *Less* total log production costs | | 28 |
| **DERIVED STUMPAGE VALUE** (maximum WTP) | | **50** |

Source: Gray (1983): table 4.2, p. 37.
Note: WTP = willingness to pay.

### 4.4.3 Value of production increases as a measure of minimum value of some input

The increased market value of production of goods and services with and without the change or activity being valued can sometimes be used to value that activity or change. An example is the estimation of the value of a windbreak. A windbreak can increase crop production behind it; the value of this "extra" production can be taken as a proxy measure of the minimum value of the benefits from the windbreak. The same windbreak, according to the context, may also provide other benefits, such as fodder, shade for cattle, firewood and so on.

### 4.4.4 Surrogate prices, replacement costs or costs avoided[39]

#### *4.4.4.1 Surrogate prices*

This method estimates the value of a particular good or service from the known values or prices of substitute or comparable goods and services under comparable conditions. It assumes that the value of a particular good or service can be closely approximated by the prices of similar goods and services established under similar conditions.

To illustrate, the value of some forest products, such as fuelwood, can be valued also in terms of the value of a traded substitute. In the case of fuelwood, for example, substitutes can be (i) traded items, e.g. kerosene, and (ii) non-traded items, e.g. cow dung and crop residues. Hence, the value of fuelwood can be estimated as a proxy of the value of an alternative fuel, e.g. kerosene, in that market, after adjusting for calorific value of the two fuels. Table 12 provides an example of this estimation.

**Table 12. - Estimated value of fuelwood on the basis of the value of a substitute product[a]**

| | |
|---|---|
| Substitute product | Kerosene, now imported with an estimated CIF price of $0.40/litre |
| Calorific values | Kerosene: 3200 kcal/litre (burnt at 35% efficiency) |
| | Air-dry wood: 188,000 kcal/$m^3$ (burnt at 8% efficiency) |
| Imputed substitution for wood | ($/$m^3$) ÷ 188,000 kcal = $0.40 ÷ 3200 kcal |
| | *or* |
| | ($/$m^3$) = (188,000 x $0.40) ÷ 3200 |
| | ($/$m^3$) = $23.50 |

Source: Gregersen and Contreras (1992): p. 90.

Note: a hypothetical example.

This method has been suggested as a way to estimate the value of a good, fuelwood for example, on the basis of the value of another product for which it can be substituted. In all cases of surrogate prices, caution needs to be applied. For example, Kanel (1990) points out that there are at least three problems with the method of valuing fuelwood through residual stumpage on the basis of the value of a traded substitute, namely:

- Though the technical relationship between fuelwood and kerosene in terms of calorific values may be the same as described in table 12, people are interested in the total useful energy from the substitute. The utilizable energy from the traditional fuelwood stove may be around 10 to 20 percent, whereas the utilizable energy from kerosene stove will be substantially higher, about 50 percent;

- Other benefits from alternative energy sources may be ignored; for example, kerosene is a cleaner energy than fuelwood;

39 Annex 2 provides additional examples, see Nos 2, 4 and 6.

- It ignores differences in purchase and maintenance costs for alternative energy sources. Kerosene stoves cost more than fuelwood stoves. Moreover, the rural people can repair fuelwood stoves themselves, whereas it needs more expertise and, thus more expense, to repair a kerosene stove.

Kanel also points out two problems associated with non-traded substitutes, as is the case where cow dung replaces fuelwood, namely:

- It is difficult to find information on the technical relationship between dung applied in agriculture and the incremental crop production;

- There are some cultural factors also involved in the use of dung as fuelwood substitute. Virtually no dung is used in the hills of Nepal, but it is used extensively in the southern part of Nepal adjoining India.

*4.4.4.2 Replacement costs or costs avoided*

These methods are generally used where damage has occurred. They look at the cost of replacing or restoring a damaged asset to its original state and use this cost as a measure of the benefit of restoration[40]. They have been used to estimate the value of environmental damage, such as that from soil erosion and siltation. The required data can be obtained from direct observation or from professional estimates. Westman (1977) calls attention to the fact that, in practice, people rarely repair all the damage. For example, the earthworm population decimated by erosion may not recuperate after restoration; similarly, the function of regulating the global climate cannot easily be restored, if at all. Westman also argues that “the interconnected nature of the complex systems of nature” makes valuation of individual lost services inevitably misleading.

“Cost avoided” relies on the assumption that damage estimates are a measure of value. According to Panayotou and Ashton (1992), the basic assumptions of this technique (not all fully justified) are: (a) the real value of damages can be accurately measured; (b) the irreversible loss of an environmental asset can be replaced by another asset of equal value to society (over space and time); and (c) there are no externalities associated with the necessary expenditures.

Pearce and Moran (1994) refer to its application to forestry valuation, for instance for estimating flood protection and water regulatory services of forests serving as natural barrages. Unfortunately, the methods have, according to Andersson and Bojö (1992), been used to demonstrate very high values for the services of forests, thus creating problems of credibility. Points to consider in the use of these methods are summarized in box 8.

[40] By investing a certain sum in restoration, the investors imply that they set the value of the asset at least as high as what they are willing to spend to restore it from its damaged state.

**Box 8. - Considerations when using the technique of replacement costs or costs avoided**

- Useful in estimating indirect use benefits when ecological data are not available for estimating damage functions with better methods;

- Useful for estimating flood protection and water regulatory services supplied by forested watersheds which provide natural barrages;

- Difficult to ensure that net benefits of the replacement do not exceed those of the original environmental function. May overstate willingness to pay if only physical indicators of benefits are available;

- Some damage may not be fully perceived, or may arise only in the long term: benefits assessed now will therefore be an underestimate of what is really lost;

- It is assumed that the asset can be fully restored back to its original state; however, in practice, some aspects are not or cannot be fully restorable (i.e. are irreversible);

- Comparable goods or services may not be available.

### 4.4.5 Opportunity cost technique

#### *4.4.5.1 Approach to application*

This technique estimates the value of opportunities forgone in providing a particular good or service. It assumes that the value of the desired good or service is at least equal to the value of the best alternative forgone to obtain it. For example, the opportunity cost of using cow dung as fuel would be worth the increase in crop yields forgone by not using it as fertilizer. The technique has frequently been used to estimate the value of fuelwood and forest fodder in developing countries by assessing the opportunity cost of time spent gathering them. In other words, the value of time used in the collection of firewood and fodder is a proxy for the minimum value of the commodity in question. Points to consider are summarized in box 9.

**Box 9. Considerations when using opportunity cost technique.**

- Opportunity cost of time takes into account social impacts;

- Opportunity cost of resources and services used takes into account environmental impacts;

- It is often site-specific and, as such, requires local surveys; data requirements may be high and data collection costly and time-consuming;

- It requires assumptions about the value of alternative benefits forgone for which scientific information may be no better than for the value of the forest function itself.

#### *4.4.5.2 Example of application of opportunity cost technique*

The example below, adapted from Kanel (1990), utilizes opportunity cost technique to value fuelwood in Nepal.

a. An average hill family devotes about 75 person-days of labour per year to collect 4 tonnes of fuelwood;
b. Fuelwood collection takes place throughout the year, two-thirds being collected during the off-peak season and the remainder during the peak season;
c. One-third of fuelwood collection is done by children;
d. The wage rate is NR (Nepalese Rupees) 20 per person-day;
e. Child labour is valued the same as adult labour because children do other work, e.g. animal feeding and tending, so substituting for adult labour, and because other pursuits (including schooling) may present higher social costs;
f. The shadow wage rate during the off-peak and peak season is assumed to be 60 and 90 percent respectively of the going wage rate;
g. The economic value of 4 tonnes of fuelwood equates to:
   (75 x 2/3 x 20 x 0.6) + (75 x 1/3 x 20 x 0.9) = NR1,050;
h. The economic value of one tonne of fuelwood equals NR262.

### 4.4.6 Hedonic pricing method

This is a method that uses surrogate markets to input values of a non-marketed good or service. Mendelsohn and Markstrom (1988) report that the hedonic price method was originally designed as a measure of the quality difference among goods; however, it gradually became a tool to measure the value of goods' attributes. It assumes that people choose specific goods because of their objective characteristics. Therefore, the value of a good or service can be estimated from a technical relationship; for example, housing values may decline the closer houses are to a loud noise source such as an airport. There are two major variants in application of the method: property values and wage differentials.

In practice, property values are a prime example of the surrogate market approach. The value of a house, for example, is affected by many variables, such as size, construction and location. The basic assumption is that a property has a collection of attributes (some structural, some environmental, some aesthetic) that will influence the purchaser's WTP. Some property value studies require a great many assumptions and considerable data, for example, the benefits from an urban project for flood control and the benefits to households of an improved water supply system. The method has been used to value, for example, aircraft noise nuisance and households' WTP for water. In principle, it can be applied also to estimate the value of benefits to property from the proximity of forests. However, a review of the literature suggests no evidence for its use in forestry investment projects.

The second major application of the hedonic method is in wage differentials. It uses information on differences in wages for workers in different occupations under diverse degrees of risk. Its characteristics and aims suggest that is unlikely that this variant would be relevant to tropical forestry (Winpenny, 1992). Again, a review of the literature showed no evidence of using wage differential in tropical forest valuation. Points to consider are summarized in box 10.

**Box 10. - Considerations when using hedonic pricing methods**

- It may have potential for valuing certain forest functions (e.g. micro-climate regulation, ground water recharge) in terms of their impact on agricultural land values;

- Its application to the environmental functions of forests requires that these values are reflected in surrogate markets;

- Its uses may be limited where markets are distorted, choices are constrained by income, information about environmental conditions and changes are not widespread and data are scarce. This suggests difficulty in its utilization in a developing country context where all of these conditions are commonplace;

- Data requirements are substantial and, consequently, the method may be costly and time-consuming;

- It requires considerable expertise in economics and collection and analysis of data.

### 4.4.7 Travel cost method

#### *4.4.7.1 General considerations*

According to Mendelsohn and Markstrom (1988), this method was originally conceived to value recreation sites; it has been used for almost three decades in the United States. It estimates the willingness to pay for using a particular resource on the basis of expenditures incurred in using it. It can be used to place a value on cultural and historical sites threatened by development projects. However, it has been most commonly used to estimate the benefits from recreation and ecotourism. As Munasinghe (1993c) explains, it uses the "amounts of time and money visitors spend travelling to a site as the price proxies, together with participation rates and visitor attributes, to estimate the recreational value of the site". It is most appropriate for estimating value for short distances. It is important to bear in mind that the amount of the travel cost[41] *per se* is not equal to the value of the park. The travel cost data allow estimation of a demand curve for site visits (Dixon et al., 1988b).

Pearce and Moran (1994) report on attempts that have been made to value forests for fuelwood and for water supply (in each case using travel time as proxies for the value of fuelwood or water respectively). Points to consider are summarized in box 11.

#### *4.4.7.2 Example of application of travel cost method (TCM)*[42]

An example of practical application of TCM in a developing country is the study carried out by Tobias and Mendelsohn (1991) to value the ecotourism at the Monteverde Cloud Forest Biological Reserve (MCFBR) in Costa Rica. The demand function was:

$$Q = f(P,X),$$

where,

Q is the quantity purchased, P is the price, and X represents a number of socio-economic variables which might shift the demand function, such as income or age.

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[41] A problem arises of what proportion of travel costs to attribute to a park or forest if visitors undertake a joint trip to several destinations.

[42] For additional examples, see annex 2, Nos 2 and 3.

The reserve management collected data at the reserve's headquarters by offering those who gave their names and addresses the opportunity to win wildlife photographs. A total of 755 domestic visitors (out of approximately 3000) entered the draw in 1988. For the purpose of this study each of Costa Rica's 81 cantons was treated as an observation. Visitation rates (number of visits per 100,000 residents) were calculated for each canton by dividing observed numbers of trips by census populations. The demand function for visits was assumed to be linear in this study:

$$V = a_0 + a_1P + a_2X_1 + a_3X_2 + e$$

where e is an error term assumed to be independent and normally distributed, and the two X variables are population density and the illiteracy rate. The above model was estimated using multiple regressions. The results are presented in table 13.

**Box 11. - Considerations when using travel cost method**

- It assumes that people will react equally to an increase in travel costs and admission fees. Thus, at a certain level of cost increase no one will use the park since there are other recreational options. This method therefore helps to calculate "optimal" recreational fees.
- May require local survey: data requirements are substantial. These are activities that can be both expensive and time-consuming;
- Estimated benefits reflect only the willingness to pay (WTP) of those who use the facility or the environmental resource (which may be a non-representative sample) and not the WTP of the society as a whole;
- Computationally difficult. It is susceptible to bias (e.g. double-visitation bias). Thus, it requires high expertise in economics and statistics to elaborate and apply the questionnaire and analyse and compute the answers.

**Table 13. - Domestic demand for visits to Monteverde Cloud Forest Biological Reserve[a]**

| | | | | |
|---|---|---|---|---|
| VISITATION RATE | = 36.17 - 0.121 DISTANCE + 0.008 DENSITY | | | |
| | (4.20) | (2.77) | (2.76) | |
| Adjusted $R^2$ = 0.145[b] | | | | |
| VISITATION | = 44.42 - 0.107 DISTANCE + 0.006 DENSITY + 0.001 ILLITERR | | | |
| | (4.28) | (2.40) | (1.82) | (1.40) |
| Adjusted $R^2$ = 0.156 [b] | | | | |

Source: Tobias and Mendelsohn (1991): table 1, p. 93.

Notes: a The t-statistics are in parentheses. The number of observations (cantóns) is 81.

b. The low $R^2$ values are probably because of the lack of aggregate data. Unfortunately, information on socio-economic variables (which might explain differences in visitor travel behaviour) is unavailable.

This study concluded that Costa Rican citizens place a value of about US$35 per visit upon the MCFBR and that domestic recreation alone represents an annual value of between US$97,500 and US$116,200 (this estimate does not include foreign visitors). The authors concluded that the expansion of protected areas near the reserve was a well-justified investment "both from an economic and social perspective". If this conclusion is considered in terms of MCFBR being privately owned and that the value is being captured, its expansion can well be a justified investment. However, even if a good investment to the reserve's owners, what are the implications of this expansion, for example, to people who sell their lands to the reserve? What would they do and where would they go for after selling their lands? It is possible that they would go to cities close to the reserve or to the capital, so perhaps leading to an increase in urban pressures and maybe even to promoting other environmental problems. It is very important to bear in mind that, although expanding the reserve's area could contribute to preservation, there is also the possibility of new environmental and social problems being created.

## 4.5 Non-market price valuation methods

With these methods, values are inferred from surveys of what people would be willing to pay to secure some environmental changes or what they would be willing to accept (WTA) to give it up. In the absence of real markets these surveys are carried out according to what is collectively termed "contingent valuation methods" (CVMs). The CVM allows the setting up of hypothetical situations.

### 4.5.1 Contingent valuation method (CVM)

#### *4.5.1.1 Approach to application*

CVM is used where prices are not available because markets do not exist, are not well developed or where there are no alternative markets. Under such conditions, market or surrogate market techniques are unable to value the effects of a particular project. According to Hutchinson et al. (1995), the CVM directly elicits people's views to determine how much they might be willing to pay for a resource or service, or how much compensation they would be willing to accept if they were deprived of the same resource. Munasinghe (1993c) reports that "demand for nonmarket goods is established by first describing a simulated market to the respondents, and then asking them directly to reveal their preferences in terms of some common denominator". CVM has been successfully applied to the valuation of non-use values. An interesting problem discovered is that although theoretically WTP should be equal to WTA, empirical evidence suggests that they are not equal; WTA has tended to be significantly greater than the corresponding WTP. This disparity has been a matter of debate among economists[43] and should be kept in mind to avoid any confusion.

CVM has been subject to criticism for various biases[44]. There are also some application problems in contingent valuation: where people are not used to purchasing a particular forest product or service, they find it difficult to attribute a monetary value to it. For example, a question on monetary value can be meaningless for many subsistence resource users. Thus, modifications are required in order to ask, for example, about relative preferences that can be easier to express than monetary valuations; such modifications require specific expertise. It is also important to bear in mind that "preference" is not synonymous with willingness to pay.

According to Brown et al. (1995), CVM is more effective when the respondents are familiar with the environmental good or service and have adequate information on which to base their preferences. It is likely to be far less reliable when the object of the valuation exercise is a more abstract aspect, e.g. existence value. Winpenny (1992) feels that the fact that CVM does not deal in the real market makes it "somewhat implausible for serious decision-making".

In order to overcome these criticisms, CVM has become diverse and sophisticated incorporating, for example, Delphi technique, take-it-or-leave-it experiments, bidding games, trade-off games and costless choice[45]. Points to consider when using CVM are summarized in box 12.

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[43] For an example, see Fisher et al. (1998).

[44] See: Harris et al. (1988); Mitchell and Carson (1988). For further information on bias and its reduction, see, in particular: Fischhoff and Furby (1988) (quoted in Brown et al., 1995); Brown and Slovic (1988).

[45] For further details, see, for example: Dixon et al. (1988a, 1988b); Pearce and Moran (1994).

**Box 12. - Considerations when using contingent valuation method**

- Estimates economic value directly;
- It is the only way to elicit non-use values directly;
- It can be helpful in economic decision-making, especially when other valuation methods are unavailable;
- Very susceptible to bias (e.g. strategic bias, scenario mis-specification bias, aggregation bias, starting-point bias). It requires expertise to detect and avoid, or at least minimize, these biases[46];
- Requires survey. Thus, it can be time-consuming and costly. Brown et al. (1995) reported, for example, that a well designed national CVM study intended for use as evidence in damage assessment litigation may cost several million dollars to design, implement, analyse and report.

#### *4.5.1.2 Example of application of contingent valuation method*

Examples of the use of CVM, presented in annex 2, are focused on its application in a developing country context (examples 2, 3, 4 and 5).

46 For further information on bias and its reduction, see, in particular: Fischhoff and Furby (1988) (quoted in Brown et al., 1995); Brown and Slovic (1988).

# Chapter 5: DEALING WITH VALUE UNCERTAINTIES[47]

## 5.1 General considerations

To deal with the future is to deal with uncertainties. The world is characterized by uncertainties; everything undergoes change, often in unexpected and unforeseeable ways. In recent decades, the world has experienced an unprecedented technological revolution. As a consequence, societies are changing in a relatively short period of time.

In forestry there is nothing certain except uncertainty. This can be attributed to forestry's inherent peculiarities, e.g. long rotation during which forest ecosystems as well as people's tastes, preferences and perceptions undergo continuous change. There are also other uncertainties related to natural and technological factors.

Although some people claim that it is not possible to predict the future, nor even the probabilities of different futures, this does not mean that nothing can be done. The analyst should be aware of potential uncertainties underlying the data and information used and presented in the analysis, and develop strategies to increase understanding of these uncertainties and how to cope with them. Explicitly recognizing and dealing with uncertainties can reduce the chance of making serious mistakes. Thus, flexibility in adapting to new situations is fundamental. The results of a valuation are site- and context-specific and the context is likely to change over time.

Treating uncertainties is a difficult but necessary task which cannot be ignored. What follows in this chapter is a brief discussion of uncertainties followed by a pragmatic, simple approach of suggested strategies to deal with value uncertainties.

## 5.2 Uncertainties

Analysts must always cope with a number of uncertainties in the valuation process. For the purpose of this work they have been grouped into natural factors, technical and socio-economic uncertainties.

*Uncertainties originating from natural factors.* Biological and other factors associated with climatic processes and their irregularity (e.g. pests, diseases, windstorms, flooding, rainfall frequency, timing, quantity, droughts) are key factors in forestry development. This is particularly crucial in arid regions, where survival and growth of plants is often near the critical level. The climatic irregularities make forecasts of future climatic events uncertain.

It has been widely claimed that forest change has an impact on climate change. For example, it has been suggested that deforestation followed by fire has been responsible for climate change because of release of $CO_2$ into the atmosphere. However, from current knowledge it is not clear to what extent this additional $CO_2$ is absorbed, for example, by the vegetation or agricultural crop that replaces the burned land. And the resulting linkages between $CO_2$ concentration in the atmosphere and specific changes in climate are imperfectly understood. Thus, there remain some uncertainties about the net contribution of deforestation to climate change.

*Technological uncertainties.* Changes in technology are difficult to forecast. Information about alternative technologies that might be used in forestry development, including management activities, is often difficult to obtain or even unavailable for the particular situation of a valuation study. Technological advances can contribute to establishment of plantations and more intensive production.

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[47] For a detailed discussion on value uncertainties, see, for example: FAO Forestry Papers 106 and 127; FAO Conservation Guide 16; Lundgren and Thompson (1972); FFSD (1989).

The production process in a forest may differ considerably from that in a plantation. This can alter the valuation assumptions and introduce the complicating factor of deciding which part of the value derives from the natural forest and which from plantations.

In many instances, analysts have to rely on their expertise and experience to infer what the outputs are likely to be, and a great deal of uncertainty surrounds such estimates.

*Socio-economic uncertainties.* If technology constitutes an uncertainty factor, uncertainties about socio-economic factors are even greater. Human systems evolve over time; during this century, the development of many countries has been exceptionally rapid. Hence, people's tastes and preferences are dynamic, and there are innumerable variables that account for their changes over time. For example, political unrest creates economic and social instabilities. These, in turn, will likely influence the future direction of natural resource policy and other policies (such as those on land tenure) which may affect the type of forest use as well as the users, particularly local people. The scale of this disturbance can vary from low to high levels.

The world is undergoing great transformations with direct impacts on socio-economic conditions, especially in developing countries where populations are increasing, urbanization is expanding and economies are evolving. The world economy is becoming globalized; the terms of trade of commodities have a great influence on national markets and, consequently, on the use of forest resources. The demand and supply of many forest products, specially NWFPs, are highly uncertain, although the exploitation of NWFPs has been widely publicized as a way to conserve tropical forests and/or as a source of income.

Because of the intrinsic characteristics of forestry, an analyst carrying out a forestry valuation probably deals with a greater number of uncertainties in gathering information than an analyst in another field. There is no easy and systematic approach for picking the key factors in uncertainty for a given valuation related to a given project type. The analyst has to rely on personal experience and individual judgement and the past records from other projects. However, analysts should be aware that there are strategies for coping with uncertainty that can be incorporated into their forestry valuation process.

## 5.3 Strategies for coping with uncertainty

Sophisticated probability models are available. However, the approach suggested here is simpler and is based on past experience and available information. Although in both approaches experience and expertise are required, in the former these requirements are greater and can be more time consuming and costly and their results may not be sufficiently better to justify the additional complexity. The suggested approach tries to be workable, practical, cheap to apply and defensible in terms of decision-making. The process recommended is adapted from Lundgren (1983) who has suggested several strategies to cope with uncertainty in forestry planning. These strategies can be grouped under two major headings.

### 5.3.1 Increase understanding

One approach to dealing with an unknown and uncertain future is to increase our understanding of the world. Strategies for doing this include:

#### *5.3.1.1 Identify the likely sources of uncertainty*

For each likely source, make an estimate of a reasonable range of values for the parameters involved. Past experience and direct evidence can contribute. This should help to increase the understanding of the context.

#### *5.3.1.2 Postpone the decision in order to obtain more relevant information*

This may not always be a valid option, because time may be pressing. But careful use of this strategy (namely, avoiding making decisions before they need to be made, thereby obtaining more relevant information) can reduce the uncertainty surrounding a decision.

#### *5.3.1.3 Conduct sensitivity analysis*

Systematically explore how changes in assumptions made affect the results. This can help analysts learn a great deal about their model of the world. Critical points can be identified and they can be sensitive to assumptions made and estimates about the world. This technique can even be used for qualitative models of the world, for example, exploring changes in economic policies. It is one of the most useful techniques for analysts[48].

#### *5.3.1.4 Imagine alternative futures*

The future cannot be experienced; it can only be imagined. One powerful planning tool is to imagine alternative futures and estimate the consequences of possible future changes. In planning a valuation, analysts can then consider how they can cope with such alternatives. By confronting these imagined worlds in their planning they may reduce future surprises.

### 5.3.2 Increase flexibility

Another way of coping with uncertainty is to increase management and organizational flexibility, so that it is easier to take advantage of unforeseen opportunities that arise, or respond quickly to unexpected situations. Strategies related to increased flexibility include:

#### *5.3.2.1 Incrementalism and monitoring*

One strategy for dealing with an uncertain future is to plan for small incremental changes, allowing for constant monitoring and evaluation as the analyst goes along. One does not get locked into planning for a long time period, but rather plans for a step at a time, and for continual revision of plans as new information becomes available.

#### *5.3.2.2 Contingency planning*

Things rarely go according to plan. One way to deal with this in planning is to identify where there is a likelihood that things might go wrong, estimate what the consequences might be, and then calculate what might be done if such a thing happened. For example, automobiles may carry a spare tyre, just in case one of the tyres gets a puncture. Thus, contingency planning is common in one’s everyday life. It should be more common in a formal planning.

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48 For further details on sensitivity analysis, see, for example, Gregersen and Contreras (1992).

#### *5.3.2.3 Diversification*

When faced with uncertainties about the future, one strategy that can be followed is to diversify. For example, future demand may change, so, instead of valuing a particular NWFP to meet a particular demand, try to value another NWFP that can be complementary or substitute. There is another reason for diversifying. Analysts tend to focus on the average condition or typical cases, forgetting about the diversity that underlies any such average. For example, in valuing a forest for local people analysts tend to focus on certain NWFPs, e.g. fuelwood, but overlook the diversity of other needs that villagers may seek to satisfy from this forest.

#### *5.3.2.4 Planned obsolescence*

One strategy for coping with change is planned obsolescence. Rapid and great technological evolution has led to innovation. Societies, also, have experienced fast changes which can influence the use and perception of the forest. Thus, for example, an NWFP (or even a timber species) that is consumed today may no longer be consumed tomorrow. The converse may also occur. Evidence also suggests that many NWFPs are considered inferior goods and, as such, they are no longer consumed or demanded when people become more affluent.

## 5.4. Final remarks

There are no easy answers to dealing with value uncertainty. Ecosystems and societies are not static, but both are continually changing. This change may be slow and gradual, but it may also be dramatic and swift. For example, a long drought period can set the stage for a series of fires that drastically alter a major part of the forest ecosystem. So an ecosystem that took many years to evolve is changed in a short period. Most natural ecosystems are far too complex for an analyst to completely understand and model within a planning framework. An analyst can make use only of whatever data are available in such a way as to reduce the degree of uncertainty.

The above strategies suggest some of the ways to deal with value uncertainty. The potential importance of any of the above strategies will vary from case to case and time to time. The basic point here is that no easy and systematic approaches exist for picking the key factors in uncertainty. The analyst has to rely on personal experience and judgement and past records from other projects. It becomes an exercise in individual judgement.

The major interest of the exercise of valuation is to contribute to more effective decision-making. However, evidence suggests that there has been a greater fascination in finding monetary values than in finding how to integrate these values into forest decision-making processes. A new research agenda should give more consideration to providing an outcome that is in the interest of the decision-maker, and consequently would help to produce a sound forestry development policy, including sustainable forestry management. Ultimately, however, an analyst cannot escape making assumptions and guesses about the future. Points to consider are summarized in box 13.

**Box 13. - Uncertainties in the valuation process**

REMEMBER:

- Changes are an inevitable part of human society;
- Such changes create many uncertainties regarding the future;
- All valuations incorporate many uncertainties;
- These uncertainties should be recognized and dealt with in the valuation process.

Source: Adapted from FFSD (1989): p. 156.

# Chapter 6: CONCLUSIONS AND FUTURE DIRECTIONS

## 6.1 Conclusions

Effective economic valuation of the different goods and services that can be provided by a forest is a complicated and complex task. A sophisticated economic valuation exercise requires expertise from economics and other disciplines to provide /adequate assurance that valid conclusions can be drawn. The major problem of forestry valuation is not a lack of methodologies, many of which have been described here. Such methods have been widely applied in both developed and developing country contexts and their application does not seem to be a major constraint. However, these studies have tended to be academic exercises with no major practical application. There is little evidence to indicate that government planning offices or development agencies have successfully integrated study results into their decision-making processes except in cases where valuation has been applied to confirm decisions already taken.

One of the greatest challenges is therefore to produce valuation studies that will actually be used in the process of decision-making and that will contribute to better management of the forest resources. Otherwise, valuation will not help to overcome the great barrier posed by lack of political will in support of sustainable forest management. However, remember that economic values are just one, often small, input into the decision-making context. A forest valuation *per se* cannot assure that a forest will be better managed.

To summarize what has been discussed in this paper, several suggestions are presented below to help guide the preparation of forest valuations. These are not intended to be “rules” to be followed in all cases, but represent some aspects that should be considered during the process of valuation.

### 6.1.1 Define the decision to be made

- First ask why the valuation should be undertaken or if there is an adequate alternative basis for decision;

- Be sure that those who will make decisions are interested in valuation information and, if not, convince them of its importance before undertaking the exercise;

- Find out what questions valuation will help to answer, i.e. have a very clear statement of purpose; for example, which are the particular forest benefits that people demand?;

- Remember that valuation should not be used as a tool for advocating preconceived preferences;

- Remember that economic values are just one, often small, input into the decision-making context. Valuation is not the sole (or even necessarily the most critical) basis for decision-making. Many decisions are made on the basis of value judgements which are generally made by politicians and they do not necessarily rely on economic grounds.

### 6.1.2 Clarify the purpose of the valuation, its context and outputs

- Create an awareness of the need to look at more than financial flows, e.g. consider economic efficiency factors;

- Pay attention to benefits, but also consider costs, feasibility considerations and the claims of the most affected populations (usually local);

- Always consider who pays and who benefits from the proposed changes because there are always social implications; valuation should be done with the perspective from which it is carried out identified;

- Pay attention to the role that non-wood forest products (NWFPs) play in the life of the rural poor, since this may be important to a successful forestry project;

- In weighing various values or benefits, avoid the tendency to be influenced by the "flavour of the month" in popular opinion;

- Reduce the probability of analyst bias in the assumptions made by having a consultative mechanism among analysts and clients, including local people, before analysis goes too far.

### 6.1.3 Identify and determine the input and output information needs and constraints to meeting those needs

- Look at the size of project or programme being considered and scale the costs of valuation accordingly[49];

- Focus on getting data and information that is relevant to the valuation being done. Remember that there is a great difference between producing data and having it used. Data production is time-consuming and costly. An overload of data and information does not make decisions easier. On the contrary, it can contribute to making decisions more difficult;

- Remember that there are values that cannot be presented in monetary form but that are as important, or even more important, than those that can be put in monetary terms; thus, when a weight is assigned it should be a function of the importance of the good or service in the context of the valuation rather than only of its ability to be expressed in monetary form.

### 6.1.4 Choose and apply the valuation methods and techniques to meet the information needs

- Assess the capacity of local institutions and adapt techniques to them in terms of skills, data availability, etc.;

- Remember that the total economic value (TEV) of a forest is an ideal which cannot be reached. There is a question of compatibility among the different uses of the forest;

- Remember that people do not necessarily act according to their expressed opinions as to willingness to pay or willingness to accept.

### 6.1.5 Consider potential uncertainties in values

- Even if it is assumed that every remaining plant species has potential medicinal or other importance for mankind, remember that there is only a low probability of finding such "hits" and that there may be a long wait before the next such discovery whereas people have immediate survival needs;

[49] Given that valuation costs are incurred even before a project starts, they have high present value and therefore can carry relatively great weight in terms of project costs.

- Remember that estimating economic values does not ensure their being captured in practice;

- Recognize that markets for hitherto subsistence-based products may not exist beyond the purely local setting or, if they exist, that (i) they may be limited in scope, (ii) their production may be unstable and cyclical, (iii) costs of research and development before full market acceptance may be high or even prohibitive, and (iv) there may be losses in the processing and storage or trading chain. Do not underestimate the costs of commercializing such products which may result in very low or even negative gains;

- Consider what damages to the forest may result from increasing the production of, for example, non-wood forest products from a subsistence to a commercial level.

## 6.2 Future directions

From what has been discussed so far, it becomes clear that the subject of forestry valuation has received a lot of attention. However, there is little evidence to suggest that results of these studies have been widely used by government planning offices or by decision-makers. This suggests some points that need to be addressed in order to transform forestry valuation into an effective tool in formulating forestry development policy.

a. Forest valuation studies have been carried out in the context of both developed and developing countries. This suggests that there are no major problems in applying the theory or techniques available. However, most of these studies appear to be quite academic and it is not clear in the literature how they are being used, or even if they have been used in an actual decision-making context. The great challenge, then, is not so much how to carry out new studies, but:

    i. to know why these studies have not been used in the decision-making context;

    ii. once this has been understood, to effect the changes necessary to make them useful to the decision-making context;

    iii. to apply them to concrete problems in order to contribute to forestry development policy or to practical action;

iv. to find ways to capture these values.

b. During its second meeting in Geneva in March 1996, the UN Commission on Sustainable Development's Intergovernmental Panel on Forests pointed out that the complexity and costs involved in forestry valuation techniques and methodologies might limit their widespread application: it suggested that innovative and simple scientific valuation methods were needed. Experience also shows that exercises attempted to date demand too much in terms of skills, time and money; they are still too complex. Their results are not necessarily better than if more simplified ways were found. Within this context, another set of challenges deserves attention, namely:

    i. to develop simpler and less costly approaches that will better meet the needs of decision-makers, managers and administrators as well as provide them with information that is relevant, timely, accurate and usable;

ii. to develop methods that are less time-consuming because time constraints demand immediate decisions. This is in recognition of the fact that orders of magnitude rather than fine-tuned numbers are often what is needed. To be imprecise but have the correct objective can be better than to be precise about the wrong objective;

iii. major attention should be given to determining the biophysical production functions, such as how much of any specified products or services could be yielded over what time and in return for what inputs. From the professional/technical viewpoint, it is essential to develop a knowledge base of how much and which non-market goods and services are produced by forests. At present, productivity coefficients are available only for timber. There is little or nothing on wild fruits, carbon capture efficiency and carbon release indices of ecosystems, wildlife, latexes/gums, medicinal plants (or the seasonality and periodicity of their useful products), carrying capacity of ecotourism sites, probability levels of discovering "miracle cure" species and so on. Until this information exists, valuation will remain dependent on guesswork and can easily be manipulated for advocacy.

c. One reason valuation results may have failed to influence decisions is their lack of credibility when, for example, estimated values are unrealistically high or vary according to analyst or when many prove impossible to capture. To interest policy-makers in valuation, ways must be found to capture the benefits identified; practical instruments are needed to convert potential benefits into real ones. A priority is to find ways for carbon sequestration and biological diversity (which have the two highest values among forest goods and services) to yield practical benefits for those who conserve forests. At present, the benefits of outputs such as carbon sequestration and biological diversity are ascribed mainly to a vague "international community" without a clear indication of its willingness to pay.

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# ANNEXES[A]

## 1. THE VALUES, BENEFITS AND COSTS TO CONSIDER IN FOREST VALUATION

## 2. EXAMPLES OF RECENT ESTIMATES OF FOREST VALUES

## 3. ESTIMATES OF ECONOMIC VALUES OF FOREST BENEFITS

[A] Details of the papers cited in annex 1 are published in the bibliography that precedes this annex. Papers cited in annexes 2 and 3 are listed at the end of each annex.

# ANNEX 1 : THE VALUES, BENEFITS AND COSTS TO CONSIDER IN FOREST VALUATION

## A1.1 General scheme of values, benefits and costs

The functions of forests and the benefits derived from them were summarized in box 1 in the introduction; they are the origin of forest values. In the process of capturing these values, "penalties" are incurred, often in the form of opportunity costs arising from missed opportunities to use resources in a different way. Table A1.1 summarizes examples of forest benefits, values and associated costs.

It has become conventional wisdom that forests (particularly the tropical ones) are much more than a stock of wood and that the lack of proper valuation of non-timber goods and services has encouraged a perception that forests have low value and so has contributed to deforestation in favour of more "valuable" land uses. Interest has come to focus on goods and services other than wood provided by a forest, e.g. non-wood forest products (NWFPs), habitat conservation and biological diversity, carbon sequestration for reducing global warming and existence values which leave options for future use open.

Valuation exercises need to take into account at least the most important of the values in table A1.1. To illustrate the process, this section will provide suggestions under the following products or functions: commercial timber stands, non-wood forest products, recreation, watershed, carbon sequestration, habitat protection and biological diversity, and option and existence values, selected from among the sources of value in the scheme of Table A1.1 (see also box 1 in Chapter 1).

## A1.2 Valuation of marketed goods and services: the case of commercial timber stands

*Using market prices at face value*

The treatment of commercial/industrial market goods in this document focuses not on valuation by straightforward use of market prices, which is a simple exercise, but on techniques where alternative ways have to be adopted. Market prices also exist for certain services, such as ecotourism: for these, as for market goods, it can be fairly easy to work out the demand at given prices and so to calculate overall value derivable.

In many countries forests are largely or even exclusively under public ownership and the exercise of a more rewarding control over the utilization of forest resources has become a major concern. The term "forest fees" is used to designate all payments which the grantee has to make to the owner for the rights to remove and utilize the wood in a specific forest area and for the purchase of that wood. These fees include area fee, forest fees for specific purposes and stumpage fee. The latter, by far the most important of forest fees, is the price at which the forest owner sells the raw material to the grantee. Forest fees do not include transport taxes, export duties on sawnwood or logs, and duties on imported machinery and equipment which are not levied specially for the granted rights (Schmithüsen, 1977).

The stumpage fee can be determined by a unilateral act of the forest owner setting out a fixed schedule of fees, by public auction or tender or by individual negotiations between the parties (Schmithüsen, 1977). "Stumpage appraisal" is commonly understood to cover the estimation of the unit residual value to a prospective purchaser of standing timber, as derived from the prices and costs of log prices or of production of processed products[A1.1].

[A1.1] For a more detailed discussion on determination of forest fees and forest revenue systems, see, for example, Schmithüsen (1977) and Gray (1983).

**Table A1.1. Values associated with forest contributions to human welfare.**

| A. USE VALUES, of which: | | POTENTIAL BENEFITS | POTENTIAL COSTS |
|---|---|---|---|
| *A.1* | *Values derived from consumptive uses* | | |
| A.1.1 | Commercial/industrial market goods | - fuel, timber, pulpwood, poles, fruits, animals, fodder, medicines, etc.<br>- jobs<br>- economic growth<br>- foreign currency | - biodiversity losses;<br>- pollution;<br>- release of carbon (fire, use of firewood);<br>- forest degradation if not properly managed, through physical disturbance during logging and removal of nutrients in the harvest. |
| A.1.2 | Indigenous non-market goods and services | - fuel, animals, skins, poles, fruits, nuts, medicinal plants, etc.<br>- food security;<br>-medicinal plants;<br>- utility material (poles, etc.);<br>- can contribute to reduce rural-urban migration. | - in some cases, may exclude any other commercial use;<br>- may have losses of revenue, particularly foreign currency, because of no management of the forest;<br>- tourists may commercialize local subsistence products and price them beyond local people's purchasing power. |
| *A.2* | *Values derived from non-consumptive uses* | | |
| A.2.1 | Recreation | - jungle cruises, wildlife photography, trekking, etc.<br>- tourist revenues including employment;<br>- economic growth;<br>- rural development. | - this can bypass local people;<br>- tours and other recreation activities may restrict access and use to local people;<br>- tourists may commercialize local subsistence products and price them beyond local people's purchasing power. |
| A.2.2 | Science/education | - forest studies of various kinds;<br>- scientific advance;<br>- local employment;<br>- may contribute to a better use/management of the forest. | - as above. |
| **B. USE VALUES, of which:** | | **POTENTIAL BENEFITS** | **POTENTIAL COSTS** |
| B.1 | Watershed protection | - stabilization of water supplies;<br>- protection of downstream areas;<br>- slowing down dam sedimentation;<br>- reduction of flooding; | - may restrict or even exclude any other commercial use;<br>- losses of revenue, including foreign currency, because of no management of forest;<br>- in some cases, can deny the use of the forest by local people. |

*Table A1.1 continues*

**Table A1.1** *continued***.**

| B. USE VALUES, of which: | | POTENTIAL BENEFITS | POTENTIAL COSTS |
|---|---|---|---|
| B.2 | Soil improvement | | |
| B.2.1 | Soil protection, fertility improvements | - maintenance of soil fertility (especially important in tropical regions); | - may reduce space for agricultural crops and livestock expansion. |
| B.2.2 | Soil productivity on converted forest land | - space and soil productivity for agricultural/horticultural crops and livestock; | - may lose productivity;<br>- deforestation;<br>- forest degradation. |
| B.3 | Gas exchange and carbon storage | - improvement of air quality ($CO_2/0_2$ exchange);<br>- reduction of greenhouse gases (especially carbon dioxide); | - may impose restrictions or even exclude use of the forest, including local people's use;<br>- may impose opportunity costs on forest's users, including local people. |
| B.4 | Habitat and protection of biological diversity and species | - potential drug sources, source of germplasm for agricultural crops and so on. | - may restrict or exclude the use of the forest, including local people's use;<br>- may impose opportunity costs on forest's users, including local people. |
| B.5 | Aesthetic, cultural and spiritual values | | |
| **C. NON-USE VALUES, of which:** | | **POTENTIAL BENEFITS** | **POTENTIAL COSTS** |
| C.1 | Option value | - people may value the option to use a forest in the future, or merely the option to have it available in the future. Although such values are difficult to measure in economic terms, they should be recognized in valuing the contributions of forests to human welfare;<br>- can contribute to conservation and preservation of forests; | - most of them are opportunity costs of non-use. |
| C.2 | Existence value | - people may value a forest or resource complex purely for its existence and without any intention to directly use the resource in the future. This includes intrinsic value;<br>- can contribute to conservation and preservation of forests. | - as above |

Source: Adapted from Gregersen et al. (1995).

Notes:
- The above table presents only some examples of potential benefits and costs. The reader is expected to go further and think about others;
- Any of the above values can be considered at different levels, e.g. individual forest, watershed catchment, country, regional, global.

*Using shadow prices*

A second example of less straightforward valuation applied to market goods is to cover cases (and there are many) where market prices are distorted and shadow prices have to be used as proxies. Derivation procedures for such shadow prices are well documented in the literature on project evaluation: e.g., Little and Mirrlees (1974); Squire and van der Tak (1975); Gregersen and Contreras (1979); Gittinger (1982); Gregersen and Contreras (1992); Gregersen et al. (1993). Many of these procedures are of general application but can be adapted to commercial forest products[A1.2].

As a rule of thumb, Gregersen and Contreras (1992: p. 79) suggest that the development of shadow prices is usually required for:

- Anything imported or exported (anything that involves the expenditure of foreign exchange, especially if the exchange rate is artificially pegged);

- Anything subsidized or bearing fixed prices (any good or service to be used in the project that is currently subsidized, such as the production and sale of seedlings in nurseries);

- Labour, if there is chronic unemployment or underemployment in the country.

However, in deciding to use market or shadow pricing, the analyst generally is faced with time and budget constraints. Not every input and output will be shadow priced. The choice has to be made between using a rough “guesstimate” of an appropriate shadow price or using the market price, even though it is recognized to be a less than perfect measure of economic analysis. This choice requires the analyst’s expertise and experience.

Forestry is characterized by many indirect effects (externalities or non-market priced effects) for which it is difficult, if not impossible, to establish a value and consequently to develop an acceptable shadow price (e.g. in valuing scenic beauty, spiritual and cultural values). In such cases it can be suggested that the analyst describe the effects in physical and/or qualitative terms and suggest how they are likely to affect the project outcome and its impact on society.

Table A1.2 illustrates a very simple case of shadow pricing calculation as a proxy value based on substitution. Suppose that in a specified region animal dung and crop residues are used as fuel in the absence of the fuelwood. Assume further that if they were incorporated into the soil they could contribute to an increase in the value of agricultural crops because of their properties as soil builders and fertilizers. Thus, the net value of the increase in crop output or the value of crop losses avoided can provide a measure of the benefits of establishing a fuelwood plantation. The fuelwood would be an indirect substitute for fertilizer and soil builders, and this value is determined by the value of these resources when they are released and available for agricultural production.

[A1.2] Shadow pricing requires expertise and experience and its estimation can be complex. If it is not properly done it can easily lead to distortions. In such cases the use of market prices may be more useful. Shadow pricing is also discussed in section 4.3.1.2.

## A1.3 Valuation of non-market direct use goods: the case of non-wood forest products

Among the direct consumptive uses of forests, many products do not enter the market: of these, many are non-wood forest products (NWFPs), which are used here as an example of other non-marketed forest products[A1.3].

**Table A1.2. - Derivation of shadow price for fuelwood substituting for crop residues[a]**

| | |
|---|---|
| **Basic Information:** | |
| Crop residues removed per ha/year | 2 tonnes |
| Corn crop value increase per ha/year if residues are left on fields | $20 |
| Heating value of 2 tonnes crop residues | 376,000 kilocalories (kcal) |
| Heating value, 1 $m^3$ of project fuelwood | 188,000 kcal |
| **Calculation of fuelwood shadow price:** | |
| Heating value of 1$m^3$ of project fuelwood | heating value of 1 tonne of crop residues |
| Corn crop value increase due to 1 tonne of crop residue | $20 ÷ 2 = $10 |
| **Value of 1 $m^3$ of fuelwood** | **$10** |

Source: Gregersen and Contreras (1992): p. 84.
Notes a Hypothetical example.

### A1.3.1 Elements of non-wood forest product values

Valuation of NWFPs has received great attention[A1.4]. Many attempts have been made to fully value non-marketed forest products, especially NWFPs. Extraction and increased trade of NWFPs has been advocated as an alternative to timber-focused utilization, on the grounds that it could be pursued without causing tropical deforestation. Consequently, NWFPs are thought capable of playing a constructive role in forest conservation and development[A1.5]. However, this assumes that their harvesting, even at commercial level, would have little or no adverse ecological impact on a forest. This can be questioned. The impact on the forest ecosystem of an increase in harvesting NWFPs is unknown (Gunatilake et al., 1993; Peters, 1994). Lescuyer (1996) argues that the establishment of monetary value for each NWFP leads to a change in the modes of use of the resource which, in turn, can cause or accelerate a process of restrictive appropriation of these resources.

NWFPs are a source of income, medicines and foods. Edible NWFPs, including fruits, nuts and game, are a major and accessible source of vitamins, minerals, proteins, carbohydrates and fats. For forest-dependent people, they may be the principal source of dietary intake. According to Roche (1986), over 1500 species of wild uncultivated plants are used by local people in the tropics as leafy vegetables. In Nigeria, studies have shown that there are about 150 species of woody plants used by local people for a variety of nutritional purposes (Roche, 1986). Gentry and Blaney (1990) report that in Iquitos, Peru, 139 out of 193 forest fruit trees are used locally and at least one-tenth of the diet of the *campesino* is derived from wild fruit. Jacobs (1982), quoted in Myers (1990), reports that Peninsular Malaysia's forests contain at least 1250 non-timber plant species (roughly one in six of all

[A1.3] There is no agreed definition of non-timber forest products (NTFPs); some organizations, e.g. FAO, prefer "non-wood forest products" (NWFPs) so that fuelwood, charcoal and other forms of non-processed wood are not included. Non-marketed products, including many NWFPs, fall into the category of direct consumptive use. For recent work, see, for example, Lampietti and Dixon (1994, 1995) and Wibe (1994). NWFPs are defined by some to mean non-timber forest resource, such as fuelwood, fodder, edible fruit, nut, oil seed, medicine, latex or gum. Fuelwood is included by some among NTFPs, in which case it and fodder are likely to be the two most heavily exploited NWFPs. Fauna, also considered as an NTFP, is also a very important activity for many people. For the lowland forests of Southeast Asia, it has been estimated that one out of every six species found produces an NWFP (Peters, 1994).

[A1.4] See, for example, Lindal (1994).

[A1.5] See Myers (1983, 1988), Godoy and Feaw (1989), Nepstad and Schwartzman (1992).

species present) of use to humans. Lescuyer (1996) reports that in a short study carried out in Gouté (East Cameroon) more than 500 forest products were listed, not including game. So, when local people have their access to collect NWFPs denied, for example, by the establishment of a park or a reserve, they are the ones who bear the costs while the benefits are shared at global level.

Other examples of the importance of the forest to local people are provided in Clay (1988), Shukla et al. (1990), Berkes and Folke (1992), Appasamy (1993) and Ganesan (1993). Medicines and fauna are among those NWFPs that deserve attention but are better covered within the context of habitat and biological diversity conservation (section A1.7). Fauna is a major source of protein for human consumption in many parts of the world (De Vos, 1977). Wildlife-based tourism can also be a major source of value-addition to forests.

The existence of NWFPs is perceived by many experts as essential for household food security, specially during drought periods when other foods are scarce (Chambers, 1981; Falconer and Arnold, 1989; Tacconi, 1995; Lescuyer, 1996). Kanel (1990) felt that under such conditions, the value-in-use, i.e. the true benefits brought to resource users, is much greater than the value-in-exchange, i.e. market value. Bettencourt (1992) suggested that, since only a small proportion of the products consumed are traded in the market, any full valuation that relies on prices and quantities found at the market level (value-in-exchange) will underestimate the true economic value of the resource. The argument of Grut (1987) is that, because the marketable and easily quantifiable benefits of forests are sometimes only the tip of the iceberg, the market is a poor guide in this sector.

### A1.3.2 Basis for assessing realistic values of non-wood forest products

NWFPs should be valued on the basis of sound estimation of demand and supply potential[A1.6]. Factors to consider include: whether there is a market and the possibility that markets fail to materialize; whether an increase in income might lead to growth or decline in consumption of NWFPs (Bishop and Eaton, 1996); and whether the yield of the NWFP is sufficient to cope with a shift from a subsistence to a commercial harvest level; and what might be the effects to the forest in the case of such a shift. The analyst should bear in mind such factors and seek assurance that they can be satisfactorily answered as far as current knowledge allows, otherwise it is difficult to put defensible values on NWFPs.

Contrary to correct professional practice, which should be to use conservative estimates until better knowledge is available, analysts have tended to downplay supply constraints and to take an optimistic view of markets for even the most obscure NWFPs. Products that have hitherto been used or consumed only by local populations far from the main demand centres are assumed to be required in large quantities and to have the total production sold at full price.

Questions as to the size, geographical distribution and stability of the market for these products need to be answered. In most cases this market is locally restricted. According to Padoch (1987), utilization is often associated with traditions of only local significance, the pattern of which can be highly varied and complex. In many societies the harvesting of NWFPs can be understood not just as an economic, monetarized activity but as a much more socio-cultural activity (Lescuyer, 1996). Even within a single country the market potential for many valuable NWFPs may be only guessed. People living within the same country or even only a short distance apart may have different tastes for NWFPs. For example, Southgate and Clark (1993) mention failed attempts to “export” NWFPs within Peru from Iquitos to Lima. The valuation analyst should be wary of over-optimism in estimating likely future contribution of NWFPs. Many of these commodities have been in use for thousands of years and yet have not made a breakthrough in terms of market value; assumptions of radical change must be supported by very good reasons. It should also be remembered that the actions of other countries through international trade increasingly influence national commodity markets in ways that are difficult to predict.

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[A1.6] See, for example, Dewees and Scherr (1995) for a discussion on policies and markets for NWFPs.

On the supply side, it is often assumed (for reasons that are unclear) that storage and transport problems, even for perishable NWFPs, have been solved or can easily be solved. The possibility that production may vary considerably from season to season is not taken fully into account. Such assumptions need to be guarded against.

Economic, social, legal and other societal institutions will change over time in ways that are difficult to foresee. Hence, in the face of rapid socio-economic change, estimates of future market supply and demand for specific products are often highly uncertain.

Once the market and production aspects of NWFPs have been studied and monetary values estimated, the main additional aspect to consider is the value of their cultural significance. How is one to do this in monetary terms? In practice, all that may be possible is to strongly highlight this cultural aspect in qualitative terms, without attempting to place monetary values. This recognizes that the decision-maker can take account both quantitative and qualitative factors.

Often, it cannot be assumed that NWFPs will continue to give value in the long term. Lack of land and resource tenure and the need for immediate survival lead peasants or forest-dependent people to feel insecure and to have short time horizons. Consequently they prefer to realize the value of NTFPs in the short term rather than the more distant future.

#### A1.3.3 Benefits and costs

NWFPs are very important, not just in the rural economy, but also because they can represent food security for many poor rural people. In some instances, such as the Brazil nut, the NWFP can be a source of foreign currency and, consequently, contribute to the national economy. One of the costs that can be imposed on rural people that rely on NWFPs, including game, is when their access to the forest is denied, for example, because of the establishment of a reserve or park. Many people, even nations, have been faced by serious economic problems which lead them to need cash desperately. This, in turn, can lead to an increasing harvest of those NWFPs that have higher values, particularly those that can be sold on the international market. This can impose very high costs in terms of damage to the forest ecosystem.

#### A1.3.4 Constraints to realizing non-wood forest product benefits

The extraction of economically valuable NWFPs is an ancient practice. According to Padoch (1987), in Peru some NWFPs were being traded even before the founding of Iquitos in the 17th and 18th centuries; these included medicinal plants, e.g. copaiba (*Copaifera reticulata*), naval stores, e.g. copal (*Dacryodes* spp.), condiments, e.g. vanilla (*Vanilla planifolia*) and sarsaparilla (*Smilax* spp.). Since then, many other NWFPs have been exploited, traded and exported; many of these have, according to Homma (1992), passed through their expansion phase and have reached stagnation and decline. Natural rubber in Brazil is one example, lac in India is another. Substitutions both for NWFPs and timber have taken place: Indian lac was entirely displaced by synthetics in the manufacture of gramophone records and natural rubber by the plantation equivalent and by synthetics; in Britain the major oak timber industry was shattered when iron and steel replaced timber in shipbuilding.

Estimating the values associated with non-wood resources, particularly in tropical forests, is difficult because of the absence of market prices and because of insufficient knowledge of who are the beneficiaries and what are the benefits involved (Condon and White, 1994). For example, according to Emerton (1996), the use of Oldonyo Orok Forest, Kenya, is almost entirely for subsistence purposes and there has been virtually no commercial exploitation. There is no local market or price, and there are no close market substitutes for forest resources (Emerton, 1996). This suggests that a monetary economy plays little role in local production and consumption systems. Although throughout the world millions of people rely on NWFPs in their daily lives (Burgess, 1993), the use of many wild forest foods is not well documented and often not properly accounted for.

In spite of this, Gregersen (1982) concluded that non-market outputs (goods and services) from the tropical forest probably are not short-changed in development decisions because of the fact that they cannot be valued in monetary terms. If they are neglected, it is rather because they are considered relatively unimportant in a broader, often political, context. Another factor is the period over which reliable values can be derived for NWFPs. As stated earlier, lack of land and resource tenure and the need to survive lead forest-dependent people to feel insecure and hence prefer to realize the value of NWFPs in the short term. Thus, although exploring how to derive monetary measures of values for non-market outputs is an interesting and possibly productive task, it is not the most effective antidote to poor land use and rapid destructive deforestation.

The assumption that extraction of NWFPs does not disturb the forest as much as logging needs to be tested, particularly if harvesting rises above the subsistence needs of a sparse rural population. Indeed, there is evidence that even indigenous and/or local people may also deplete the forest. As with timber, many NWFPs can be harvested on a large scale to provide cash[A1.7].

Factors for consideration in the valuation of NWFPs or other non-marketed direct use goods are summarized in box A1.1.

## A1.4 Recreation values (non-consumptive direct use)

### A1.4.1 General considerations

Recreational services of the forest tend to be more valuable to urban people in affluent societies. Such services are unlikely to have the same appeal for poor people, even those living in urban areas of developing countries as they struggle to survive. For developing countries, particularly those endowed with luxurious tropical forests, the use of these forests for recreational purposes has been advocated mainly as income generator.

A forest used as a recreational area may help prevent the impoverishment of biological diversity. However, a recreational site does not necessarily mean an area of great biological diversity. In some circumstances an increase in diversity may even lead to impaired recreational experiences (Naskali, 1995).

### A1.4.2 Elements of recreation values

Use of the forest for recreational purposes was probably the first non-consumptive use of the forest to be advocated. As early as the 1950s recreation was of importance in the United States. Recently, along with the emergence of the environmentalist movement, the use of forest for recreation purposes as a way to save forests, particularly tropical ones, (with the advantage of being a possible income generator) has been highly publicized. The concept of “ecotourism” has become very popular.

Recreational activities are many and varied. They can include hunting for sport but, given major concern about the environment, greater emphasis has been put on recreational activities focused on hiking, camping, sightseeing and photography of scenic beauty, diverse wildlife populations, relative clean air, picnicking and so on. It is important to bear in mind that these values have a greater appeal for people in urban areas, particularly in industrialized countries, than to people who live in and/or rely on the forest for their survival.

A1.7 For further information, see, for example: Browder (1992); Salick (1992); Godoy and Bawa (1993); Hall and Bawa (1993), Lescuyer (1996).

**Box A1.1. - Considerations in valuation of non-marketed direct use goods such as non-wood forest products**

- It has been assumed that, unlike timber-focused utilization, extraction of non-wood forest products (NWFPs) does not damage the forest and instead has a constructive role in forest conservation and development. This assumption can be questioned on the basis, for example, that the impact on the forest ecosystem of a shift from subsistence to commercial harvesting of NWFPs is unknown. Evidence suggests that an increase in collection of NWFPs may lead to damage of the forest ecosystem in the same fashion as logging;

- The establishment of monetary value for each NWFP may lead to a change in the modes of use of the resource which, in turn, may cause or accelerate a process of restrictive appropriation of these resources, such as privatization of user's rights;

- For forest-dependent people, edible NWFPs may be an important source of dietary intake, and even a question of household food security, particularly during drought periods when other foods are scarce. Within this context, harvesting of NWFPs does not necessarily mean a monetary economy; on the contrary, it is primarily a subsistence economy and there is no local market or price for them;

- In many contexts the value-in-use of NWFPs, i.e. the true benefits brought to resource users, is much greater than the value-in-exchange, i.e. market value. So, a valuation that relies on prices and quantities found at the market level (value-in-exchange) can underestimate the true economic value of the resource. The marketable and easily quantifiable benefits of forests are sometimes only the tip of the iceberg. The market can be a poor guide in this sector;

- The potential supply and demand of many NWFPs is unknown; sometimes the market is only local or is short-lived. The possibility of markets failing to materialize should be considered. For example, an increase in people's income can lead to a decline in their consumption of some NWFPs (i.e. they may be "inferior goods" in economic terms, with negative income elasticity of demand);

- The yield of the NWFPs may be enough to cope with subsistence harvesting but not with commercial harvesting. Yields of NWFPs are unpredictable, by season or by other time period. Some forest species yield the desirable products on unpredictable time cycles;

- The extraction of economically valuable NWFPs is an ancient practice. However, many of them have passed through an expansion phase, reached stagnation and then declined. This may be attributable to substitution effects, among other things, or to passing fashions and tastes;

- Thus valuation of NWFPs deserves caution.

### A1.4.3 Basis for assessing recreation values

Statistics on the levels of the non-consumptive uses referred to above are generally incomplete or even non-existent. However, because of the emphasis that has been put on non-consumptive use of the forest, studies have been carried out to demonstrate the importance of recreational activities. The travel cost method (TCM) and contingent valuation method (CVM) have been widely used by these studies, in both developed and developing country contexts. However, it should be stressed that the estimated values do not have necessarily the same importance in both contexts.

### A1.4.4 Benefits and costs

Recreational activities have different environmental impacts. Activities such as camping, boating and fishing can be considered as activities with minor impacts whereas others, such as hunting and off-road vehicle travel, can be classified as activities with major impacts. This is not a fixed classification since any of these activities can have destructive effects on the environment if they take place in an uncontrolled way. Hence, the benefits and costs are a function of how these activities take place.

The benefits may be in terms of employment and income generation in rural areas, e.g. local tour guides. However, they may impose opportunity costs on local people if they have their access to the forest denied.

### A1.4.5 Constraints to realization of recreation values

Income generation has been assumed to be one of the major benefits of recreational activities. However, this should be taken into account with caution. There may be hidden revenues obtained from hotels, travel agents and retail economies. These revenues are not always generated within the country and therefore do not necessarily return to or remain within the country. As far as local people are concerned, it is likely that just a small proportion of the income generated accrues to them. In extreme situations, they have no gain at all and, on the contrary, may suffer losses if, for example, they have their access rights denied.

Revenues obtained from licences, permits and fees for permission to hunt for sport are not always channelled back to the appropriate recipient. In the United States, a significant proportion of revenues from licences and permits is channelled back to the local wildlife manager to improve habitats and hunting conditions. However, in countries such as Kenya, these revenues go to the central government and little money returns to the wildlife manager for conservation purposes (Ffolliott et al., 1995). Indeed, this is not surprising, given that any developing country exploits its natural resources such as forests in order to earn foreign currency which is expected to contribute to its economic growth as well as its balance of payments (Chowdhry, 1992). Points to consider in valuation of recreational services are summarized in box A1.2.

## A1.5 Watershed[A1.8] values (indirect use value)

### A1.5.1 General considerations

Watershed management should be viewed as multiple-use management involving the manipulation of natural, agricultural and human resources and taking into consideration social, economic and institutional factors operating within the boundaries of a watershed. Within this context, a wide range of forestry projects can contribute to watershed conservation. Therefore, the project does not necessary need to be focused only on watershed conservation. For example, a plantation established to produce fuelwood can also contribute to watershed conservation. Its effectiveness in contributing to watershed conservation will depend, among other things, on how this plantation is to be managed.

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[A1.8] For the purpose of this work watershed is understood as “a topographically delineated area that is drained by a stream system, i.e., the total land area that drains to some point on a stream or river. The watershed is a hydrologic unit that has been described and used as a physical-biological unit and a socio-economic-political unit for planning and management of natural resources” (Gregersen et al., 1987). A river basin is defined similarly, but is on a larger scale. Usually, watershed can also refer to the smaller upstream catchment that is part of a river basin (Ffolliott et al., 1995).

**Box A1.2. - Considerations in valuation of recreational services**

- Recreational services of the forest tend to be more valuable and have a greater appeal to urban people, particularly in affluent societies, whereas forest-dependent people will have a different scale of values;

- Recreation may benefit foreign tourists more than local people;

- A forest used as a recreational area may prevent the impoverishment of biological diversity. However, a recreational site does not necessarily mean an area of great biological diversity. An increase in diversity may even lead to impaired recreational experiences;

- Too many visitors can damage a forest. The income must then be offset against the value of damage (i.e., the cost of repair);

- Use of the forest for recreational purposes (often termed "ecotourism") has become very popular and has been assumed to be a way to save forests, particularly tropical ones, with the advantage of being able to be an income generator. However, if a forest is put aside for recreational purposes and local people are denied their access to it, this constitutes an opportunity cost to them and should be considered as such;

- Recreational activities include hunting for sport, but more emphasis has been put on hiking, camping and so on. Such pursuits can have different impacts on the forests: for example, camping, boating and fishing can be considered as activities with minor impacts whereas hunting and off-road vehicle travel can be classified as activities with major impacts. This is not a fixed classification: any of the negative impacts will depend on how the activities take place;

- Statistics on recreation, particularly in developing countries, are incomplete or non-existent. The travel cost method (TCM) and contingent valuation method (CVM) have been widely used to estimate recreational values. In many instances, values from one area or country have been extrapolated to another to produce estimated values. The estimated values do not necessarily have the same importance in different contexts, e.g. tourists and local people will have different perceptions and, consequently, entirely different figures will be reached;

- Income generation has been assumed to be one of the major benefits of recreational activities. However, this should be taken into account with caution. There can be hidden revenues for hotels, travel agents and so on that are not always paid for within the country; the income is made abroad and does not necessarily return to the country with the forests;

- Revenues obtained from licences, permits and fees to visit or to hunt for sport are not always channelled back to the local manager to promote improvements in the area. These revenues often go to the central government and only a small proportion returns to the recreation area concerned.

### A1.5.2 Elements of watershed values

Watershed conservation has been advocated on the basis of its contribution to conserve soil and water, thereby yielding local, national and transnational benefits. Deforestation has been assumed to impose externalities on watersheds: (i) increased soil erosion entailing on-site and off-site sedimentation costs; (ii) accelerated water run-off leading to localized flooding; and (iii) reduced hydrological cycling and recharge of groundwater and water courses (CSERGE, 1993).

However, it is not just deforestation that may have negative effects on a watershed. Contrary to a common belief, afforestation with exotic species may also contribute to a decrease in stream flow. An example of this is the case study from South African *fynbos* ecosystems presented by Van Wilgen et al. (1996). Unfortunately, hydrological benefits from forest preservation are not yet fully understood (Chomitz and Kumari, 1996).

#### A1.5.3 Basis for assessing watershed values

The costs of mitigation or reparation of damages have been used as a basis for assessing watershed values. They provide a first-order surrogate measure to estimate the value of protective forest functions. Note that such estimates are site specific.

#### A1.5.4 Benefits and costs

The benefits and costs of watershed conservation are not perceived equally. For example, the interests of upland inhabitants may not coincide with those of downstream communities. The cost of erosion may be largely external to watershed inhabitants. A separate political jurisdiction in the upper watershed may not find it advantageous to cooperate in a project that largely benefits downstream areas: different watershed management alternatives determine the share of costs and benefits for each locality.

Throughout the world watersheds are being overgrazed and farmed to such an extent that acute erosion and sedimentation has taken place. This, in turn, imposes high costs in irrigation, hydroelectric power generation and provision of water catchment for domestic use. Thus, implementation of a variety of land use practices, such as terracing and afforestation, may bring benefits.

#### A1.5.5 Constraints to realization of watershed values

There are various constraints to the realization of watershed values. Three are discussed briefly to illustrate the subject.

One is of a political nature since political boundaries and landholdings seldom coincide with watershed boundaries. However, the physical world has little respect for political boundaries and so inappropriate upstream land use practices cause devastation downstream regardless of the political boundaries. Nevertheless, because political jurisdictions effect change, it is advisable to plan and act in terms of such political boundaries.

A second sort of constraint is related to lack of knowledge of the many events that occur in a watershed, for instance, the timing of sedimentation. In most valuation studies it is assumed that sedimentation will be reduced in the first year after watershed forestry interventions take place, and that benefits occur in the near future. That means their net present value (NPV) becomes significant. However, many soil stabilization benefits take place only after many years, if not decades. Thus, the NPV can become small or even negligible (Chomitz and Kumari, 1996). Also not fully understood are the biophysical impacts of tropical deforestation on water yield (Aylward et al. 1995). Flood events are more likely to be closely linked to major climatic and geomorphic factors than to land use *per se*.

The third constraint recognizes that many of the derived benefits cannot be readily priced in the marketplace. Watershed conservation may result in outputs that cannot be directly valued. Others can be estimated indirectly, e.g. crop increases made possible by erosion prevention. Given this characteristic, watershed conservation is generally one of the components of other projects with a more direct production orientation, e.g. a fuelwood production project.

One of the greatest challenges that developing countries face is how government and farmers can agree on better land use in the watersheds, i.e. where there is not only less erosion but also a balance between sufficient income going to farmers and a government's need for foreign exchange earnings. These points are summarized in box A1.3.

## A1.6 Carbon sequestration values (indirect use value)

Trees are of relatively large size and the life span of most trees is longer than that of other vegetation types. Forests are able to store from 20 to 100 times more carbon per unit area than croplands. Therefore, they can play a crucial role in regulating the level of atmospheric carbon (Ciesla, 1995). The relationship of climate change (one of today's leading environmental concerns) to the conservation and development of the world's forests has become a major issue. The issue is a complex one and continues to be a matter of more uncertainty than certainty.

Efforts have been made to value forests as a source of carbon storage and for their contribution to carbon sequestration[A1.9]. Some of the highest value estimates given for forests in recent years have been for such services. For example, Kumari (1995b) estimated the TEV of the flow of benefits under a range of management options for the peat swamp forests of North Selangor in Malaysia. The results of this study are summarized in table 4 (section 2.7.2). What is notable in this study is that timber, for which Malaysia is best known, was valued in the base option (A) at only M$2,149/ha which corresponds to 21.3 percent of the TEV, whereas carbon sequestration accounted for M$7,080/ha and 69.2 percent respectively. Under the other management options, timber value even became negative while that of carbon became increasingly dominant.

The question to be asked is whether the threat of global warming and the efficacy of forests as an antidote to it are such as to justify carbon storage becoming the single most important value of a tropical (or any other) forest. Other studies have been concerned with estimating the capacity of the forest to storage carbon. An example of three such studies carried out in Mexico is summarized in table A1.2.

[A1.9] See, for example, Faeth and Livernash (1994), Sedjo et al. (1995) and Trexler and Haugen (1995).

**Box A1.3. - Considerations in valuation of watershed values**

- Watershed management should be viewed as multiple-use management involving the manipulation of natural, agricultural and human resources, and taking into consideration social, economic and institutional factors operating within the boundaries of a watershed;

- A wide range of forestry projects can contribute to watershed conservation, e.g. a plantation established to produce fuelwood can also contribute to watershed conservation. Its effectiveness in contributing will depend, among other things, on how this forest is to be managed;

- Hydrological benefits from forest preservation are not yet fully understood. Evidence suggests that afforestation with some exotic species may decrease stream flow rather than assist in water availability;

- Biophysical impacts of deforestation on water yield are not yet fully understood. Some authors argue that flood or avalanche events, for example, are more likely to be closely linked to major climatic and geomorphic factors than to land use *per se*;

- The benefits and costs of watershed conservation are not perceived equally by all interest groups. For example, interests of upland inhabitants may not coincide (or may even conflict) with those of downstream communities. Hence, the share of costs and benefits is different for each group and estimated values will depend on which perspective is taken;

- Any intervention in a watershed can affect people who are separated geographically. For example, the costs of erosion may be largely external to watershed inhabitants or the costs may be both in the watershed (topsoil/fertility loss) and downstream (siltation of dams);

- Political boundaries and landholdings do not necessarily coincide with watershed boundaries. Inappropriate upstream land use practices can cause devastation downstream regardless of the political boundaries. However, it is advisable to plan and act in terms of the political context;

- Many events that occur in a watershed are not fully understood, for instance the speed with which forests give sedimentation control benefits. It has sometimes been assumed that sedimentation will be reduced in the first year after watershed forestry interventions have taken place and that benefits occur in the near future. Evidence is that soil stabilization benefits take place only after many years, if not decades. This has implications in the calculation of the net present value (NPV);

- Many derived benefits from watershed management cannot be readily priced in the marketplace whereas others can be estimated only indirectly, e.g. crop increases made possible by erosion prevention. Given these characteristics, watershed conservation is generally one of the components of other projects with a more direct production orientation, e.g. a fuelwood production project.

**Table A1.2 - Carbon storage estimates for forest and non-forest land uses in Mexico**

| Land use | Masera et al. (1992) Total above ground biomass (t C/ha) | Masera et al. (1992) Soil and below ground biomass (t C/ha) | Houghton et al. (1991) Total above ground biomass (t C/ha) | Houghton et al. (1991) Soil and below ground biomass (t C/ha) | Brown (1992) Total above ground biomass (t C/ha) | Brown (1992) Soil and below ground biomass (t C/ha) |
|---|---|---|---|---|---|---|
| Temperate coniferous | 56.0 | 109.1 | 168.0 | 134-231 | - | - |
| Temperate broadleaved | 39.0 | 29.5 | 100.0 | 111-134 | - | - |
| Tropical evergreen | 144.0 | 66.0 | 82-200 | 98-104 | - | - |
| Tropical deciduous | 67.5 | 29.5 | 85-140 | 98-104 | - | - |
| Pasture | - | - | 10 | 42-63 | 5 | 41-75 |
| Agriculture | - | - | 10 | 42-63 | 5-10 | 51-60 |

Source: CSERGE (1993): table A.3.2, p. 77 (annex 3).

Note: Biomass and soil carbon figures reported are averaged for all tropics (Brown) and for Latin America (Houghton et al.).

Full references for the three studies may be found in CSERGE (1993).

### A1.6.1 Elements of carbon sequestration values

Changes in the earth's temperature and associated changes in climate are not because of a single factor, but have complex causes which can be classified, according to related factors, in the following categories: (i) astronomical; (ii) geological; (iii) oceanic; (iv) land surface; and (v) atmospheric (Ciesla, 1995). The United Nations Framework Convention on Climate Change calls on its parties to reduce their sources and strengthen their "sinks" of greenhouse gases[A1.10]. There has been considerable recent discussion on the fact that the global carbon cycle is out of balance and that this could make rapid global climate change more likely. The Intergovernmental Panel on Climate Change (IPCC), the Convention's scientific adviser, has specifically identified forestry and other land-use-based mitigation measures as possible sources and sinks of greenhouse gases. The role of forests in the global carbon cycle is to act as a sink as well as a stock of carbon (although the size of the sink in unclear). It is also noteworthy that climax forests are carbon reservoirs but not necessarily net carbon sinks: in these forests there is an equilibrium between the amount of carbon released through decay of dead and diseased tree and the carbon absorbed.

The forest's sink function occurs mainly during its growing stage. Carbon is released upon clearing and burning. It is assumed that the world's forests store 90 percent of all carbon accumulated in terrestrial vegetation. As such, they should be an important variable in the global carbon cycle, although the specific effects of forests on the global climate are not fully understood. The tropics have been suggested as able to provide clear opportunities for mitigating climate change through

[A1.10] Greenhouse gases (GHGs) or radiatively important gases (RIGs) include water vapour ($H_2O$), carbon monoxide (CO); carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), nitrogen oxides ($NO_x$); tropospheric ozone ($O_3$) and chlorofluorocarbons (CFCs). These gases absorb and radiate long-wave thermal radiation so that the net outgoing radiation is reduced. This effect causes the global warming which is known as the "greenhouse effect". Scientists have designated $CO_2$ the benchmark GHG against which the properties of all other GHGs are measured (Ciesla, 1995). For more details on the diverse links between atmosphere and vegetation in an example focusing on the Brazilian Amazon, see Shuttleworth and Nobre (1992) and, for a more general discussion, Ciesla (1995) and Apps and Price (1996).

forestry (Bekkering, 1992). An example is found in the carbon offset deals which are generally private- and public-sector joint ventures which have as their aim to sequester an amount of $CO_2$ equivalent to that emitted. For example, in the Netherlands in 1990 the state electricity generating board (SEP) established a non-profit-making enterprise (FACE, Forests Absorbing Carbon Dioxide Emissions) which aims to sequester an amount of $CO_2$ equivalent to that emitted by one 600 MW power station. To do so requires an estimated forest area of some 150,000 hectares divided into 5000 ha in the Netherlands, 20,000 ha in central Europe and 125,000 ha in tropical countries. At the end of 1993 the total area increased to 180,000 ha with the additional area being in tropical countries. The total cost has been estimated at US$112.17 million. Another example is the New England Power Company's investment in carbon sequestration in Sabah, Malaysia, through the reduction of carbon waste from inefficient logging activities. This company estimated that some 300,000 to 600,000 tonnes of carbon (C) will be offset at a cost of below $2/t C (Steele and Pearce, 1996)[A1.11]. However, forests alone cannot be expected to be the definitive answer to the problem of carbon sequestration. Many other measures should be taken to reduce emission of carbon into the atmosphere.

### A1.6.2 Basis for assessing carbon sequestration

Tropical forestry programmes undertaken with carbon sequestration as their aim must be integrated into the social, environmental and economic contexts of the countries in which they are located. There are several methods available to estimate the carbon storage in forests (and hence the fluxes involved in the loss of forests), for example, extrapolation from experimental plots and modelling from inventory data. These different approaches usually arrive at different figures: even similar methods can supply different values. This can be attributed to data availability and collection, assumptions, categorization of forests and so on. An example of these differences is summarized in table A1.2[A1.12].

It is important that the analyst take into account that there are factors such as forest age, intended utilization or use of fire which are likely to affect the balance between the tendency for the forest to sink and/or store carbon as opposed to releasing it.

### A1.6.3 Benefits and costs

As mentioned, valuation of forest resources is incomplete, particularly in respect of assessing the scale and distribution of costs and benefits. Some services provided by the forest, such as carbon sequestration, can be awarded values that are very high, even exceeding those of the standing timber. However, most of the benefits are higher at the international level than at national level. Local people are those who bear the greatest costs since, generally, they have their access to the forest denied.

Costs of implementing tropical forestry measures to mitigate global climate change can be high. One of the greatest challenges is to establish who will pay for this environmental value either within or outside the country.

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A1.11 For other examples see table A3.6B in annex 3.

A1.12 Efforts have also been made to estimate a monetary value for a tonne of carbon emission into the atmosphere. One example of such was a colloquium carried out in December 1995 at the Federation of American Scientists (FAS) in Washington, D.C., to review the present state of knowledge about climate change. The participants (World Bank representatives, scientists and economists) agreed that a "shadow price" of $10-20 a tonne of carbon emissions was a reasonable estimate of potential damage from climate change. As a practical exercise, the World Bank agreed to undertake a backdating study, applying a cost range centred on a $20/tonne figure to a selected portfolio of greenhouse-gases-intensive projects. This exercise should be completed by early 1997. It is interesting to note that the Intergovernmental Panel on Climate Change (IPCC) did not endorse any particular range of values for the marginal damage of $CO_2$ emissions. In the literature estimate values range from $5 to $125 per tonne of carbon emitted (Feinstein, 1996).

Many benefits of the forest, such as carbon sequestration, can be higher at global level than at national level. This is so where "valuation by itself is of little interest to the country owning the environmental assets, although valuation illuminates the scale of economic distortions due to undervaluation" (CSERGE, 1993: p. 1). Under such conditions of unfair distribution of costs to the poor and benefits to the wealthy[A1.13], valuation could have the role of providing a rational basis for estimating the level of adequate international transfer payments to compensate those countries that are conserving forests beyond their own needs for the sake of global gain.

### A1.6.4 Constraints to realization of carbon sequestration values

One of the major constraints to the realization of carbon sequestration values is the fact that carbon cycling falls outside national borders, so there is little interest to a country owning environmental assets unless it can capture at least part of this global value. Definition of a compensation mechanism is a very difficult task. Thus, notwithstanding the very high values being calculated for carbon sequestration, it does not seem to be "realistic to boost tropical forestry for the sake of sequestering carbon dioxide alone and [it is] preferred that the fixation of carbon be a positive side-effect with the focus to be on other, more direct, benefits whereas the fixation of carbon should be seen as a positive side-effect" (Bekkering, 1992: p. 414).

One of the great challenges is to seek ways to capture the environmental values of services such as carbon sequestration. Economically, the values that accrue to the international community as a free good should be captured by the country where the forest is located. Different forms of payment have been suggested. For example, the Climate Change Convention allows private companies or foreign countries to fund forestry projects to enhance carbon sequestration in order to offset their own emissions.  Points to consider in the valuation of carbon sequestration are summarized in box A1.4.

## A1.7 Habitat protection and biological diversity (indirect use values)

### A1.7.1 Elements of habitat protection and biological diversity values

Biological diversity is the variety and variability of all animals, plants and micro-organisms on earth. Forests are probably the most important terrestrial ecosystem for conservation of this variability. Tropical forests, in particular, are a source of genetic material so rich that it is not yet fully known; their importance has been highly publicized. Two major interests can be noted with respect to conservation of biological diversity. One is associated with ecosystems and species in natural and modified habitats. The other is related to genetic diversity among species of current economic use, particularly in agriculture (World Bank, 1995). Within the latter context, not only may species of flora and fauna become a source of new drugs with great market potential but also forest genes may be used to enhance resistance to disease, drought, salinity etc. or to enhance productivity or other desirable traits of farm stock: thus, forests can help provide an insurance cover for agriculture[A1.14].

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A1.13 Carbon sequestration by forests would, like any other sink mechanism, most demonstrably benefit countries that contribute disproportionately to $CO_2$ emissions, such as the industrialized countries.

A1.14 For more details, see, for example, Tisdell (1990), Ehrlich and Ehrlich (1992), Munasinghe (1992), Nelson and Serafin (1992), Perrings et al. (1992), Brown (1994) and Kumari (1995a).

**Box A1.4. - Considerations in valuation of carbon sequestration**

- Trees have relatively large sizes and their life span is longer than that of other vegetation types. Hence, forests are able to store 20-100 times more carbon per unit area than croplands. The relationship of climate change to the conservation and development of the world's forests has become a major issue, although the issue is complex and a matter of more uncertainty than certainty. The precise effects forests have on the global climate are not fully understood;

- Forests can sequester carbon or act as a sink or store. Given the great concern about climate change, carbon sequestration has become the single most important value of a forest. However, how to capture this value is not clear nor the scale and distribution of costs and benefits. Many benefits are likely to be higher at global level rather than national level. The size of the sink is also unclear;

- The management or use of a forest does not necessarily release carbon into the atmosphere. Factors such as forest age, intended utilization or use of fire are likely to affect the balance between the tendency for the forest to sink and/or store carbon as opposed to releasing it. Young forests are more efficient at capture whereas a fully mature forest or a forest in climax may store more carbon but is unlikely to trap any more;

- Forests alone cannot be expected to be the definitive answer to carbon sequestration. Many other measures should be taken to reduce emission of carbon into the atmosphere;

- Estimated values have ranged from $5 to $125/tonne carbon, but recently a "shadow price" of $10-20 per tonne of carbon emissions has been generally accepted as a reasonable estimate of potential damage from climate change;

- Like watershed functions, the carbon cycle does not respect political boundaries: indeed, its benefits may be greater outside national ones. This has political implications. Those who release most carbon (e.g. industrialized countries) may therefore be the interest group that puts the most value on carbon sequestration functions;

- Forestry management and development may focus on more direct benefits whereas the fixation of carbon should be seen as a positive side-effect. Remember that some analysts have given very high values to it, even exceeding those of timber. Be moderate.

CSERGE (1993) reports that some 250 plant species are used as sources of drugs in western medicine with approximately 120 pharmaceuticals being based on plant materials. Over a quarter of all United States prescription drugs are reportedly plant-based. The annual value in 1985 of purchased drugs was US$18 billion. The CSERGE report states further that a "blockbuster" drug developed from plant derivatives may have an annual world-wide value in the region of US$1 billion[A1.15]. The possibility of finding "blockbuster" drugs has been the basis for great value being given to biological diversity. This assumption has raised questions of what is the value of tropical forests as sources of plant-based pharmaceuticals given their high biological diversity. The impression is sometimes given that finding plants of critical medical value is an easy task, especially in tropical forests.

[A1.15] The agreement between Merck and Instituto Nacional de Biodiversidad (INBIO from Costa Rica has been highly publicized as an example of the benefits of conserving biological diversity.

Forest habitat conservation is also important for the world's wildlife[A1.16]. Certain varieties of this wildlife, particularly the major mammals and bird life, are attractive for tourists and have become the mainstay of commercial tourism, particularly in savannah Africa. In certain countries of that region tourist revenues are among the top three sources of foreign exchange. It is assumed that multiplier effects of this industry, including rural employment and enterprise-based income, will take place and contribute to social stability. These effects. in turn, are expected to trickle down throughout the society[A1.17]. Evidence from the literature on development does not suggest that the trickle-down effect takes place.

### A1.7.2 Basis for assessing habitat protection and biological diversity values

Although a matter of consensus that the conservation of biological diversity can assist in protecting critical life support functions, there is divergence regarding its economic value[A1.18]. Biological diversity valuation is a matter of great debate. Studies have often provided only partial values, for example, by considering hypothetical benefits to spatially dispersed potential beneficiaries rather than considering important economic impacts that may have only regional importance, as in studies on the northern spotted owl in the Pacific Northwest region of the United States (Chappelle, 1993). Similarly, emphasis has been put on creating parks and reserves in developing countries in order to contribute to hypothetical global benefits regardless of local people's needs. Usually this is done based on assumptions that are unrealistic, abstract and alien to local conditions. Protection of the environment cannot be viewed in isolation, but must contribute to the advancement of human development.

#### *A1.7.2.1 An ecotourism perspective*

Forest habitats and biological diversity are the key attractions in ecotourism: given the particular interest of industrialized countries in these aspects, analysts are often tempted to survey only or mostly people from developed countries even when they are operating in developing countries. For example, many studies on recreation and ecotourism which have been carried out in developing countries have been based on CVM or TCM which may rely on interviews mostly with foreign tourists from wealthier countries. This tends to inflate the values estimated. Munasinghe (1993c) expressed concern that, if conflicting claims to park access were to be determined purely on a WTP basis, residents, especially the poor local villagers, were likely to be excluded.

#### *A1.7.2.2 A "blockbuster" drug?*

The analyst needs to exercise judgement regarding the likelihood of many species of the tropical forests being the source of new drugs to combat major illnesses. The likelihood of such a discovery is a matter of statistical probability; it is speculative, both as to the likelihood itself and as to how soon. According to Principe (1991)[A1.19], the probability of a given plant species giving rise to a successful drug is estimated at between 1 in 1000 and 1 in 10,000. Moreover, from the initial research to the final result can take up to 10 years. Mendelsohn and Balick (1995) illustrate how complex is this question of using the potential value of undiscovered drugs as a strong argument to conserve tropical forests: (i) experiences with large samples of botanical tests suggest that only between one in 50,000 and one in a million tests result in viable commercial drugs; (ii) the whole process of drug development in the United States from its start up to Federal Drug Administration approval for sale can take from 9 to 12 years; (iii) the average successful drug costs about US$125 million to find and develop. Also of relevance are recent developments in the pharmaceutical industry, e.g. biotechnology.

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A1.16 See, for example, Kumari (1996) for a discussion on incremental cost of changing forestry practices to protect rhinoceros in North Selangor peat swamps forests in Malaysia.

A1.17 The trickle-down effect was advocated largely in the economic development theory of the 1950s and 1960s. However, this assumption has been challenged in the literature on development.

A1.18 For an example of valuing genetic resources for plant breeding, see Evenson (1996).

A1.19 Quoted in Pearce and Moran (1994).

For developing countries, struggling to meet their basic needs, it is difficult to have a long-term perspective. What is the opportunity cost for a country or for the people in keeping an area preserved waiting for such a discovery and who is going to pay for them not to use the forest in the meantime?

From the valuation viewpoint, having assessed the probability of a "blockbuster" discovery, the potential of forest plants as a source of new drugs should then be analysed with as much caution as for other NWFPs, avoiding undue euphoria about global potential. Global market considerations should not lead to ignoring the social importance of plants at the local or national level. The analyst should give full weight to the fact that many plants have an important role as, for example, the only medicines accessible to local people[A1.20]. However, since this "market" is composed largely of the poor, monetary values may not exist or may be drastically reduced if calculated through proxy techniques.

"Who gets what" is a particularly important issue in considering the value of habitat and biological diversity conservation. For example, there is no guarantee that the discovery of a new drug will necessarily mean a contribution to the well-being of either the country of origin or of local people. It can be argued that this is a political rather than a valuation issue. However, it is relevant also to valuation since a deliberate choice has to be made as to whose perspective and what level of value assessment will prevail in the analysis.

McNeeley (1992) notes that farmers (and consumers) in Europe benefit when India conserves wild relatives of rice, or the many pharmaceuticals that have been derived from Ayurvedic medicine. The wealthy nations may therefore earn a considerable consumer surplus when India conserves a natural area containing a high degree of biological diversity. The question is whether India's own gain from the option and bequest values justify the conservation efforts and costs it has to shoulder. This argument can be extended to other developing countries when they are encouraged to conserve their natural forest resources.

A second illustration is Madagascar where the *Rosy periwinkle* grows naturally and now provides a drug for curing childhood leukaemia. Children have been saved and millions of dollars have been made from this discovery. It has been widely used to illustrate the importance of biological diversity conservation. The question that arises is what are the actual benefits to Madagascar and to its people? According to Schiøtz (1989), the answer is none at all. Schiøtz argues further that it "is even unlikely that the drug itself is available to the poor peasants of Madagascar, should they need it"[A1.21]. So, why should Madagascar preserve the *Rosy periwinkle*? In this example, an analyst carrying out a valuation from Madagascar's perspective could reasonably report a low value for the *Rosy periwinkle* until this country, where such a valuable plant is located, can capture a fair part of the benefits.

### A1.7.3 Benefits and costs

In the case of developing countries, calls for the conservation of the tropical forests imply that specific developing countries should carry the management costs necessary to satisfy people, mainly in developed countries, for whom costs will occur only if and when species become extinct or ecosystems disappear. Upon creation of protected areas to conserve habitats and biological diversity, the problem arises over poor incentives to encourage local people to sustain the protected areas. Local-level benefits from the national parks and reserves are often low and can even be negative if, for example, local people are denied access to the area (Gadgil, 1993; Michael, 1995). In other words, "the opportunity costs of modern conservation programs which restrict access to resources are falling disproportionately upon the very communities that development projects are designed to assist" (McNeely, 1992: p. 126).

A1.20 For more details on the use of plants not only as a source of medicine but also for many other purposes, as well as resource management by local people in the Amazon basin, see, for example, Posey and Balée (eds, 1989); Nepstad and Schwartzman (eds, 1992) and Balée (1994). For other regions, see, for example, Basnet (1992) on Nepal.

A1.21 Schiøtz (1989): p. 454.

A study in Sri Lanka, for example, points out that "those villagers living around forests that were recently declared to be National Heritage Wilderness areas are the most affected, because all forms of extractive use in such areas are strictly prohibited" (Gunatilleke et al., 1993: p. 284). Another example: "the virtual extinction of the Ik people who were dispossessed with the establishment of Kidepo National Park in Uganda is only the most extreme illustration of this problem" (McNeely, 1993: p. 144).

Rural people who live closest to areas with greatest biological diversity are often the most disadvantaged and the farthest from the global cash economy: they are profoundly affected by such developments without being able to capture any gains. Evidence suggests that distribution of the costs and benefits of habitat and biological diversity conservation, in low-income countries at least, may be inversely related to the distance from the forest. The local people pay the most and gain the least while the global community pays the least and gains the most. For example, the change in land use because of the new national park in Madagascar, although "economically efficient, since the potential for compensation exists, it will aggravate poverty where compensation is absent or inadequate" (Bishop and Eaton, 1996). Hence, evidence suggests that distribution of the benefits and costs of biological diversity conservation have opposite directions, i.e. the benefits increase from the local to the global level whereas the costs follow an opposite trend (Wells, 1992). Within such a context, it is unlikely that local people would have a major incentive for habitat protection (Besong, 1992).

#### A1.7.4 Constraints to realization of habitat protection and biological diversity values

Biological diversity has gained in popularity and the need to conserve it is much advocated. Possibly because of this, Panayotou (1994) has observed a "tendency in the developed countries to view tropical biodiversity as a global resource, and the host country as both a beneficiary and a custodian of this resource on behalf of humanity". Panayotou feels that the conservation benefits to the host country tend to be exaggerated because of failure to recognize differences in technology, preferences and discount rates at different levels of development. In spite of being endowed with biological resources, developing tropical countries lack the capacity to capture the benefits and so fully realize the value for themselves.

In some developing countries a fast-growing demand for farmland because of population increase and the low productivity of agriculture makes it difficult for large areas to be set aside as protected areas. As early as 1977, Leslie (1977) asserted that forest reservation "on a large scale without commercial utilization or conversion to agriculture simply to preserve them [forests] as a major ecosystem, is hardly a serious option". A "hands-off" approach is neither practical nor necessary. The establishment of parks and reserves can be considered part of the solution to biological diversity conservation which should be complemented by production forests to be managed to supply goods and services needed by either the local population or the country (Vanclay, 1992; Earl, 1992).

As stated earlier, if protected areas to conserve habitats and biological diversity are created, the problem arises of poor incentives to encourage local people to sustain them. The establishment of buffer zones and a major participation of local people in biological conservation has been suggested (Wells and Brandon, 1993).

Although biodiversity conservation can contribute to sustainable use of natural resources, unregulated biodiversity prospecting (such as drug development) may cause resource depletion. For example, Oldfield (1984)[A1.22] reports that an entire population of *Maytenus buchananni*, source of the anti-cancer compound maytansine, was destroyed when the United States National Cancer Institute harvested 27,215 kg in Kenya for testing in its drug development programme.

[A1.22] Quoted in CSERGE (1993).

**Box A1.5. - Considerations in valuation of habitat protection and biological diversity**

- Forests, particularly the tropical ones, are a source of genetic material so rich that it is not yet fully known although its importance has been highly publicized;

- Two major interests can be noted in biological diversity conservation: (i) associated with ecosystems and species in natural and modified habitats, (ii) associated with genetic diversity among species of current economic use, particularly in agriculture;

- Many species of the flora and fauna may be a potential source of new drugs with social and economic implications. However, recent developments in the pharmaceutical industry, e.g. biotechnology, may lead to a decreasing interest in the development of new botanical products. Also, once discovered, a drug is often produced in plantations or synthesized. In the long term, therefore, the value of the discovery tends to decrease;

- Forest genes can be used to enhance resistance to disease, drought, salinity etc. or to enhance productivity or any other desirable traits of farm stock;

- Although forests can, indeed, store species of flora and fauna with potential pharmaceutical value as well as serve as a genetic bank, these are only potentials. Such a discovery is not an easy task: it is costly, time-consuming and obeys the laws of probability;

- Following discovery, research and development costs to produce commercial pharmaceuticals from a plant are often high and can reduce net value drastically;

- Creation of national parks and/or reserves can impose opportunity costs on local people who have their access to the area denied;

- It is of crucial importance to take into account who gets what in considering the value of habitat and biological diversity conservation;

- In selecting the perspective from which to value, consider that of a country carrying out habitat protection and biological diversity conservation, where the opportunity costs of modern conservation programmes which restrict access to resources may fall disproportionately upon the very communities that such programmes are designed to assist;

- Evidence suggests that the conservation benefits to the host country tend to be exaggerated because of the assumption that it has the capacity to capture the benefits and so fully realize the value for itself. Instead, very often it lacks the technology and, despite being endowed with biological resources, it lacks the capacity to gain from them.

Notwithstanding the increasing demand for “natural products”, which should boost the pharmaceutical industry’s interest in research on plants, recent developments in biotechnology put at risk the potential use of plant-derived drugs[A1.23]. Pearce and Moran (1994) refer to work done by Principe (1989) which suggests that “the pharmaceutical companies have shown a decreasing interest in the development of new botanical products ... processing plant genetic material is time-consuming and expensive”. Randall (1991) argues that the emerging technologies of bioengineering may not necessarily enhance the value of naturally occurring genetic material and could yield substitutes

[A1.23] Panayotou and Ashton (1992); Pearce and Moran (1994).

instead. Winpenny (1992) goes further to argue that "given the trend towards the production of synthetic drugs, pharmaceutical firms might only offer low 'bids'". Furthermore, once the active principle of the natural product is known, it is likely that there will be a shift towards having it synthetically produced. Points to consider in valuation of habitat protection and biological diversity are summarized in box A1.5.

## A1.8 Option and existence values[A1.24]

The origin of existence value can be traced to John Krutilla who in 1967 proposed that economists should not just assign values to goods and services that are directly consumed, but should also attribute a value to the knowledge that a particular wilderness, endangered species or other object in nature exists (Nelson, 1996). Option and existence values of forests relate primarily to non-use values and to the role that forests play in the global context. The option value reflects the value of the environment as a potential source of benefit, in the future, as opposed to actual present use value. Existence value is the satisfaction people obtain from an amenity for various reasons other than their expected personal use. According to Chopra (1993): "option values become significant when accelerated deforestation begins to deplete forest resources. Existence value measures the value of forests as carbon sinks, and as preservers of biodiversity."

Apart from expectations of drug discovery and genetic pools for agriculture, biological diversity conservation has been advocated mainly on the basis of its existence value. The way to value it has been through assessing how much people are willing to pay to ensure that an area continues to exist undisturbed regardless of whether or not people are going to make use of or even visit that area. Van Wilgen et al. (1996) contend, however, that "existence values are becoming increasingly difficult to quantify and to defend, particularly in developing countries, where basic human needs and economic growth are the overriding concerns."

McNeely (1992) suggests that many of the benefits earned from existence values "are being earned by 'free riders', who obtain them without having to pay the costs involved". The free riders may be national or international. One author has suggested, for example, that conserving the tiger in India is of much greater importance to comfortable urban dwellers than to the local people who lose livestock or even family members to tigers. Similar problems face small farmers in Africa. In Mozambique, for example, because of the semi-arid conditions of the country, farmers grow their crops close to or along the rivers. Thus, they can have their entire crop destroyed by elephants and rhinoceros when they go to drink water. This was shown in a survey carried out by Nhantumbo in 1994/95 within and surrounding the Maputo Reserve located in the Maputo Province (pers. comm.).

### A1.8.1 Elements of option and existence values

Option and existence values refer to fundamental issues of the value of life for its own sake and to the importance of keeping options open for the future. What are these options for the future? Economic and socio-cultural factors influence people's perception of the importance of forests. These factors in turn interact with and are related to a great diversity of needs and concerns. This suggests that there are no universally accepted option and existence values. It is likely that indigenous people who live in the forest have a much stronger perception of option and existence values because the forest resources can mean their own survival. However, these are values to which it is almost impossible to assign a monetary value. They are inherent to the forest and to what it represents for these people. Within this context, even if a monetary value could be placed, it is unlikely that normal rules of time discounting would apply to option and existence values.

[A1.24] Besides existence and option values, other classifications of non-use values of the forest have been proposed in the literature: e.g. quasi-option value, bequest value, vicarious value, scientific values, scenic values, genetic value, stewardship value, altruistic value, on-site value, off-site value, preservation value.

### A1.8.2 Basis for assessing option and existence values

Although widely used, the concept of existence value has been the focus of criticism by some economists who argue that it is inconsistent with accepted economic theory and in practice will often yield implausible results (Nelson, 1996). These values can be controversial and their valuation a challenging task, particularly in a developing country context. This is so because most of these countries are faced by major problems such as large foreign debts, population growth, poverty and resource degradation which, in turn, set in motion a downward spiral of even greater poverty and greater environmental degradation. In such a situation, it is unlikely that they can take a long-term view. Moral and equity considerations are also very important for this type of value.

### A1.8.3 Benefits and costs

As in the case of carbon sequestration and biological conservation, many of the benefits of existence value go to people who do not pay the costs involved. As stated earlier, conserving the tiger in India or elephant in Africa is of much greater importance to distant urban dwellers than to the local who suffers loss of crops, stock or human life.

### A1.8.4 Constraints to realization of option and existence values

As mentioned, measurement of option and existence values is a challenging task, particularly in a developing country context where arguments based on option and existence values are unlikely to sway decision-makers of these countries. The values are unlikely to be substantiated by quantitative proofs that economic benefits may be forthcoming in the short term. These points are summarized in box A1.6.

**Box A1.6. - Considerations in valuation of option and existence values**

- They are abstract values. Economic and socio-cultural factors influence people's perception of the importance of the forest and interact with a great diversity of needs and concerns. This suggests that there is no single option or existence value;

- They are difficult to quantify. Values can be controversial and valuing them a challenging task. (For example, what is the meaning of an option or existence value of a forest when this value is the result of a survey carried out in another region or even in another country?)

- Given the problems faced by most developing countries and the lack of quantitative proofs that economic benefits may be forthcoming in the short term, it is unlikely that arguments based on option and existence values would influence their decision-makers.

- Many values are inherent to the forest and to what it represents for different people. So it is difficult to place monetary values as well as unlikely that normal rules of time discounting would apply to option and existence values;

- The concept of existence values has been criticized by some authors who argue that it is inconsistent with accepted economic theory and in practice will often yield implausible results;

- In all situations, seek the value perception of a wide range of interest groups before presenting an estimate.

# ANNEX 2 - EXAMPLES OF RECENT ESTIMATES OF FOREST VALUES[A2.1]

## A2.1 Example No. 1

**Title:** Barbier, E. B., 1993. Sustainable use of wetlands. Valuing tropical wetlands benefits: Economic methodologies and applications. *The Geographical Journal 159(1)* (March): 22-32.

**Country:** America Central (Guatemala and Nicaragua), Nigeria and Indonesia

**Agency:**

**Description:**

Preliminary applications in Central America (Guatemala and Nicaragua) suggest the importance of ranking wetland characteristics and distinguishing between direct use values, indirect use values and non-use values (Barbier, 1989 (quoted in Barbier, 1993)).

A further application in a study of a Nigerian flood plain, carried out in the early 1990s (Barbier et al., 1991 (quoted in Barbier, 1993)), shows how calculation of a few direct use values alone — for agriculture, fuelwood and fishing — demonstrates that wetland benefits are significant, particularly when contrasted with the benefits from irrigation projects that are diverting water away from the flood plain. The analysis shows that sustainable use of the flood plain can yield substantial economic returns to local inhabitants, and these benefits should not be excluded as an opportunity cost of any scheme that diverts water away from the wetland system.

Finally, an economic analysis of the mangrove wetlands of Bintuni Bay, Irian Jaya, Indonesia (Ruitenbeek, 1991 (quoted in Barbier, 1993)), also carried out in the early 1990s, illustrates how the degree of "environmental linkages" between the components of the system are critical in determining the extent to which the mangrove forest can be exploited for woodchip production.

**Valuation method(s) used:**

The choice of appropriate valuation technique(s) is critical to the assessment of costs and benefits. The assessment required can be grouped in three broad categories, each one corresponding to the type of policy decision concerning wetland use that needs evaluating. According to Barbier (1993) these categories are:

- impact analysis: an assessment of the damages inflicted on the wetland from a specific environmental impact (e.g. oil spills);

- partial valuation: an assessment of alternative resource allocations or project options involving wetland systems or resources (e.g. whether to divert water from the wetlands for other uses, or to convert/develop part of the wetlands at the expense of other uses). An example is the analysis of Hadejia-Jama'are flood plain, Nigeria, where its economic importance was assessed (and thus the opportunity cost to Nigeria of its loss) by estimating some of the key direct use values the flood plain provides to local populations through crop production, fuelwood and fishing.

[A2.1] The bulk of information in these examples, including tables, has been directly quoted from the source.

- total valuation: an assessment of the total economic value of the wetland system (e.g. for national income accounting or to determine its worth as a protected area). This can be illustrated with the economic analysis of the mangrove wetlands of Bintuni Bay, Irian Jaya, Indonesia. The economic analysis compared different forest management options for their effects on the total economic value of the mangrove wetlands. The forestry options ranged from clear-cutting of the mangrove forest for woodchip production through selective cutting regimes of various intensities to a cutting ban.

**Outcome:**

In the case of the Hadejia-Jama'are flood plain the economic analysis indicates that the benefits were substantial on both a per hectare basis and a water input basis. This suggests that the benefits it provides cannot be excluded as an opportunity cost of any scheme that diverts water away from the flood plain system. The present value of the aggregate stream of agricultural, fishing and fuelwood benefits was estimated to be around N850 to N1280 per hectare, or around N240 to N370 per $10^3$ $m^3$ of water ("maximum" flood inputs). (In 1989/90 prices, 7.5 Nigerian Naira [N] = US$1).

Given that there is still considerable uncertainty over the dynamics of the mangrove ecosystem, and that alteration and conversion may be irreversible and exhibit high economic costs, the analysis suggests that there is little economic advantage to cutting significant amounts of the mangrove area in the Bintuni Bay wetlands. Under a scenario of linear but delayed linkages of five years, selective cutting of the mangroves has a present value (in Indonesian rupiah) of Rp70 billion greater than the clear-cutting option, and only Rp3 billion greater than the cutting ban option. Even if weak interactions exist, an 80 percent selective cutting policy with replanting is preferable to clear-cutting. (In 1991, approximately 2.95 Rp = US$1).

**Comments:**

Barbier's paper discusses three different cases that have in common the aim of valuation of tropical wetland benefits. Despite the common aim, a different approach was used in each country taking into account the context. This reinforces the importance that must be given to the context in a valuation. It is also important to bear in mind that "the basic methodology for assessing and valuing the economic benefits of tropical wetlands is relatively straightforward, but difficult to apply because of data and resource constraints". The paper also suggests that "there is still considerable uncertainty over the dynamics of the mangrove ecosystem, and that alteration and conversion may be irreversible and exhibit high economic costs". It is fair to assume that this assertion is not restricted to mangrove ecosystems but can be extended to other ecosystems.

## A2.1 Example No. 2

**Title:** Centre for Social and Economic Research on the Global Environment (CSERGE). 1993. Mexico forestry and conservation sector review: Sub-study of economic valuation of forests. Report to the World Bank: Latin America and the Caribbean. Country Department II (LA2). November 1993.

**Country:** Mexico

**Agency:** The World Bank

**Description:**

This study identifies and quantifies in monetary terms the environmental values associated with forest conservation and management. These environmental values typically are not captured by private decision-makers and are not considered in their production decisions. The study was carried out in 1993.

The study generates estimates for representative forests of the following environmental values:

i. Option and existence values of biodiversity:
   potential value of genetic resources for pharmaceuticals
   existence value: review of studies
   existence value: implicit prices from conservation funding;

ii. Use values:
   tourism and recreational values of protected and non-protected areas
   non-timber forest products;

iii. Functional values:
   carbon sequestration and storage
   watershed protection.

The products also include analysis of mechanisms for capturing global values and for providing local incentives for conservation of those environmental values.

**Valuation method(s) used:**

The values associated with forests are greater than their timber values. They include other direct uses of forests, indirect or functional services of forests, and option and existence values maintaining forests for future generations. These are elements of total economic value (TEV). Total economic value is a concept used to express the different components of value of an environmental resource. This is necessary in the case of a forest (with its characteristics as a public good) because the price of such assets generally do not reflect their full value to society. Practical applications of TEV are few because of problems of non-additivity of the elements and of quantification. A comprehensive approach would be difficult in practice (CSERGE, 1993).

A summary of the methodologies used for estimating the value of each one of the categories covered in the report is presented below. However, a detailed description, including additional calculations to provide a national picture, can be found in annexes 1-6 of the CSERGE report.

*Tourism*. The original data were generated by a visitor survey carried out in the Barranca del Cobre (Copper Canyon) 24-26 May 1993. The questionnaire consisted of 13 questions divided in two groups and was available both in English and in Spanish. The first group of questions was designed to elicit the visitor's travel cost pattern (travel cost method, TVM). The purpose of these questions was to construct a demand function for visits to Barranca del Cobre, which could be used to estimate consumer surplus. The second set of questions employed the contingent valuation method (CVM). It was intended to elicit respondents' willingness to pay (WTP) for conserving the forest area. Respondents were also invited to allocate their stated WTP to four distinct value categories, roughly corresponding to: (i) use value related to forest recreation, (ii) use value related to enjoyment of cultural diversity, (iii) option value and (iv) existence value.

Because of lack of available data, some inferences were made to provide an order of magnitude for the overall economic importance of the ecotourism sector. Multipurpose tourism data were estimated on the basis of a survey for the study in Barranca del Cobre.

*Non-timber forest products (NTFPs)*[A2.2]. The assessment of the use value of NTFPs is complicated by the large numbers of different products and their uses. The main problem concerning the evaluation of the use value of NTFPs is the lack of accessible and quantified data. For the CSERGE report, data were compiled from, first, available national production figures and then from a range of indicative values of various NTFPs that were collated from ethnobotanical studies, a variety of referenced sources and anecdotal sources.

*Carbon.* The values for the carbon sequestration benefits of forest conservation and of plantation forestry were estimated in a two-stage process:

(1) the carbon sequestration and storage was estimated through physical models of forest type and land use change;

(2) studies on the valuation of this carbon sequestration in terms of global warming damage avoided were reviewed.

*Watershed protection.* The values were estimated for soil erosion and the off-site costs of erosion. Sedimentation costs are described and examples of them given. These costs were assumed to provide a surrogate value for the forest protection function.

*Option value of pharmaceuticals.* The methodology used in this study to estimate this value was adapted from a model used by Pearce and Puroshothaman (1992)[A2.3] and calibrated for Mexico. This model estimates option values as a function of the number of species at risk, the number of drugs based

[A2.2] NTFPs are not the same as NWFPs - the former may include important wood products such as fuelwood and charcoal according to some definitions.

[A2.3] Pearce, D.W. and Puroshthaman, S. 1992. Protecting Biological Diversity: the economic value of medicinal plants. London, Norwich: CSERGE.

on plant species, and the number of hectares likely to support medicinal plants (taken to be total area of tropical forest). The basic formula, which expresses the value on a per hectare basis, is then:

$$V_p(L) = \{N.p.r.a.V/n\}/H \text{ per annum}$$

where:

| | | |
|---|---|---|
| $V_p(L)$ | = | The pharmaceutical value of a ha of forest (US$/ha) |
| N | = | The number of plant species in forests |
| p | = | The probability of a "hit" |
| r | = | The royalty rate |
| a | = | The appropriation rate, or rent capture |
| V/n | = | The average value of drugs developed (US$ per year) |
| H | = | The area of forest (ha). |

These components and their empirical magnitudes are discussed in detail in annex 5 of the CSERGE report.

*Existence Value.* The existence value is discussed in this study in terms of:

- Evidence concerning existence value in the United States and other Organization for Economic Cooperation and Development (OECD) countries;
- Measuring implicit existence value from "Debt-for-Nature" Swaps (methodology and evidence);
- Conservation easements and franchise agreements as instruments to capture existence value;
- Property rights attenuation such as through franchise agreements and conservation easements.

**Outcomes:**

Results of the empirical estimated values of elements of TEV of Mexican forests are shown in the table A2.1.

**Table A2.1. - Estimated values of elements of total economic value (TEV) of Mexican forests**

| | Area (million ha) | Tourism | NTFPs ($/ha/year) | Carbon ($/ha/year) | Watershed protection | Option value ($/ha/year) | Existence value |
|---|---|---|---|---|---|---|---|
| Tropical evergreen | 9.7 | | 330 | 100 | | 6.4 | |
| Tropical deciduous | 16.1 | | | 56 | | | |
| Temperate coniferous | 16.9 | | | 103 | | | |
| Temperate deciduous | 8.8 | | 330 | 20 | | | |
| Total area | 51.5 | | | | | | |
| **Total value** ($ million/year) | | **32.1** | n/a | **3788.3** | **2.3** | **331.7** | **60.2** |

Source: CSERGE (1993).

In general, conservative estimates have been presented. These values have global elements of which Mexico may be able to capture a proportion.

By adding the non-priced benefits of ecotourism and the potential priced benefits of multipurpose tourism, the total benefits of tourism ranged from $30.6 million to $33.6 million per year. Ecotourism was characterized by a low number of visits and high willingness to pay whereas multipurpose tourism showed an opposite pattern, i.e. a higher number of visits but a lower price paid per visit. For two recorded ecotourist destinations (El Tiunfo, Chiapas, and Sian Ka'an, Quintana Roo) the number of recorded visitors was 150-500 per year and the price paid for the recreational experience $17-$500. Corresponding figures for the multipurpose tourism are 12,000-55,000 and $1-$8.

Ethnobotanical studies indicate that over 2000 plant species from Mexico's forests are utilized. These range from internationally traded products such as resins, turpentine and pitch from pine forests and chicle from the chicle forests in the Yucatan, to a multiplicity of medicinal plants and wild foods utilized at a subsistence level. Their benefits may be significant in forest management decisions. Te'lom intensive management, for example, can produce $330/ha/year value added. Important forest products include chicle, medicines and building materials. The report's data are intended to provide some indicative figures for actual use values as well as to illustrate the complex nature of the use of NTFPs. The report goes further to argue that "the most important conclusion of this study is that the lack of quantitative and comparable data severely hampers attempts to estimate the use value of NTFPs from Mexico's forests". However, despite the lack of data, the study highlights the importance of NTFPs both in subsistence use and also for income generation. It also lists the major obstacles to maximizing and capturing the value of NTFPs:

- a critical lack of accurate data at both national and local level;
- a licensing/permit system that stifles exploitation of NTFPs, forces trade into the "contraband" sector and makes collection of accurate information difficult;
- that local collectors and gatherers, who are also the primary managers of the resource, capture only a small proportion of the value because of international trading and marketing;
- the danger of over-exploitation of valuable species because of lack of well defined property rights.

The carbon sequestration function of forests provides large global benefits. A range of capital carbon value from $650 to $3,400 per ha is estimated (shown in table A2.1 as an annual value of $20-$100/ha/year). This functional value alone is greater than typical land values in tropical forest areas in many parts of the world.

Watershed protection is estimated at $2.3 million per year from sedimentation costs alone. Other functions such as watershed regulation and infrastructure damage would expand this lower bound figure. Although this is lower than other values, it is a highly localized problem. The study concluded that the most significant off-site damages from forest conversion are sedimentation costs and alterations to hydrological balances.

The option value of pharmaceuticals is estimated in the range from $26 million to $4,600 million, with a central estimate of $330 million presented in table A2.1. This value stems from the probability of discovering genetic material in the average hectare of forest which may yield billion-dollar benefits. The study concluded that the option value of pharmaceuticals developed from genetic material contained within Mexico's forests may well be large and may provide an incentive to conserve these resources. However, measures are needed to ensure that Mexico is able to capture a larger share of this value. Similar to those presented for NTFPs, the report lists the following obstacles to maximizing the option value of pharmaceuticals:

- the lack of information; the number of unknown and unscreened species;
- the loss of stock of biodiversity by the accelerated loss of species and habitat, coupled with the loss of indigenous technical knowledge, including folk taxonomy and plant use;
- the lack of clearly defined intellectual property rights. Lack of patent protection may stimulate local initiatives and the development of pharmaceutical-based industry, but it will mean that Mexico (as a country or as private firms and individuals) fails to capture much of value of any products developed;
- a lack of institutional capacity and R&D capacity adding to the failure to appropriate value.

**Table A2.2. - Policy recommendations to capture global value of Mexico's forests**

| **Value** | **Mechanisms** | **Property rights regime** | **Recommendation** |
|---|---|---|---|
| Carbon sequestration | International offsets, public and private | Potential donors desire local benefits and ease of enforcement. Intermediate management structures to deliver management plans and enforcement, such as through *ejidos* groups are necessary | Increasing future prospects for public and private capital for offsets. *Ejidos* groups have necessary institutional structure and should be encouraged to seek deals. Government involvement required for intergovernmental deals (GEF) |
| Option value of pharmaceuticals | Contracts, public and private, domestic and foreign institutions | The government should aim to increase appropriation, and also link any biodiversity conservation schemes with local-level development | Intellectual property rights require clarification so that Mexico can capture a greater share of profits of any products developed. Collaboration of public and private R&D institutions, and possible involvement of local communities (*ejidos*, communities, indigenous NGOs) in *in situ* conservation of genetic resources highly desirable |
| Tourism | Differential entrance fees for international & national visitors<br>Infrastructural investment<br>Community training | Communities and *ejidos* and private property | Identify areas with high ecotourism potential (many already exist). Investigate ejidal and communal structures and training needs; intermediaries to operate the structures. Investigate fee structure for protected areas with complementary countries in Central America |
| Existence value | Property right attenuation<br>Land purchase<br>Debt-for-Nature Swaps<br>Global transfers (GEF, NGOs) | Union of *ejidos* or communities<br>Private property | Investment potential with property right attenuation under new property laws<br>Identify GEF funding priorities and global incremental costs |

Notes: GEF = Global Environment Facility managed by the World Bank, UNEP and UNDP. NGO = non-governmental organization.

The existence value can be imputed from the willingness of international agencies to pay for conservation, or from direct survey responses. A value of $60 million is estimated for Mexico. Interpreting WTP for sustainable biodiversity use in “Debt-for-Nature Swaps”, this study estimated a value of $5/ha for Mexico.

**Comments:**

The CSERGE report once more emphasizes the importance of the context in which the valuation is being carried out. For example, it calls attention to the fact that watershed protection values appear relatively insignificant although these costs may be concentrated in specific areas and no account was taken of infrastructure costs. The complexity and difficulty of estimating the use value of NTFPs because of the lack of quantitative and comparable data makes clear the need for further research on NTFPs to properly estimate their value. Another point that deserves special attention is related to the question of “capturability” of these values. The report concludes that the size of these non-market values promised considerable returns (both to private decision-makers and to society) if they could be captured. However, the size of the global values is not correlated with “capturability” (see table A2.2).

## A2.3 Example No. 3

**Title:** Kramer, R.A., Sharma, N. and Munasinghe, M. 1995. Valuing tropical forests: Methodology and case study of Madagascar. *World Bank Environment Paper No. 13.* Washington, D.C.: The World Bank.

**Country:** Madagascar

**Agency:** The World Bank

**Description:**

Development projects in which large forest areas are protected or converted to other land uses, such as agriculture or grazing for livestock, have often failed to take into account the impacts on people with traditional rights to forests. The failure to adequately compensate people for or involve them in the establishment and management of protected areas has resulted in poor performance of many projects dealing with reserves and natural parks. In many instances, these parks and reserve areas are vulnerable to problems related to access by local populations. The study by Kramer et al. focuses on environmental valuation of a forest development and conservation project in Madagascar. It attempts to answer questions such as: Is the value of a park with a buffer zone greater than one without? What is the appropriate level of compensation for local people unable to continue their forest extraction activities because of a reserve? How much are foreign tourists willing to pay to visit national parks in developing countries?

The objective was to adapt several valuation methods for use in economic analysis of a conservation project, in particular, to examine the use of several valuation tools for assessing the benefits and costs of establishing a new national park. The results of the study should have implications for future economic analysis of forestry projects and other environmental projects.

**Valuation method(s) used:**

The study used four methods for empirically measuring the change in environmental values resulting from the park. These methods were: (i) contingent valuation method (CVM); (ii) recreation demand analysis; (iii) opportunity cost analysis; and (iv) productivity analysis.

The referendum style of contingent valuation questions was used. This style divides the sample into a discrete number of subsamples. Individuals in each subsample are asked whether or not they would be willing to pay a specified amount for the particular non-market good and they respond either "yes" or "no". The procedure was used in both the village survey and the tourist survey. In the village survey, household members were asked about their willingness to accept (WTA) compensation for having lost access to the forest contained in the park. This component of the study analyses the economic and social impacts of establishing the park in Madagascar on village households living adjacent to the protected tropical rain forests. The measure used for the compensation mechanism was units of rice. In the tourism survey, the CVM was used (as an alternative to the recreation demand method) for estimating the total value of the park to tourists.

When environmental conservation projects increase nature tourism activities, economic valuation techniques can be used to measure the associated benefits. Most studies have focused on the value to domestic tourists. The study described here examined the potential benefits that might accrue to international nature tourists from the creation of Mantadia National Park. Recreation demand models use the amounts of time and money visitors spend travelling to a site as price proxies, together with participation rates and visitor attributes, to estimate the recreational value of the site.

Most studies portray the problem in terms of a single-purpose, single-destination, day trip to a site that affords some particular recreational experience of a type and quality that can be substituted for those available at many similar sites. Recreation in Madagascar's national parks contrasts sharply with these assumptions. Park users in Madagascar can be divided into local people and international nature tourists.: these two groups consume distinct goods. The study focused on international tourists. Demand by international tourists required a reformulation of the traditional travel cost models. Data were collected during the summer of 1991.

Opportunity cost analysis is an approach that uses standard economic analysis of market values to determine the net economic benefits associated with the alternative uses of one or more resources. It is a relatively simple, but data-intensive, form of analysis with practical applications for conceptualizing development programmes and for involving people in the management of programmes. It is also a powerful tool in understanding the interrelationships between micro-economics factors relating to use and management of parks. In this study, the opportunity costs of interest are those associated with alternative land uses by people living in or near the park. Given the dependence of the villagers on the forests for a significant portion of their livelihood, creating a national park out of a large tract of forests and imposing restrictions over future use imposes a considerable economic burden on local villagers.

There is a mounting concern that increasing rates of deforestation are causing greater flooding on the eastern half of the island of Madagascar where the monsoon rains are particularly heavy. Productivity analysis was used in this study to measure the benefits to farmers of reduced flooding from reduced deforestation resulting from the establishment of the park and buffer zone. The productivity analysis for this study proceeds by first estimating deforestation rates in the Mantadia area using remote sensing. Deforestation rates for the future are projected based on the historical analysis. These land use changes are then used to project effects on flooding. Finally, the predicted reductions in flooding brought about by the park and buffer zone are used to predict reduced crop losses which are estimated and valued in economic terms. This component represents the combination of ecological and economic information to better understand interactions between humans and a rapidly changing environmental system.

**Outcomes:**

The household survey covered a total of 17 villages lying to the east and south of the Mantadia region. The total population covered by the household survey is 1598, and the average household size in this region is 4.6 persons. Most of the villages do not have access to any medical facilities, running tap water or electricity. Education is also deficient: most of the villages surveyed had (or were within 4-5 kilometres of) primary school facilities but the survey indicated the average number of years of education per person to be only 2.4 years. Rice production is the primary economic activity in the area. The average household produces 487 kilograms of paddy rice per year, worth about US$128**.**

Most households also engage in shifting cultivation. Eighty percent of the households surveyed said that they would add to existing land for cultivation. Other crops grown include maize, beans, manioc, sweet potato, taro, sugar cane, ginger, banana and coffee. Fuelwood is the most economically important forest product obtained by the households.

Based on the data collected on agricultural and forestry inputs and outputs, the cash flow models were used to estimate the opportunity costs borne by the villages as a result of losing access to the forests in the park. These results are summarized in the table A2.3.

**Table A2.3. - Estimates of economic losses to local villagers from establishment of Mantadia National Park**

| Method used | Annual mean value per household | Aggregate net present value[a] |
|---|---|---|
| Opportunity cost | $91 | $566,000 |
| Contingent valuation | $108 | $673,000 |

Note: a. Estimated assuming a 10 percent discount rate and a 20-year time horizon.

Approximately 3400 people in three sets of villages will be negatively affected by the park. The results suggest that an annual compensation of approximately $100 per household would be required. Such compensation could be made in the form of education, health facilities, alternative income-earning enterprises in the buffer zone or other development activities. These compensation costs appear to be a significant part of the true cost of implementing protected area projects and should be built into project design at an early stage. Without adequate compensation and active cooperation of local residents, natural resource management projects are more likely to fail.

The analysis indicates that CVM, rigorously applied, can be effectively used in the developing country context. However, despite all of this encouraging evidence to support the use of the CVM in such a context, further research is required to improve its widespread applicability.

Investigating the impacts on tourism, the study examined the potential benefits that accrue to international nature tourists from the creation of Mantadia National Park. A summary of the benefit estimates for international tourists based on the econometric models used in the study are presented in table A2.4.

**Table A2.4. - Estimates of benefits to international tourists from establishment of the Mantadia National Park**

| Method | Mean increase in consumer surplus per tourist | Total annual increase in consumer surplus | Discounted present value (10% discount rate)* |
|---|---|---|---|
| Typical trip | $45 | $174,720 | $1.7 million |
| Random utility model (RUM) | $24 | $93,600 | $0.9 million |
| Contingent valuation method (CVM) | $65 | $253,500 | $2.5 million |

* Figures rounded up.

Although the estimated tourism benefits are only one part of the total value of the new national park, the results suggest that tourism can be a significant source of benefits when parks are created in a tropical country, even one with a modest level of international visitors. Clearly, the potential nature tourism benefits should be included in any reasonable benefit-cost analysis for project evaluation.

The productivity analysis proceeds by examining the history of deforestation in the Mantadia area using remote sensing. These deforestation rates are projected into the future to capture the effect on flooding. The relationship between deforestation and flooding is examined using two different data sets, one based on monitored small watersheds in the Mantadia area and one on weather data and flow rates of the Vohitra River. Finally, the predicted reductions in flooding brought about by the creation of the park and buffer zone are used to predict reduced crop losses which are valued in economic terms. All of these predictions are in a “with and without park” framework. In the “with park” case, these losses are considerably diminished.

Because of the interest in measuring the benefits of the park, only crop losses from changed flooding in the vicinity of the park and buffer zone were analysed. The results of this analysis (summarized in table A2.5) suggested that these impacts are modest, but this analysis may underestimate the total watershed protection benefits of the project. It is important to note that the benefits and costs of watershed protection are not borne by the same individuals. Future research projects should be designed to shed further light on these complex and important interrelationships and on the human-ecosystem interface. Productivity analysis is suggested as the best analytical tool to employ in such research.

**Table A2.5. - Net present values of flooding damage**

| Net present value of year 1 | Total expected loss | Aggregate net present value of total expected loss |
|---|---|---|
| Growth in damage | $51,691 | $547,176 |
| No growth in damage | $50,787 | $475,620 |

Note: the aggregate net present value (NPV) was considered over a 20-year life of the project and a discount rate of 10% was used to calculate the NPV.

Many of the benefits of biodiversity protection occur in countries remote from the resource being valued. The study carried out a survey to explore whether CVM is a workable method for valuing a global good such as existence value. It used a contingent valuation in a national mail survey in the United States to assess the value that residents placed on rain forest protection. The results of this survey are summarized in tables A2.6 and A2.7.

**Table A2.6. - Percentage of respondents answering "yes" and "no" to questions about knowledge of, visits to, and obligations to pay for rain forests**

| | YES (%) | NO (%) |
|---|---|---|
| Any knowledge of rain forests | 91 | 9 |
| Knowledge of causes of deforestation | 81 | 19 |
| Previously visited a rain forest | 11 | 89 |
| Plan to visit a rain forest | 8 | 61 |
| Should industrial countries help developing countries pay for preserving their rain forests | 67 | 33 |

**Table A2.7. - Willingness-to-pay estimates for tropical rain forest preservation**

| Type of question format | Mean WTP ($/household) | Total WTP (all households)[a] | Total WTP (income > $35,000)[ab] |
|---|---|---|---|
| Referendum | 24 | 2,184,000,000 | 780,000,000 |
| Payment card | 31 | 2,821,000,000 | 1,007,000,00 |

Notes a. Assuming 91,000,000 million households in the United States in 1989 (US Bureau of Census).

b. Income distribution in 1989 (US Bureau of Census).

For the study sample, tropical deforestation ranked below most other environmental problems, perhaps reflecting a higher priority for domestic environmental issues.

**Comments:**

This is one of the most detailed studies on forest valuation using sophisticated methods within the context of a developing country. It showed the potential of several valuation methods for improving the economic analysis of projects and their applicability within such a context. However, as the authors recognize in their conclusions, “a study of this scope is impractical for every environmental or natural resource project”. How to adapt these methods to provide useful results remains an open question. As stated in the overview, “the results of the study should have implications for future economic analysis of forestry and other environmental projects”. It is necessary to ask whether elaborate valuation, in general, is able to influence the decision-making process: whether, this study, in particular, achieved this remains to be seen.

## A2.4 Example No. 4

**Title:** Kumari, K. 1995. An environmental and economic assessment of forest management options: A case study in Malaysia. The World Bank. *Environment Department paper No. 026.* Washington, D.C.: The World Bank.

**Country:** Malaysia

**Agency:** The World Bank

**Description:**

The study seeks to demonstrate, using the total economic value (TEV) approach, the economics of shifting from a narrow “sustained timber practice” to a “sustainable forest management” system for a specific forest site in Malaysia. The results have management and policy relevance, both at the national and global levels. The incremental costs and benefits of shifting from less sustainable to more sustainable forms of management provide meaningful insight into whether sustainable forest management is a realistic option at the national level.

The study site selected for analysis consists of the peat swamp forests located in the Malaysian state of Selangor. These peat swamps are vital to the viability of the Integrated Agricultural Development Project (IADP) that is adjacent. They are important because of their water storage and supply roles. The World Bank appraisal of the IADP attached great importance to government assurances that the peat swamps would be protected as forest reserves, and not drained. The Selangor State Authority changed the status of the area from state land forests to forest reserves.

The TEV concept was applied to the study site for a series of alternative management options reflecting a shift from unsustainability to sustainability. What is important to understand here is that the TEV for a particular tract of forest (i.e., the study site) is not a fixed value; rather, the total value at any one time is a function of the type of management practised at that forest site.

**Valuation method(s) used:**

The framework for valuation adopted in this study was the TEV approach. A variety of methods, such as use of market prices (where available), damage cost avoided approach, surrogate/replacement cost approach and production function effect, were adopted to value some key goods and services that could be appropriated from the forests of the study site. This summarized in table A2.8.

**Table A2.8. - Goods and services valued at the study site**

| Type of good/service | Product/ Function | Type of value | Valuation method | Data source/Approach |
|---|---|---|---|---|
| Timber | Wood | Direct | Market price | From forest harvest levels, mean annual increments, etc. National Forest Inventories (FFD, 1987). |
| Non-timber | Rattan, bamboo | Direct | Market price | National Forest Inventory 2 (FFD, 1988). |
| Hydrological | Agricultural | Indirect | Effect on production | Equal to second crop of rice. Data on the hydrological disturbance in the swamps used to determine the effect of water shortage on the crop of paddy. |
| | Domestic | Direct | Market price | Water abstracted from the Main Canal to meet the domestic requirements for the residents at the agricultural scheme. |
| Recreation | Recreation | Indirect | Surrogate travel cost | Derived potential recreational value of the Study Site based on information from existing visitor numbers to the Nearly Kuala Selangor Nature Park. Valued using result of consumer surplus derived using TCM for visits to forest recreational sites in Malaysia. |
| Carbon sequestration | Carbon sink | Indirect | Damage avoided cost | Used information on the biomass and carbon stock in peat swamp forests to determine the amount of carbon stored in the forests. Establish the rate of carbon sequestration from the growth activity. |
| Sumatran rhino | Endangered | Existence | Contingent valuation Opportunity cost | Used mean CVM estimated from other sources to calculate WTP by Malaysians for the population of rhinos at the study site. Forgone timber benefits deducted out for area set aside for preservation. |

Source: Kumari (1995): table 2, p. 11.

**Outcomes:**

The outcome of the study is summarized in table A2.9.

**Table A2.9. - Summary of results for the study site** (1990 prices, 8 percent discount rate)

| Good/ Service | Base option (Unsustainable, A) (M$/ha) | % of TEV | Change from base option to sustainable option B1 (M$/ha) | B2 (M$/ha) | B3 (M$/ha) |
|---|---|---|---|---|---|
| Timber | 2,149 | 21.3 | -696 | -399 | -873 |
| Agro-hydrological | 319 | 3.1 | 0 | 411 | 680 |
| Endangered species | 454 | 4.4 | 35 | 20 | 44 |
| Carbon stock | 7,080 | 69.2 | 969 | 1597 | 1597 |
| Rattan | 22 | 0.2 | 88 | 172 | 192 |
| Bamboo | 98 | 1.0 | 0 | -20 | -20 |
| Recreation | 57 | 0.6 | 0 | 0 | 0 |
| Domestic water | 30 | 0.3 | 0 | 0 | 0 |
| Fish | 29 | 0.3 | 0 | 0 | 0 |
| TEV | 10,238 | 100.0 | 396 | 1782 | 1620 |

Source: Kumari (1995b): table 12, p. 28.

Notes: TEV = total economic value.

The author notes that these results should not be seen as fine-tuned numbers but rather as indicating orders of magnitude to enable identification of key sensitivity parameters relating to overall option results. More refined analyses can then be focused on these parameters and their valuation.

The results in table A2.9 show that timber and carbon stock components comprise about 20 percent and 70 percent of the TEV respectively. The shift to increasingly sustainable regimes causes financial losses in timber harvesting, whereas the forest’s carbon stock function value increases substantially. Similarly, further increases occur in the agro-hydrological service and the conservation of the endangered species components as the management option shifts towards greater sustainability. This suggests that shifts from unsustainable to sustainable options increase the private losses and decrease the social and global losses. The data in table A2.9 indicate that there are positive gains to be made in TEV when more sustainable management options are chosen: however, it is also suggested that the largest portion of the benefits accrue to the global community. This study argues that a shift from the current unsustainable practice (option A) to the recommended sustainable option B2 would require compensation payments from the global community to Malaysia. To do so, it is necessary that new resource transfer mechanisms are agreed and implemented.

**Comments:**

This is another very well done study that once more proves that the use of current valuation techniques is possible within the context of a developing country. The study is also very interesting because it was not limited to give values to different goods and services provided by the forest, but also showed how the flow of benefits from them changes under a range of management options.

It is beyond of this scope of this work to go into the details of the appropriation methods or tools to capture these social and global values. However, there are some questions that emerge when one reads such a study. The feasibility of carrying out a study of this scope for every environmental or natural resource project is questionable. The challenge is to adapt these methods to provide useful results in a less costly and time-consuming way.

The study points out that biological, ecological and economic uncertainties still surround forest management: “The precise dynamics of the tropical forests is still not well understood ... given this complexity, economic assessments and projections will necessarily be somewhat speculative ... this, however, should not be construed as a criticism of all that has been done, but of the need to recognize its practical limitations.” This suggests that, parallel to valuation of forest resources, there is also a need for other activities such as research on forest management and instruments to make viable the capture of the calculated values. Otherwise, statements that forests can supply many goods and services will not be supported by reliable values.

## A2.5 Example No. 5

**Title:** Michael, S.G. 1995. Economic valuation of the multiple use of forests: The case of Bwindi Impenetrable National Park (BINP), Uganda. Unpublished M.Sc. dissertation. University of Edinburgh.

**Country:** Uganda

**Description:**

This is a dissertation presented for the degree of Master of Science at the University of Edinburgh.

The study presupposes that the overall economic value of Bwindi Impenetrable National Park (BINP) depends on the values the local community places on the goods and services provided by the forest. The surrounding people had expressed grave concern that the change of status of the Bwindi forest from a forest reserve to a national park would result in their loss of access to these resources. There are costs and benefits borne by society when a park is created or whenever a new management policy is introduced. Observable market prices and CVM were used in this study to measure the impact of the formation of BINP on the local communities. The objective of undertaking an economic valuation of multiple use of the forest was to determine the value of BINP to the local people. Valuation may help to place the needs of the local community on an equal footing with conservation, thus lessening the conflict between them.

The importance of the creation of BINP to global conservation of biodiversity has been internationally recognized. However, the change in status of the area imposed new conditions on the locals. Before this transformation the local population utilized forest products under the supervision of the forest and game departments. Later, under the management of the Uganda National Parks Authority, utilization of most of these products was no longer allowed. However, research into the potential for multiple use of the forest provided a basis for developing a sound programme framework. Permissions started to be granted. The first was granted in 1992 to beekeepers. Later, in 1993, permission was granted to basketry and medicinal resource users. Other ongoing activities include the collection of indigenous tree seedlings for distribution to community members and establishment of an ethnobotany database. In addition, a multiple-use zone was established on the periphery within two kilometres of the park boundary: this represented about 20 percent of the total park area. Fragile or vulnerable areas, rare habitats and other areas of high conservation importance were excluded from this multiple-use zone.

Michael's study is concerned only with the consumptive, direct benefits. Other multiple uses of the forest for research, education, ecological processes, maintenance of biodiversity and soil conservation, cultural and aesthetic values are beyond the scope of the study. Despite its narrow focus, the study is important because it discusses a real situation. Its aims were:

- to examine the economic opportunities that local people have at their disposal with respect to collection of forest products;
- to place monetary value on forest products;
- to survey the attitude of the local community towards multiple use; and
- to measure the impact of the park on the local community.

**Valuation method(s) used:**

The objectives of the survey were to assess the economic value of the forest and, where possible, monetize the forest resources, to survey the attitudes of the people towards multiple-use management, to identify the economic opportunities that the local community has at its disposal and to examine the relationship between independent variables such as education age, household size, sex, income, tribe, occupation and willingness to accept (WTA) compensation to tolerate a loss of benefits when Bwindi became a national park. Specific hypotheses considered were: the bid responses were independent of the socio-economic variables and that the bid responses came from the same population mean.

A questionnaire survey was administered between 8 May and 30 June 1995 among the local communities of the parishes adjacent to the BINP by the lead investigator and one research interpreter. Based on criteria detailed in the study the parishes of Rutugunda, Mpungu, Mukono and Katojo were selected. Data were collected on a number of levels: from households, by meeting individual resource users and by visiting local markets (to confirm the local prices) when necessary.

In all parishes a number of interviews were conducted with former and current resource collectors: basket-makers, medicinal specialists, beekeepers, fishers and collectors of fuelwood, building poles and bamboo. These were open discussions aimed at collecting quantitative information about the resources harvested from the forest. The discussions also centred on the future of the multiple-use activities.

The methodology used was a closed-ended, dichotomous-choice CVM that was administered to 187 households. The underlying hypothesis was that households would be worse off if they were completely denied use of the resources within the park. Given that the communities around the BINP had a subsistence economy with limited market transactions, millet was chosen as the appropriate commodity for estimating the monetary measures of indirect and non-use values.

**Outcomes:**

On the basis of the quantitative data on resources collected in BINP, calculations were carried out to determine the average amount of each resource harvested annually by the households sampled in each of the parishes. These values were then extrapolated to all households within each parish to estimate the quantity of resources collected annually[A2.4] . To capture a view of the wider forest use account, the values from the sample parishes were further extrapolated to the forest-adjacent parishes from which they were selected and the result of this extrapolation is presented in table A2.10. This gives an indication of the total amount of resources collected from BINP annually.

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A2.4. Only the estimated total amount of resources collected from BINP annually is presented here. The results by household and the respective extrapolation to the whole parish are discussed and summarized in tables 2 and 3 of the case study.

**Table A2.10. - Annual collection of forest resources by parishes adjacent to BINP (extrapolated from four representative parishes)**

| Resource | Villages 0-3 km from park boundary | Villages >3 km from park boundary |
|---|---|---|
| Fuelwood (bundles)[a] | 690,028 | 242,961 |
| Building poles | 176,250 | 13,545 |
| Ropes (bundles)[b] | 1240 | 735 |
| Beer boats (stems)[c] | 410 | 0 |
| Basket material (bundles) | 21,600 | 0 |
| Bamboo (shoots) | 30,985 | 0 |
| Honey (litres) | 72,220 | 9760 |

Source: Adapted from Michael (1995): table 4, p. 39.

Notes: a bundle of firewood = 15-20 stems

b bundle of ropes = 500 ropes.

c Author does not explain what “beer boats” are.

Once these quantities where estimated, the next step was to estimate the value of the resources collected in order to infer the monetary value of the forest in supplying these resources. These values are summarized in tables A2.11 and A2.12. All values are expressed in Ugandan Shillings where 1,000 Ugandan Shillings equals US$1.

**Table A2.11. - Summary of financial value[a] to households (according to parish[b]) for households 0-3 km from the park boundary**

| | Maximum value (labour at zero cost) | | | | Minimum value (labour varies between parishes) | | | |
|---|---|---|---|---|---|---|---|---|
| Resource | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| Fuelwood | 55,100 | 43,700 | 32,900 | 67,300 | 40,700 | 30,993 | 21,400 | 48,000 |
| Building poles | 7,800 | 4,600 | 2,500 | 4,304 | 3,900 | 358 | 4,600 | 4,304 |
| Ropes | 1,180 | 500 | 210 | 370 | 720 | 103 | 334 | 170 |
| Bamboo | 0 | 3,000 | 0 | 0 | 0 | 1,900 | 0 | 0 |
| Basket material | 2,814 | 0 | 90 | 0 | 1,140 | 0 | 36 | 0 |
| Beer boat material | 94 | 200 | 0 | 100 | 73 | 0 | 143 | 72 |
| Honey | 8,280 | 4,200 | 1,600 | 2,250 | 8,200 | 800 | 4,160 | 2,226 |
| Total | 83,448 | 55,710 | 33,221 | 74,324 | 54,733 | 35,881 | 22,661 | 55,365 |

Source: Adapted from Michael (1995): table 13, p. 45.

Notes: a Currency: Ugandan shillings.

b Parishes: 1 = Mpungu; 2 = Katojo; 3 = Rutugunda; 4 = Mukono.

**Table A2.12. - Summary of financial value[a] to households (according to parish[b]) for households 0-3 km from the park boundary**

| Resource | Maximum value (labour at zero cost) 1 | 2 | 3 | 4 | Minimum value (labour varies between parishes) 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|
| Fuelwood | 22,048 | 13,600 | 10,200 | 20,872 | 16,390 | 9,620 | 6,640 | 15,060 |
| Building poles | 800 | 161 | 161 | 79 | 430 | 2 | 2 | 79 |
| Ropes | 300 | 89 | 0 | 0 | 180 | 60 | 0 | 0 |
| Bamboo | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Basket material | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beer boat material | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Honey | 2,400 | 0 | 0 | 0 | 2,370 | 0 | 0 | 0 |
| Total | 25,548 | 13,700 | 10,210 | 20,951 | 19,270 | 9,841 | 6,642 | 15,139 |

Source: Adapted from Michael (1995): table 14, p. 45.

Notes: a Currency: Ugandan shillings.

b Parishes: 1 = Mpungu; 2 = Katojo; 3 = Rutugunda; 4 = Mukono.

From the tables it is clear that fuelwood is the product that currently carries the highest monetary value. In second place comes honey. The tables also show that as the distance increases from the park boundaries many products lose value.

This study concludes that the estimated annual financial value that would accrue to a household located within 0-3 km of the BINP boundary is US$47-63 whereas for a household located more than 3 km from the boundary the range changes to US$12-16. It is also important to point out that the shift from a purely preservationist management to a multiple-use policy appears to have been well received by the adjacent forest community. This reinforces the argument that the pursuit of conservation objectives without an effective participation of the local community is unsustainable. The traditional attachment to the forest and forest resources reflects the forest patrimony of the local community: individual respondents felt that they had a stake in Bwindi as part of the natural endowment to them.

This study has indicated that, on average, a compensation of 5 bags of millet (equivalent to approximately US$80 per household) would make households as well off with the park as without. This finding is similar to that of the study by Kramer et al. (1995) in Madagascar (case study number 3 discussed earlier) that obtained a value of about US$108 per year per household to make households as well off with the park as without.

**Comments:**

Michael’s study supports the argument that a knowledge of the local language is very important when a CVM is carried out. The author points out that, because he comes from the eastern part of the country and the park is located in the western region with a completely different culture, language and dialect, he had to rely on a translator. The risk associated with this is that translator plays the interpreter’s role, posing questions and relating answers in line with his/her perception of what the survey is aiming to achieve. Another problem was related to the concept of valuation itself: sometimes it was necessary to explain the meaning of the concept to the respondents and this could have contributed to bias. Another problem was fear relating to the intentions of the Uganda National Parks Authority and government. The author calls attention to the fact that the respondents invested some time and effort in decision-making and hence their contingent choices might have deviated from the choices they would make in real markets.

How relevant is the introduction of the multiple-use policy in the conservation efforts of BINP? This question is difficult to answer because many of the benefits of such policies do not show up in the form of immediate monetary gain. The benefits may be found in the local community’s quality of life rather than in any increment to a nation’s economic output.

The results of this study suggest that is possible to carry out a CVM in a poor community and obtain a reasonable result. However, it is very important to bear in mind that special care is required in such cases.

Finally, as argued by Tacconi (1995: p. 234): “the question whether the livelihood of a community should be traded-off against pecuniary benefits clearly has ethical and distributional implication. These issues cannot be simply reduced to a problem of efficient allocation of resources.”

## A2.6 Example No. 6

**Title:** Sedjo, R.A. and Ley, E. 1995. Argentina: Carbon and forests. Report prepared for the Global Environment Facility, Washington DC, Resources for the future for the World Bank (mimeo.). December.

**Country:** Argentina

**Agency:** Global Environment Facility (GEF) (Commissioned by the World Bank)

**Description:**

In concept there are two approaches to mitigate the build-up of greenhouse gases (GHGs) in the atmosphere: (i) the reduction of emissions and (ii) the increased capture of carbon and other GHGs. Forestry is a particularly attractive approach to carbon mitigation because:

- forests have the potential to sequester large amounts of carbon;
- the technology for establishing large areas of additional forests already exists and has been tried and proven;
- forests have other environmental benefits in addition to carbon sequestration;
- most studies indicate that the costs of carbon sequestration using forest, at least for low levels of planting in a global context, are relatively modest.

The Sedjo and Ley report examines the possibilities of using forests as a low-cost means of carbon sequestration in Argentina. The first section presents a broad overview of the current situation involving global warming and carbon noting a variety of human responses and a number of tools that might be used to mitigate the build-up of GHGs, the major one of which is carbon dioxide.

The second section examines the potential of forests to play a significant role in carbon mitigation. It provides estimates of how much forest would be required to sequester the global annual increase of atmospheric carbon. Forests, in themselves, are unlikely to sequester enough carbon to offset the entire increase. However, they can contribute to the process, as well as being among the most low cost of the carbon sequestration techniques. Cost of carbon sequestration using forests commonly runs in the range of $2 to $10 per tonne. Forests, in addition to their environmental aspects, can be managed to provide goods such as industrial wood. Hence, there is the possibility that some of the costs of carbon sequestration might be borne by the private sector.

The third section of the report examines the specifics of the forest and carbon situation in Argentina. An overview is provided of native forests, plantation forests, biodiversity, the role of plantations both world-wide and in Argentina and market conditions. Despite the importance of industrial forest plantations as a source of the world's industrial wood supply, Argentina's role in the world market is minimal. Argentina's plantations are important for the domestic market, but their major disadvantage is their location (typically a considerable distance from the ports). The report also discusses the recent policy reforms in Argentina and their likely long-term effects. It also studies the nature of subsidies for tree planting in Argentina.

The fourth section deals firstly with establishing the baseline scenario as the situation in which the policies of the government are not creating resource distortions. The focus is on land use. Secondly, it examines alternative carbon sequestration, forest-related activities from the perspective of the baseline scenario. In this examination it notes which activities are unlikely to be undertaken by the private sector without subsidies and therefore which are potential candidates for some types of GEF funding. Natural forest management was another alternative explored, but it is likely that little natural forest management takes place in Argentina. A variety of forms of plantation management are examined. These include industrial, silvo-pastoral and mixed-species plantations in Mesopotamia and industrial and mixed-species plantations in Patagonia.

The fifth section examines some other considerations and qualifications. There is also a brief discussion of the role of discounting. This points out that, if the carbon benefits are not discounted, financial considerations suggest delaying mitigation activities as long as possible.

Finally, some other considerations on other scenarios and the role of discounting are presented at the end of the report. Some recommendations for a GEF policy are also provided.

**Valuation method(s) used:**

In this study a benefit/cost framework was applied. Sequestered carbon was viewed as a benefit. Conceptually, carbon sequestered is a proxy for climate damage that is forgone because the specific nature of the damage function relating atmospheric carbon to environmental damages is not known. However, in conformance with GEF guidelines, the analysis did not attempt to value the benefits provided by carbon sequestration nor to discount carbon sequestered at some future time. Costs, however, were discounted. Thus, in this study it is immaterial whether the carbon is sequestered in year one or year 50.

**Outcome:**

The industrial and silvo-pastoral plantations should produce industrial wood harvests that generate financial returns. The mixed-species plantations are not expected to be harvested nor to generate financial returns. The study notes that, because of a lack of sufficient financial returns, establishment and management of any of the plantations in Patagonia and the mixed-species plantations in Mesopotamia are unlikely to be undertaken by the private sector without a subsidy. Thus, subsidies that result in these types of activities are likely to be fully additive in that all of the carbon these plantations sequester is likely to constitute a net increment to total carbon sequestered.

The evidence suggests that establishment of some of the industrial and silvo-pastoral plantations in Mesopotamia could be undertaken without subsidies. Furthermore, to the extent that institutional and policy reforms remove impediments to the successful operation of (and provide financial incentives for) plantations, a subsidy would in part merely provide rents to private investors who would have undertaken the planting without the subsidy. Thus, some portion of the subsidy would not be additive and would not generate the sequestration of additional incremental carbon.

The estimates of the costs of carbon sequestration under the various scenarios run from as high as $21.95 per tonne for the mixed-species alternative to as low as $3.44 per tonne for the industrial plantation. The costs to the public sector could be lower if some of the costs are borne by private sector timber growers.

The recommendations made to the GEF are in summary:

- Set aside some types of forests. Natural forest management that would prevent deforestation can be conceptually attractive as a means to sequester carbon. However, a workable approach to preventing deforestation is hampered by the difficulties inherent in attempting to directly protect very large areas of native forests while preventing the deflection of deforestation to other regions.

- Establishment of a system of industrial forest plantation which can contribute to carbon sequestration and at the same time generate financial returns to the private sector. Where these plantations generate adequate financial returns they would not require GEF subsidies, e.g. Mesopotamia.

- Mixed-species plantations offer the benefit of being largely additive in terms of the relationship between investments and carbon sequestration gain, but they have the highest cost of the plantation systems that were examined. Also, if undertaken in areas where industrial plantations are financially viable, the opportunity cost of these lands is likely to be high.

- Although Argentina has land available for establishment of plantation forests, most of it is poorly located with respect to markets. This means that under the current economic conditions it is unlikely that these lands would be used for plantations. GEF contributions to establish plantations in regions that are largely sub-marginal for commercial wood production may be justified by the carbon sequestration values. GEF investments in these areas could be expected to be almost entirely additive with respect to creating new forest unlikely to exist without GEF support.

- If additivity is important, GEF should consider a policy that focuses its funding subsidies in regions that are now marginal for plantation establishment, even at current subsidy levels, and are likely to be sub-marginal in the face of the policy reforms. Under this approach, GEF might choose an area such as Patagonia, which has tree-growing and carbon sequestration potential but is below the threshold that is likely to make it financially viable for private investors.

Table A2.13 summarizes the incrementality of the scenarios discussed in this study.

**Table A2.13. - Implications for GEF funding**

| System | Private sector activities | GEF additive |
|---|---|---|
| **Mesopotamia** | | |
| Industrial/Silvo-pastoral | Some | Some |
| Mixed species | No | Yes |
| **Patagonia** | | |
| Industrial | No | Yes |
| Mixed species | No | Yes |
| Native forest protection | No | Yes |

Source: Sedjo and Lay (1995): table 11, p. 46.

Table A2.14 summarizes the findings of the scenarios discussed. The data suggest that the establishment of industrial/silvo-pastoral plantations in Mesopotamia is by far the single greatest new carbon sink. This should be done at a level of about 20,000 ha annually until the year 2020. This option also presents the low-cost scenario. However, the report notes that some portion of these activities would be undertaken by the private sector without any subsidy from either the government or GEF.

The other alternatives involve activities that are not attractive to private sector investments because the financial returns are non-existent or insufficient.

The report suggests that all of these options might be compared with the option of protecting the 40 million or so ha of native forest which, under current usage, is assumed to continue releasing about 2 million tonnes of carbon annually. This activity would not be funded under the baseline scenario. If a low-cost effective way could be found to protect the 40 million ha, substantial carbon benefits could be obtained.

**Table A2.14. - Summary of carbon sequestered and costs**

| System | Carbon 2020 (million tonnes) | Cost ($/tonne) | Carbon 2070 (million tonnes) | Cost ($/tonne) |
|---|---|---|---|---|
| **Mesopotamia** | | | | |
| Industrial/Silvo-pastoral | 36 | 5.56 (2.78)[a] | | |
| (25 years, 20,000ha/year, harvesting) | | | | |
| Industrial/Silvo-pastoral and associated wood stocks | | | 58 | 3.44(1.72) |
| (25 years, 20,000ha/year, harvesting) | | | | |
| Mixed species plantation | 6.55 | 13.74[b] | 14 | 6.50[b] |
| (5 years, 20,000ha/year, no harvesting) | | | | |
| **Patagonia** | | | | |
| Industrial | 10.6 | 7.60 | 13.07[c] | 5.36 |
| (5 years, 20,000ha/year, harvesting) | | | | |
| Mixed species | 4.1 | 21.95 | 12.7 | 7.87 |
| (5 years, 20,000ha/year, no harvesting) | | | | |
| **Natural Forest Protection** | | | | |
| Deforestation of 40,000 ha annually | 50 | | 150 | |

Source: Sedjo and Lay (1995): table 12, p. 47.

Notes: a one-half of the costs are attributed to industrial wood production;

b does not include the opportunity costs of higher quality lands;

c long-term average.

**Comments:**

This study is well done within the economic framework. However, there are some points that deserve consideration.

First is the social aspect. Where do the people go, particularly the farmers, in this scheme of plantations? As argued by Saxena (1994) in his work on eucalyptus plantations in India, the farmers were not consulted on these plantations. Initially they showed a great deal of enthusiasm for adopting eucalyptus as a farm crop and then gave up. Although the idea may have been technically and economically correct, the lack of a social approach, including cultural aspects, contributed to a failure. This emphasizes the need for the local population to be involved.

Another consideration is: what are the effects of an increase in forest plantations on croplands? What does it mean in terms of food production? What the opportunity costs of using such lands and who is going to pay for them? These forest plantations may contribute to carbon sequestration, but, if they are established in agricultural lands, may also contribute to reducing food production. In this were so, what are the actual benefits that they bring to Argentina?

Finally, the protection of the total 40 million or so ha of native forests for carbon sequestration, even if a low cost option, seems unrealistic. It is important to bear in mind that the major benefits of carbon sequestration accrue at global level. Who, then, is going to pay for the local benefits forgone by putting all of the remaining natural forests of Argentina under conservation?

## A2.7 Example No. 7

**Title:** Kumari, K. 1996. Incremental cost of changing forestry practices to protect the habitat of the endangered Sumatran rhinoceros: Case study of the North Selangor peat swamps forests, Malaysia. Final draft report to Global Environment Facility (GEF) of the World Bank and Asian Wetlands Bureau (AWB) (mimeo.).

**Country:** Malaysia

**Agency:** GEF

**Description:**

This study estimates the incremental cost[A2.5] of adjusting the forest management practice in the peat forests of North Selangor to achieve defined global benefits in the most cost-effective manner. This adjustment requires the adoption of reduced-impact logging methods. However, this has a cost and, at present, does not constitute a priority for the country.

The incremental costs of shifting to the more environmentally sound tramline logging method is estimated for two scenarios. First, through the use of reconditioned equipment and, second, where new equipment has to be procured. Cost savings achieved as concurrent domestic benefits by adopting this option are also estimated for two key components: treatment of water used for domestic use and forest rehabilitation.

**Valuation method(s) used:**

Incremental cost refers to the difference between the cost that a developing country will incur to generate "global environmental benefits" as required under the Convention on Biological Diversity (CBD) and what it would otherwise incur without being a party to the Convention.

The incremental cost methodology utilized in this study is that proposed by the Global Environment Facility (GEF). The first step of this methodology is the selection of the baseline upon which incremental costs are estimated. According to this study "there are formidable problems in defining the baseline for any proposed GEF intervention, but special problems arise in the case of biodiversity. Is the baseline what a country would have done, would like to have done (but cannot) or is likely to do? In reality, national conservation strategies tend to be a mixture of both ideals and what is feasible." The study took the baseline practice to be in concurrence with the domestic goal of sustained timber yield (STY) using canals and traxcavators for logging.

The second step is to choose an alternative strategy under the CBD in preference to the baseline strategy in order to achieve defined global biodiversity objectives. The study noted that, although "the combination of winch and tramline is probably the most environmentally benign combination of logging in the biodiversity context, the alternative proposed here is one which retains the traxcavator for log extraction, but advocates a shift to tramlines for log transportation. Within practical constraints, tramlines (with traxcavators) represent the least-cost option of meeting both domestic and global environmental objectives."

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[A2.5] According to Kumari (1996: p. 11): "incremental costs are only a guide for the amount of 'financing' to be provided by GEF, and are not the major criterion for project selection. Projects are selected according to programme priorities." For more details on incremental costs, see, for example: Pearce and Barrett (1994); Global Environment Facility (1995).

A refinement of the incremental cost methodology can be done by taking into consideration concurrent domestic benefits, enumerating as far as possible all associated costs, including any reductions in costs (cost savings) arising from a shift to the alternative practice and then deducting them to derive the incremental costs.

**Outcome:**

The study suggests that the incremental cost methodology can be carried out, although its specific application to biodiversity can have some problems. However, these problems can be overcome.

The results show the NPV of incremental costs to loggers (in Malaysian ringgit - approximately 2.60 RM = US$1) to range from RM1,427/ha to RM3,067/ha, for reconditioned and new equipment, respectively. The discount cost-saving for domestic water treatment is estimated at RM134/ha and for forest rehabilitation at RM2,684/ha. Deducting these total cost savings (RM2,818/ha) gives an incremental cost of RM249/ha if the logger has to acquire new equipment, whereas the use of reconditioned equipment gives an incremental cost of -RM1,391/ha, i.e. incremental savings rather than costs result in this situation. The divergence between private and social costs and the possibility of negative incremental costs have to be discussed in the context of Malaysia's current forestry practices and priorities if any meaningful and effective compensation is to be transacted. However, the results do indicate that, even where new equipment may have to be installed, the incremental cost is fairly modest and, for a relatively small transfer (RM249/ha), the change in forestry practice could significantly enhance the survival chances of the endangered Sumatran rhinoceros. A summary of these values is presented in table A2.15.

**Table A2.15. - Incremental costs in shifting from baseline to alternative management practice**
(10-year period, 8% discount rate)

| Costs | Baseline (RM/ha) | Alternative (RM/ha) | Sensitivity Analysis<br>Alternative (-20%) | <br>Alternative (+20%) |
|---|---|---|---|---|
| Operational and maintenance | 8,253 | 8,690 | 6,952 | 10,427 |
| Capital (new) @ RM263/ha/year | | 2,630 | 2,104 | 3,158 |
| Capital (reconditioned) @ RM99/ha/year | | 990 | 792 | 1,188 |
| Total logging costs | 8,253 | 11,320 (ne)<br>9,680 (r) | 9,056<br>7,744 | 13,583<br>11,615 |
| **Incremental logging costs from baseline to alternative** | **0** | **3,067 (ne)**<br>**1,427 (r)** | **803**<br>**-509** | **5,330**<br>**3,362** |
| Forest rehabilitation costs | 14,729 | 12,045 | 12,045 | 12,045 |
| **Incremental forest rehabilitation costs from baseline to alternative** | **0** | **-2,684** | **-2,684** | **-2,684** |
| Domestic water treatment costs | 456 | 322 | 322 | 322 |
| **Incremental domestic water treatment costs** | **0** | **-134** | **-134** | **-134** |
| **TOTAL INCREMENTAL COSTS** | **0** | **249 (ne)**<br>**-1,391 (r)** | **-2,015**<br>**-3,327** | **2,512**<br>**544** |

Source: Kumari (1996): table 8.

Notes: ne = new equipment; r = reconditioned.

The crucial questions, according to the study, are: "how could this shift be compensated effectively, without conflicting with other domestic priorities? Should the GEF take the *status quo* (baseline) and forest operational rules as the benchmark or should it instead require that market and institutional failures within the country be corrected as a pre-condition for funding? Conditionality is controversial even with conventional development aid. A minimum requirement could be that the government, together with GEF, could devise incentive packages for correcting national distortions. It appears that there is scope for GEF funding for this project, but the avenues for funding or financing need to be carefully worked out."

**Comments:**

This study once more suggests that the use of current valuation methodologies and/or techniques is feasible in the context of a developing country, and that the issues and challenges are not insurmountable. Other constraints deserve attention in addition to efforts to measure the environment in economic terms. There is urgent need of a serious discussion to find ways to overcome these constraints. Global benefits cannot be pursued or achieved by imposing costs on local people. The question is not just one of finding mechanisms to compensate but of creating ways that allow the local people to improve the use of the natural resource as well as improving their standard of living.

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[A2.6] Many of these references are also found in the main bibliography preceding annex 1. They are reproduced here to maintain the independence of annex 2. However, the numbering system of certain references in the text of annex 2 (e.g. 1995b) applies to their citation as part of the main publication rather than in this annex.

# ANNEX 3: ESTIMATES OF ECONOMIC VALUES OF FOREST BENEFITS[A3.1]

**Table A3.1. - Watershed values**

| Year | Locality | Value estimated (see Unit) | Unit of value | Comments | Source |
|---|---|---|---|---|---|
| 1965 | Slovakia | 2,000 | US$/ha/year | Avalanche protection | Blahouts, 1965 (quoted in FAO, 1995) |
| 1970-72 | Slovakia | 6 | US$/ha/year | Avg. soil loss 26 $m^3$/ha/year (for water erosion) | Pasak, 1970, 1972 (quoted in FAO, 1995) |
| 1970-72 | Slovakia | 1.5-12 | US$/ha/year | This is for wind erosion | As above |
| 1970-72 | Slovakia | 40 | US$/ha/year | Includes soil conservation | As above |
| 1989 | Paute, Ecuador | 54 | US$/ha/year | Structural measures to keep sedimentation control & protection of remaining forests; reforestation. Real discount rate = 6% | Southgate and Macke, 1989 (quoted in Chomitz & Kumari, 1996) |
| 1989 | Korup National Park, Cameroon | 8 | US$/ha | Benefit imputed based on crop productivity decline from soil loss which would take effect from 2010 onwards (the w/o project scenario) | Rutenbeek, 1989a (quoted in Pearce & Moran, 1994) |
| 1989 | Korup National Park, Cameroon | 23 | US$/ha | An imputed value of the expected loss from flooding resulting from alternative land use from 2010 onwards: NPV of expected value of loss by 2040 | As above |
| 1989 | Korup National Park, Cameroon | 54 | US$/ha | Arising from sustained use of the Korup forest. Existence of watershed functions affording protection to Nigerian and Cameroonian fisheries. NPV assuming that the benefit starts to accrue in 2010 and beyond (2010 represents the time horizon by which the continued use of the forest resources - in the absence of protection - would start to exhaust resources. The imputed benefit stream therefore represents the continued existence of resources). | As above |
| 1991 | Lower Agno, Philippines | 234-586 (10% discount rate)<br>68-218 (15% discount rate) | US$/ha | Gully control, vegetation management in already deforested area | Briones, 1991 (quoted in Chomitz & Kumari, 1996) |
| 1993 | Costa Rica | a. 0.25-2<br>b. 2.3-4.6<br>c. 4.0-9.0<br>d. 10-20 | US$/ha | Rough estimates of environmental values from primary forests - Hydrological benefits:<br>a. protection of agricultural lands<br>b. urban water supply<br>c. flood control<br>d. loss of hydroelectric productivity | Kishor & Constantino, 1993 |

[A3.1] This annex is not intended to be a comprehensive list of estimated values of forest benefits (as discussed in the text) but to illustrate their ordrs of magnitude and wide range.

**Table A3.2. - Conservation/Biodiversity values**

| Year | Locality | Value estimated (see Unit) | Unit of value | Comments | Source |
|---|---|---|---|---|---|
| 1990 | USA | 1.2 | US$/year/person | Endangered species and prized habitats: whooping crane | Pearce and Moran, 1994 (table 4.2: p. 40) |
| 1990 | USA | 4.5 | US$/year/person | Endangered species and prized habitats: emerald shiner | As above |
| 1990 | USA | 7 | US$/year/person | Endangered species and prized habitats: bottlenose dolphin | As above |
| 1990 | USA | 8.1 | US$/year/person | Endangered species and prized habitats: California sea otter | As above |
| 1990 | USA | 8.1 | US$/year/person | Endangered species and prized habitats: Northern elephant seal | As above |
| 1990 | USA | 8.6 | US$/year/person | Endangered species and prized habitats: bighorn sheep | As above |
| 1990 | USA | 9.3 | US$/year/person | Endangered species and prized habitats: blue whale | As above |
| 1990 | USA | 9.3-21.2 | US$/year/person | Colorado Wilderness | As above |
| 1990 | USA | 18.5 | US$/year/person | Endangered species and prized habitats: grizzly bear | |
| 1990 | USA | 27 | US$/year/person | Grand Canyon (visibility) | As above |
| 1990 | USA | 40-48 (w/o information)<br>49-64 (w/information) | US$/year/person | Endangered species and prized habitats: humpback whales | As above |
| 1990 | Australia | 28.1 | US$/year/person | Nadgee Nature Reserve, NSW | As above |
| 1990 | Australia | 40 | US$/year/person | Kakadu conservation (minor damage) | As above |
| 1990 | Australia | 93 | US$/year/person | Zone, N.T. (major damage). Two scenarios of mining development damage were given to respondents | As above |
| 1990 | Norway | 10.5 | US$/year/person | Endangered species and prized habitats: brown bear, wolf and wolverine | As above |
| 1990 | Norway | 59.0-107.0 | US$/year/person | Conservation of rivers | As above |
| 1990 | UK | 40 | US$/year/person | Nature reserves - survey of informed “expert” individuals only | As above |
| 1992 | Sweden | 12 | US$/ha/year | Includes soil conservation | Hultkrantz, 1992 (quoted in FAO, 1995) |

**Table A3.3. - Tourism values**

| Year | Locality | Value estimated (see Unit) | Unit of value | Comments | Source |
|---|---|---|---|---|---|
| 1981 | Charles River, Massachusetts, USA | 3,400 | US$/acre | Present value per acre at 8% (1990 US$) | Thibodeau & Ostro, 1981 (quoted in Pearce and Moran, 1994, table 6.1: pp. 86-91) |
| 1989 | Korup National Park, Cameroon | 19 | US$/ha | Tourism value | Rutenbeek, 1989a (as above) |
| 1989 | Louisiana Wetlands, USA | 57 | US$/acre | WTP present value at 8% (1990 US$) | Costanza et al., 1989 (as above) |
| 1990 | Louisiana Wetlands, USA | 103 | US$/acre | WTP present value at 8% (1990 US$) | Bergstrom et al., 1990 (as above) |
| 1991 | Monteverde Cloud Forest, Costa Rica | 1,250 | US$/ha | Average visitor valuation US$35 (1988 US$). Considering national and foreign visitors gives this value per hectare in the reserve relative to the market price of local non-reserve land of US$30-100/ha | Tobias and Mendelsohn, 1991 (as above) |
| 1993 | Costa Rica | 12.56-25.12 | US$/ha | Average annual dollar per hectare (1989 US$) | Kishor and Constantino, 1993 |
| 1994 | Costa Rica | 17 | US$/ha | At 8% discount rate | World Bank, 1994 |
| 1989/91 | El Triunfo, Chiapas, Mexico | 0.02-0.09 | revenue/year/ ha (US$) | Ecotourists - Biosphere Reserve | Touval, 1992 (quoted in CSERGE, 1993, Annex 1: p. 44) |
| 1989/93 | Sian Ka’an, Quintana Roo, Mexico | 0.11 | revenue/year/ ha (US$) | Ecotourists - Biosphere Reserve | Amigos de Sian Ka’an a.c. (as above) |
| 1984/87 | Izta-Popo, Morelos, Puebla, Mexico | 225 | revenue/year/ ha (US$) | Multipurpose tourists - National Park | Boo, 1990 (as above) |
| 1992/93 | Arrareko Lake, Chihuahua, Mexico | 1.24-1.65 | revenue/year/ ha (US$) | Multipurpose tourists - Complejo Ecoturistico Ejidal | Comisión de Defesa de los Derechos Humanos, A.C., Creel (as above) |
| 1986/92 | Mariposa Monarca, Michohacán, Mexico | 14.7-88.4 | revenue/year/ ha (US$) | Multipurpose tourists - Special Biosphere Reserve | SEDESOL (as above) |
| 1992 | Barranca del Cobre, Chihuahua, Mexico | 0.40-1.01 | revenue/year/ ha (US$) | Multipurpose tourists - Declared as National Park | SECTUR, Acuerdo Mexico Alemania, Author’s Survey (as above) |

**Table A3.4. - Non-wood forest products (NWFPs) values**

| Year | Locality | Value estimated (see Unit) | Unit of value | Comments | Source |
|---|---|---|---|---|---|
| 1981 | Ecuadorian Amazon | 120 | US$/ha/year | Values wildlife over 500 $km^2$ | Paucar & Gardner, 1981 (quoted in Godoy & Lubowski, 1992, Table 1: p. 425) |
| 1987 | Sarawak, East Malaysia | 8 | US$/ha/year | Values wildlife over 1 $km^2$ | Caldecott, 1987 (as above) |
| 1989 | Iquitos, Peru | 16-22 | US$/ha/year | Based partly on community diaries; flora only | Padoch & de Jong, 1989 (as above) |
| 1989 | Jenaro Herrera, Peru | 167 | US$/ha/year | Wild camu camu only; unclear whether net or gross | Peters, 1989 (as above) |
| 1989 | Amazon, Peru | 6,820 | US$/ha | Sustainable harvesting in 1 ha (timber + NWFPs), local market values. This value is higher than any other use, according the authors, e.g. clear-felling = US$1,000/ha; plantations for timber = US$3,184/ha and cattle ranching = US$2,960/ha | Peters, Gentry & Mendelsohn, 1989 |
| 1989 | Veracruz, Mexico | 116 | US$/ha/year | Flora only, excluding lumber and coffee | Alcom, 1989 (as above) |
| 1989 | San Luis Potosi, Mexico | 1,537 | US$/ha/year | Te'lom grove with coffee. Net of costs | CSERGE, 1993, Table 2: p. 7 (main report) |
| 1989 | San Luis Potosi | 330 | US$/ha/year | Te'lom grove without coffee. Net of costs | As above |
| 1989 | San Luis Potosi | 401 | US$/ha/year | Net of costs, half the product marketed | As above |
| 1989 | San Luis Potosi | 20.3 | US$/ha/year | Building materials. Net of costs | As above |
| 1989 | San Luis Potosi | 51.7 | US$/ha/year | Medicines. Cost of avoided doctor visits | As above |
| 1989 | San Luis Potosi | 14.5 | US$/ha/year | Fuelwood. Shadow price of labour method | As above |
| 1989 | Yucatan (chicle forests), Mexico | 4.9 | US$/ha/year | Average for 3 *ejidos* in Quintana Roo (net of costs) | As above |
| 1989 | Pine forests, Mexico | 3.1-281 | US$/ha/year | Costs not subtracted, 1 sp only | As above |
| 1989 | Quintana Roo | 9.0 | US$/ha/year | One *ejido* | As above |
| 1989 | all Mexico | 0.01 | US$/ha/year | Indicative only | As above |
| 1989 | Chiapas | 0.02 | US$/ha/year | Indicative only | As above |
| 1989 | Rain forest, Peten, Guatemala | 3.3 | US$/ha/year | Estimate for Peten | As above |

*Table A3.4 continues*

**Table A3.4** *continued***.**

| Year | Locality | Value estimated (see Unit) | Unit of value | Comments | Source |
|---|---|---|---|---|---|
| 1989 | Kalimantan, Indonesia | 53 | US$/ha/year | Net present value of cultivated rattan is US$529/ha over 25 years with a real discount rate of 10% | Godoy & Feaw, 1989 (quoted in Godoy & Lubowski, 1992, Table 1: p. 425) |
| 1989/91 | Ituri Forest, Zaire | 3.18-0.50 | US$/ha/year | 318 kg of game/$km^2$ of primary forest or 50 kg/$km^2$ in climax forest at US$1/kg. Estimate leaves out costs. Price is for prized meats | Wilkie, 1989; Wilkie & Curran, 1991 (as above) |
| 1989 | Mudumalal Sanctuary, South India | 3 | US$/ha/year | 0.02 domesticated elephants/ha at US$1,500/elephant. Excludes costs of domestication and training; a 10% discount rate is assumed | Sukumar, 1989 (as above) |
| 1989 | Amazon, Brazil | 4.80 | US$/ha/year | Gross return/ha/year for flora only | Schwartzman, 1989 (as above) |
| 1990 | Pará, Brazil | 110 | US$/ha/year | Value after selective thinning of competitors and pruning of Açai palm | Anderson, 1990b (as above) |
| 1991 | Amazon, Brazil | 59 | US$/ha/year | Includes kernel, charcoal and feed meal of babassu palm; unclear whether net or gross | Anderson et al., 1991 (as above) |
| 1991 | Zimbabwe | 75 | US$/$km^2$/year | Estimate from the sale of elephant goods and services. The proportion attributed to sale of goods has fallen significantly since the imposition of an international ban on ivory sales | Zimbabwe, Dept. of National Parks, 1991 (quoted in Pearce and Moran, 1994, Table 6.3: pp. 86-91) |
| 1991 | Hantana, Sri Lanka | 50 | US$/ha/year | 50 randomly chosen households surveyed in three villages; used contingent valuation and opportunity cost approach; estimate excludes cost of extraction; flora only | Abeygunawardena & Wickramasinghe, 1991 (as above) |
| 1991 | Venezuela | 0.75 | US$/ha/year | Experimental caiman harvest | Thorbjarnarson, 1991 (as above) |
| 1992 | Sweden | 8 | US$/ha/year | NWFP | Hultkrantz, 1992 (quoted in FAO, 1995, Table 3: p. 9) |
| 1993 | Poland | 3.6 | US$/ha/year | NWFP | SAR Poland, 1993 (as above) |
| 1994 | Upper Napo region of Amazonian, Ecuador | 2,939 | NPV/ha (US$) | The potential net present values (NPV) per ha from NWFP in the Upland Plot A | Grimes et al. 1994, Table 5: p. 409 |
| 1994 | As above | 2,721 | NPV/ha (US$) | The potential net present values (NPV) per ha from NWFP in the Upland Plot B | As above |
| 1994 | As above | 1,257 | NPV/ha (US$) | The potential net present values (NPV) per ha from NWFP in the Alluvial Plot C | As above |

**Table A3.5. - Existence and option values**

| Year | Locality | Value estimated (see Unit) | Unit of value | Comments | Source |
|---|---|---|---|---|---|
| 1993 | Mexico | Low 1<br>Medium 6<br>High 90 | US$/ha/year | Option value of pharmaceuticals from Mexico's forests | CSERGE, 1993, Table 4: p. 15 (main report) |
| 1993 | Selva Lacandona; Montes Azules, Chiapas, Mexico | 10.38 | WTP/ha (US$) | Debt-for-Nature Swap. Conservation International | Tajbakhsh, 1993 (as above) |
| 1993 | Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico | 0.06<br>0.05 | WTP/ha (US$) | The first figure is the total amount of donations for 1992; Sian Ka'an report that only 10% of donors have actually visited the reserve | Amigos de Sian Ka'an (as above) |
| 1993 | Barranca del Cobre, Chihuahua, Mexico | 4.4 | WTP/ha (US$) | A survey carried out in Barranca del Cobre suggests a WTP/person/year related to existence value of US$1.82. Multiplying this by the number of visitor per annum (55,000 in 1992) gives a total of US$100,100; and at a 5% discount rate, a present value of US$4.4 | Author's Survey (as above) |
| 1993 | Mexico (several areas) | 0.029 | WTP/ha (US$) | Areas involved in the calculation are those contained in a World Resources Institute, Washington, D.C. | Abramovitz, 1991 (as above) |
| 1994 | Costa Rica | 24 | US$/ha/year (8% discount rate) | | World Bank, 1994 |
| 1994 | Slovenia | 27 | US$/ha/year | | Ayres & Dixon, 1994 (quoted in FAO, 1995) |
| 1989 | Cameroon | 0.19-0.65 | Avg. US$/ha | Expected production value approach. Option value. (1989 US$) | Ruitenbeek, 1989 (quoted in Kishor & Constantino, 1994, Table 6) |
| 19?? | Costa Rica | 0.15 | Avg. US$/ha | Expected production value approach. Option value. (1989 US$) | Kishor & Constantino, 1994, Table 6 |
| 19?? | Guanacaste, Costa Rica | 12.8-32.0 | Avg. US$/ha | Transfer-of-Funds. Donations from international + domestic agencies + debt-for-nature swaps. Existence & Option Values. (1989 US$) | As above |
| 1984 | Colorado, USA | i. 2.5-9.1<br>ii. 3-11.1<br>iii. 3.1-11.3 | Avg. US$/ha | (i) option; (ii) existence and (iii) bequest values for Colorado Wilderness areas. CVM of 218 Colorado households via mail surveys. Consumer surplus, $/family/year, 1980 US$ | Walsh et al., 1984 (as above) |

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*Table A3.5 continues*

**Table A3.5** *continued***.**

| Year | Locality | Value estimated (see Unit) | Unit of value | Comments | Source |
|---|---|---|---|---|---|
| 199? | Khao Yai Park, Thailand | 21.6 | Avg. US$/ha | National Park. Existence & option values | Dixon and Sherman, 19?? (as above) |
| 1988 | USA | 21-149 | Avg. US$/ha | Total, nonconsumption WTP for preserving the Whooping crane. CVM, dichotomous choice model. 1983 US$/household/year | Bowker and Stoll, 1988 (as above) |
| 1983 | | 5.5-9.9 | Avg. US$/ha | WTP for proposed national park. CVM. 1982 US$/household/year | Majid et al., 1983 (as above) |
| 19?? | Costa Rica | 0.15 | US$/ha | Future Pharmaceuticals. Option value | Kishor & Constantino, 1993, Table 5 |
| 19?? | Mexico | 6.4 | US$/ha | Estimated option value for Mexican tropical evergreen forests | Adger et al., 1995, Table 7: p. 294 |
| 19?? | ??? | 10-25 | US$/household/year | Fragile forests. | Wibe, 1995, Table 3: p. 15[A3.2]. |
| 19?? | ??? | 17 | As above | Endangered species | As above |
| 19?? | ??? | 40 | As above | Spotted owl | As above |
| 19?? | ??? | 20-22 | As above | Bald eagle | As above |
| 19?? | ??? | 12 | As above | Wild turkey | As above |
| 19?? | ??? | 4 | As above | Coyote control | As above |
| 19?? | ??? | 5 | As above | Coyote preservation | As above |
| 19?? | ??? | 61-106 | As above | Wilderness | As above |
| 19?? | ??? | 62 | As above | Recreation forests | As above |

Notes: WTP = willingness to pay; CVM = contingent valuation method; Avg. = Average.

A3.2 Values quoted from Wibe (1995) are not specific for a particular country, but a summary of a survey of different valuation studies carried out in developed countries. They are in 1990 US$. Wibe calls attention to the fact that the existence value studies are concentrated on the value (willingness to pay, WTP) of endangered species. The values vary considerably with respect to object. Thus, it is impossible to draw any reasonable conclusion about the total existence value of forests since an aggregation of individual estimates for the thousands of different plants and animals in forests is likely to lead to unreasonable total sums. This note can also be applied to the values presented in the table on biodiversity/conservation.

**Table A3.6A. - Carbon sequestration values**

| Year | Locality | **Value estimated** (see Unit) | Unit of value | Comments | Source |
|---|---|---|---|---|---|
| 1992 | Sweden | 0.13 | US$/kg carbon | | Hultkrantz, 1992 (quoted in FAO, 1995, Table 3: p. 9) |
| 1993 | USA | 30 | US$/tonne | Net carbon sequestered | SAR Poland, 1993 (as above) |
| 1993 | Costa Rica | 60-120 | Average US$/ha | 1989 US$ | Kishor & Constantino, 1993 |
| 1994 | Costa Rica | 68 | US$/ha/year | Value at 8% discount rate | World Bank, 1994, Table A4.1: p. 4 |
| 19?? | CARE/Guatemala | 0.05-0.23 | US$/tonne | | Faeth et al., 1994, Table 1: p. 7 |
| 19?? | PDA/Thailand | 7.93-10.8 | US$/tonne | | As above |
| 19?? | ANCON/Panama | 0.35-2.43 | US$/tonne | | As above |
| 19?? | UCEFO/Mexico | 1.06-1.20 | US$/tonne | | As above |
| 19?? | KMTNC/Nepal | 13.64-16-14 | US$/tonne | | As above |
| 19?? | Oxfam/Amazon | 0.03-0.06 | US$/tonne | | As above |
| 1995 | Mesopotamia, Argentina | 5.56 | US$/tonne | Cost/tonne of carbon sequestration in industrial/silvo-pastoral plantation (25 years, 20,000 ha/year, harvesting) | Sedjo and Ley, 1995, Table 12: p. 47 |
| 1995 | Mesopotamia, Argentina | 3.44 | US$/tonne | Cost/tonne of carbon sequestration in industrial/silvo-pastoral and associated wood stocks (25 years, 20,000 ha/year, harvesting) | As above |
| 1995 | Mesopotamia, Argentina | 13.74 | US$/tonne | Cost/tonne of carbon sequestration in mixed species plantation (5 years, 20,000 ha/year, no harvesting) | As above |
| 1995 | Patagonia, Argentina | 7.6-5.36 | US$/tonne | Cost/tonne of carbon sequestration in industrial plantation (5 years, 20,000 ha/year, no harvesting). Years 2020 and 2070, respectively | As above |
| 1995 | Patagonia, Argentina | 21.95-7.87 | US$/tonne | Cost/tonne of carbon sequestration in mixed species plantation (5 years, 20,000 ha/year, no harvesting). Years 2020 and 2070, respectively | As above |

Notes: CARE (uses acronym; now registered as Cooperative for Assistance and Relief Everywhere); PDA = The Population and Development Association; ANCON = Asociación Nacional para la Conservación de la Naturaleza; KMTNC = King Mahendra Trust for Nature Conservation, UCEFO = Union de Communidades y Ejidos Forestales de Oaxaca.

**Table A3.6B. - Private sector carbon offset deals**

| **Company** | **Project** | **Other participation** | **Million t C sequestered or reduced** | **Total cost** $ (millions) | **$/t C sequestered** (for a, b, c, see notes) |
|---|---|---|---|---|---|
| AES | Agro-forestry, Guatemala | US CARE<br>Govt. of Guatemala | 15-58 over 40 years | 15 | a) 0.5-2<br>b) 1-4<br>c) 9 |
| AES | Natural reserve<br>Paraguay | US Nature Conservancy<br>FMB | 13 over 30 years | 6 | a) 0.2<br>b) 0.45<br>c) <1.5 |
| AES | Secure land tenure, sustainable agriculture<br>Bolivia, Peru, Ecuador | Other utilities giving consideration to deal | na | 2 | na |
| SEP | Reforestation: Netherlands<br>Czech Republic<br>Malaysia<br>Ecuador<br>Uganda<br>Indonesia | Innoprise | 0.9<br>3.1<br>6.3<br>9.7<br>7.2<br>6.8 | 20<br>30<br>15.7<br>17.3<br>8.0<br>21.17 | b) 22.7<br>b) 9.7<br>b) 2.5<br>b) 1.8<br>b) 1.1<br>b) 3.2 |
| Tenaska and others | Reforestation<br>Russia | EPA, Trexler, Min. of Ecology, Russian Forest Service | 0.5 over 25 years | 0.5? | a) na<br>b) 1<br>c) 1-2 |
| Tenaska | Forest conservation in Costa Rica, Reforestation in Washington State | Other utilities giving consideration | na | 5+ | b) 43 |
| PacifiCorp | Forestry<br>Oregon | Trexler | 0.06 pa | 0.1 pa | a) na<br>b) na<br>c) 15-30 |
| PacifiCorp | Urban trees<br>Utah | Trexler TreeUtah | ? | 0.1 pa | a) na<br>b) na<br>c) 15-30 |
| New England PC | Forestry<br>Malaysia | Rain Forest Alliance, COPEC | 0.1-0.15 | 0.45 | a) na<br>b) 3-4.5<br>c) na |
| New England PC | Methane recovery in Appalachians | na | na | na | na |
| Wisconsi Elec. Power; NIPSCO Ind; Edison Dev. Co. | Coal to gas conversion | Bynov Heating Plant<br>Decin, Czech Republic | 12,800 tpa? | 1.5 | b) 43 |

Source: Pearce, 1994 (quoted in Steele and Pearce, 1996, table 5: p. 55). $CO_2$ converted to C at 3.67:1. Dutch guilders converted to US$ at DG1.75 per $.

Notes: a) Assumes 10 percent discount rate applied to total cost to obtain an annuity which is then applied to carbon fixed per annum, assuming equal distribution of carbon sequestered over the time period indicated; b) assumes no discounting; c) cost per tonne C as reported in Dixon et al., 1993.

**Table A3.7. - Recreation values**

| Year | Locality | Value estimated (see Unit) | Unit of value | Comments | Source |
|---|---|---|---|---|---|
| 1965 | USA | 26 | Mean value/activity day | Camping. Travel cost method (TCM). 1990 US$ | Kalter & Gosse, 1969 (quoted in Wibe, 1995) |
| 1965 | USA | 64.2 | As above | Hiking. TCM. 1990 US$ | As above |
| 1969-70 | USA | 39-68 | As above | Deer hunting. Contingent valuation method (CVM). 1990 US$ | Capel and Pandey, 19?? (as above) |
| 1977 | Denmark | 7-14 | As above | Recreation. TCM. 1990 US$ | Christensen, 1984 (as above) |
| 1980 | USA | 37-42 | As above | Recreation. TCM. 1990 US$ | Haspel & Johnson, 1982 (as above) |
| 1980 | USA | 26 | As above | Recreation. TCM. 1990 US$ | Mendelsohn et al., 1993 (as above) |
| 1986 | Sweden | WTP = 675<br>WTA = 1584 | As above | Moose hunting. CVM. 1990 US$ | Mattsson & Kriström, 1987 (as above) |
| 1985 | USA | 13-26 | As above | Recreation. CVM. 1990 US$ | Brown et al., 1989 (as above) |
| 1987 | UK | CVM = 2<br>TCM = 4 | As above | Recreation. CVM and TCM. 1990 US$ | Hanley, 1989 (as above) |
| 1987 | UK | 3-5 | As above | Recreation. TCM. 1990 US$ | Willis and Benson, 1989 (as above) |
| 1987 | USA | 48 | As above | Hunting. TCM. 1990 US$ | Glass and More, 1992 (as above) |
| 1987-88 | Denmark | 2 | As above | Recreation. CVM. 1990 US$ | Linddal & Sondergaard-Jensen, 1991 (as above) |
| 1988 | UK | TCM = 1-2<br>CVM = 0.3-2 | As above | Recreation. TCM and CVM. 1990 US$ | Willis & Garrod, 1991 (as above) |
| 1988 | Finland | 45 | As above | Moose hunting. CVM. 1990 US$ | Ovaskainen et al., 1991 (as above) |
| 1988 | Norway | WTP = 59<br>WTA = 123 | As above | Moose hunting. CVM. 1990 US$ | Södal, 1989 (as above) |
| 1989 | USA | 5 | As above | Recreation. CVM. 1990 US$ | Halstead et al., 1990 (as above) |
| 1989 | USA | WTP = 262<br>WTA = 1082 | As above | Recreation. CVM. 1990 US$ | Brown & Hammade, 1992 (as above) |
| 1990 | Norway | 82 | As above | Moose hunting. CVM. 1990 US$ | Schei, 1991 (as above) |
| 1991 | Sweden | 52 | As above | Recreation. CVM. 1990 US$ | Bostedt & Mattsson, 1992 (as above) |

Notes: WTP = willingness to pay; WTA = willingness to accept. Note that the estimated WTA is 2-3 times higher than the WTP.

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[A3.3] Many of these references are also found in the main bibliography preceding annex 1. They are reproduced here to maintain the independence of annex 3.