Economic Valuation of Forests and Nature

A support tool for effective decision-making

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CONTENTS

PREFACE

During the past decade, the valuation of the functions of forests and nature and the development of appropriate valuation methodologies have gained increasing international attention. A great deal of progress has consequently been made on this subject, which is considered of vital importance for sound decision-making. This is expressed in the many documents that have been published. In the Netherlands, too, a country where pressure on land is high, valuation methodologies are increasingly considered when it comes to evaluating and selecting the best of a number of alternative land uses.

Environmental economic approaches basically involve the proper valuation of the positive (benefits) and negative (costs) aspects related to natural resources, be it forests, natural parks, wetlands or other types of nature. In practice, the most common way of comparing costs and benefits is in direct monetary terms, cash inflow and outflow. Costs and benefits that are more difficult to express in monetary terms, or that cannot be quantified at all, tend to be overlooked in decision-making despite their considerable value; this is particularly so if they have long-term implications. Stakeholder involvement in decision-making is increasingly considered important, especially where the values attributed are inextricably bound up with stakeholders, both in the conservative economic sense and in the approaches based on "environmental economics" that have emerged more recently.

Applying environmental economics and valuation concepts in decision-making allows one to include values other than strictly monetary ones. Some argue that the application of these concepts may lead to greater uncertainty, but in fact quantification in direct monetary values is usually equally biased because of the market or policy failures of the "free market". It is emphasised that valuation is a support tool that should not replace decision-making responsibility. Policy decisions usually are made not only on economic grounds but also on the basis of other criteria (policy, self interest, short-term, ethical, etc.). The application of valuation concepts, however, contributes to improving transparency, not only for decision-makers themselves but also for all stakeholders involved in the decision.

This document reviews the major issues and methodologies and the latest developments in the field of the valuation of forests and nature. It is intended to assist policy-makers, project and programme implementers, and funding agencies in taking informed decisions on the economic, social and ecological feasibility of development options in natural resources management and conservation.

This study was commissioned by the Ministry of Agriculture, Nature Management and Fisheries of the Netherlands and jointly implemented by the International Agricultural Centre (IAC) at Wageningen University and Research Centre and the National Reference Centre for Agriculture, Nature Management and Fisheries (EC-LNV). We sincerely hope that this study will contribute to a better understanding of the scope and limitations of valuation concepts and methodologies for informed decision-making by policy-makers.

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SUMMARY

Valuation of the intangible goods and services provided by forests and nature areas is increasingly important –at local, national and international level– when the deterioration of tropical forests, wetlands and other biodiversity-rich ecosystems is at stake. International policy discussions are progressing towards a better understanding of these "hidden values", and they are calling for the development of simple new tools with which to arrive at a more comprehensive valuation of the resources involved.

The present document explains the need for economic valuation in decision-making and touches on the causes and effects of the undervaluation of forests and nature. It emphasises the importance of thorough analysis of the various different functions of a forest or nature area and their relationship to all the relevant stakeholders that contribute in any way to maintaining those functions or who benefit from them. In other words, when decisions are to be taken on the use of a specific forest or nature area, a proposed alternative use may have a positive and/or negative impact on the various different stakeholders involved. Analysis of this relationship can identify the value (or change in value) that a specific stakeholder assigns to the different functions. In this type of economic valuation, a particular function of the forest only has value when one or more stakeholders attach some kind of interest (whether positive or negative) to it. This document presents an analysis of the different types of value associated with the various functions. Some method of quantifying these values is essential to economic decision-making; it can be facilitated by placing all values under a single common denominator, usually expressed in monetary terms.

In order to quantify the values assigned to the various functions, this document distinguishes between three categories:

a) The first –and simplest– type of valuation is that based on market prices. All the costs and benefits associated with a proposed or alternative use option can be determined by the prices that are paid on the market, assuming that there are no market distortions. In this case, Cost-Benefit Analysis can be used to assist in decision-making by simply listing all the current and expected money flows and making them comparable (costs as well as benefits).

b) In the context of forests and nature areas, however, many values are less easy to quantify and other valuation tools and techniques are required if these values are to be quantified in monetary terms. This document describes examples of various different valuation tools and examines their features. Once quantified, values can be incorporated into an "Extended Cost-Benefit Analysis" in order to assist decision-making.

c) The third category when dealing with the quantification of values concerns those that simply cannot be quantified. Some functions and uses of the forests involving ethical issues, for example, are impossible to convert into monetary terms. Some people also place psychological and ecological values in this category. In such cases, decision-making can draw on techniques such as Multi-Criteria Analysis, in which alternative uses can be matched with different criteria, with weights being assigned to them.

Decision-making is to some extent arbitrary and depends on the norms and criteria of the decision-maker. However, by applying a methodology that follows the above-mentioned logic and by arriving at the optimum type of analysis, the transparency of decision-making processes can be greatly increased.

This document consists of three sections plus a number of appendices. The main section deals briefly with the subject of "Economic valuation of forests and nature"; the second section consists of a checklist to be used by professionals involved in decision-making in the field of natural resources management; and the third section summarises six case studies demonstrating the application and effectiveness of different valuation techniques. The appendices provide a glossary of terms, literature references and a list of useful addresses (websites or institutional addresses), as well as more detailed information on the various elements covered by the main document.

Section 1. Economic valuation of forests and nature

1. Introduction

Tropical rainforests, wetlands and other biodiversity-rich ecosystems continue to decline at an alarming rate. Underestimation of the value of the many goods and services provided by forests and nature areas has been recognised as one of the major causes of the failure to protect and manage them in a sustainable way. There is an overall consensus that in decision-making procedures regarding the use of natural resources not only should the easily quantifiable costs and benefits of forests and nature areas be taken into account, but also those that are more difficult to determine: the intangible costs and benefits. This raises the need for proper valuation tools to quantify and visualise the multiple benefits –but also the costs– of forests and nature areas.

This issue has been raised in international policy debates for many years, but only since the UNCED in Rio de Janeiro in 1992, have more significant initiatives in this field been developed. The issue of the "methodologies for proper valuation of the multiple benefits of forests" was dealt with during the sessions of the Intergovernmental Panel on Forests commencing in 1996. Since 1997 the Intergovernmental Forum on Forests has continued the debate. Currently, the valuation of functions of forests and nature is mainly present in international policy dialogue through the United Nations Forum on Forests and the conventions on Biological Diversity and RAMSAR. Within the framework of the United Nations Convention on Climate Change, valuation of the functions of forests (carbon sequestration) is one of the prominent elements.

This document is intended to assist professionals that work in policy formulation and implementation in natural resources management to support effective decision-making on these issues. For this group, a very general overview of the subject is given and a checklist is provided for effective use in working situations. In addition, a number of case studies on the economic valuation of tropical ecosystems are summarised in order to illustrate some valuation tools and techniques and the subsequent policy implications of the results of those case studies. In the appendices to this document more in-depth information can be found about each subject in this section. Reference is made at the end of each section to the relevant appendix, which contains detailed information on the subjects concerned.

For more detailed background information see Appendix 1

2. What is economic valuation and why do we need it?

Economic valuation is seen as an analytical tool for decision-making intended to compare the advantages and disadvantages of certain scenarios. In other words, economic valuation is a tool that can provide decision-makers with useful information for deciding between alternatives or on preferred combinations of possible interventions. The value of natural resources depends not only on the market prices of its direct uses but is also based on other indirect uses of these resources that cannot be traded on some kind of market. We are dealing here with generated values in their broadest sense (see Box 1).

Box 1. Economics and Environment
As we know, economics is the science of the choices people make when faced with scarcity in their resources. Scarcity is a situation in which resources are limited and can be used in various different ways. This means that we must sacrifice one thing for another. In environmental economics the situation is rather specific, because the choices to be made deal with issues that are hard to compare. While in traditional economics, whether in micro-economics at household or "entity"-level or in macro-economics at national economic level, the estimates and consequences can be visualised in monetary terms, this is not always the case in issues regarding environmental values. For that reason, a variety of different tools have been developed to try to overcome this difficulty.

Valuation of the goods and services provided by forests and nature areas is needed because these areas are under great pressure and are in fact disappearing. Lack of knowledge and awareness of the total value of the goods and services provided by these natural resources will obscure the ecological and social impact of the conversion of forests into construction materials, infrastructure, industrial areas, houses or agriculture. Even when these impacts are understood, there is often a lack of financial resources for sustainable management of forests and nature areas. More information about the ecological, economic and social or cultural values of forests and nature areas, and the synergy between these values, is necessary in order to feed the public dialogue and to internalise these values as part of policy and decision-making. Moreover, in many cases those who derive benefits from the forest or from nature services, such as the owners of hotels or the visitors who enjoy nature, are not the ones who incur the costs and make the investments necessary to manage the forest properly. This means that the costs and benefits are not in the same hands. Proper valuation of all the goods and services provided by the forest or nature area can help understand the extent to which those who profit from the forest also bear the cost of managing it (Van der Lubbe, 2001).

3. Causes of undervaluation

Despite the importance of the valuation of forests and nature, undervaluation was and still is the order of the day. It is therefore extremely important to understand the causes of undervaluation because this may help policy and implementation-level decision-makers to tackle some of the problems related to undervaluation, such as deforestation.

Market failure has been identified as one of the major causes of undervaluation. When determining the economic value of a certain nature area, decision-makers usually only take into account the easily quantifiable –financial– costs and benefits related to goods and services traded on the market. However there are numerous functions of nature for which markets malfunction, are distorted or simply do not exist. Economists refer to this as market failure. Markets only exist for some of the production functions of forests and nature, such as for timber, fuel wood and non-timber products. However, even if markets exist, market prices for these goods may not reflect their real value, since markets can be *distorted*, for example by subsidies (which we would call a *policy failure*). Furthermore, the market price of a particular good may not reflect all the costs involved in producing that good. There may be benefits or costs enjoyed or borne by others not directly involved in the production of a good. Economists refer to these costs or benefits as externalities.

Where markets fail, as in the case of the valuation of functions generated by forests, the government –in principle– can adjust and influence them in order to create an environment in which the long-term interests of society as a whole are better protected. However, there are numerous reasons why governments may fail to do this. The government may be influenced by powerful pressure groups. Secondly, it may find it difficult to obtain the right information. Thirdly, bureaucracy, inadequate use of power, corruption or lack of co-ordination may hamper the implementation of good intentions. This so-called *policy failure* also contributes to the undervaluation of forests and nature areas.

For detailed information see Appendix 2

4. Functions of forests and nature

Defining the various functions of nature can help demonstrate the importance it has for humans and thus facilitate its economic valuation. The first step in a valuation exercise is therefore to identify the various different functions provided by a specific area. De Groot (1992) classifies four major groups of functions of nature; these are described below. Examples of these functions are presented in Table 1.

a. *Production functions*: Functions that are based on the provision by nature of a variety of resources.
b. *Regulation functions*: Functions that are provided by the capacity of ecosystems to regulate essential ecological processes and life support systems.
c. *Carrier functions* (also known as habitat functions): Functions that are provided by ecosystems through space and a suitable substrate or medium for the system itself as well as for many human activities.
d. *Information functions*: Functions that do not involve a physically measurable effect or output from an ecosystem, but contribute to human well-being by their importance to religion, culture or individual well-being.

Table 1. Examples of goods or services of nature according to the classification in functions (after De Groot, 1992).

Production functions	Regulation functions	Carrier or habitat functions	Information functions
Food and nutrition	Buffering of CO2 (e.g. by trees or coral reefs)	Habitat for indigenous people	Aesthetic, spiritual, religious and cultural or artistic information
Oxygen	Fixation of solar energy and biomass production	Recreation and tourism	Historic information (heritage)
Water	Climate regulation	Cultivation	Educational and scientific information
Genetic resources	Watershed protection and catchment		
Raw materials for manufacturing	Erosion protection		
Fuel and energy	Storage and/or recycling of organic matter		
Fodder and fertiliser			
Biochemicals	Maintenance of biological diversity		
Medicinal resources	Storage and/or recycling of human pollution		
Ornaments	Formation of topsoil and maintenance of soil fertility		

Some aspects such as scarcity, tradability, substitutability and sustainability of functions are important with regard to their economic valuation. This is important, for instance, when we know that different stakeholders often make different and competing claims to various functions of the forest. Not every function of a forest will always remain intact when a certain use is made of that forest. A particular use may prevent other stakeholders from benefiting from other functions.

For detailed information see Appendix 3

5. Stakeholders

Different stakeholders use various functions of forests and nature areas differently. The economic value of a function depends on the stakeholder using it. The next step in the valuation process is therefore to identify the various stakeholders (interested groups) involved. Table 2 gives an example of stakeholder identification for forest resources. Stakeholders can be categorised by scale: local, regional, national and international, but also in time, such as current stakeholders and future stakeholders. When valuing forests, it is important to include as many relevant stakeholders as possible.

Table 2. Example of stakeholder identification for forest resources on a macro-micro continuum

Institutional level	Examples of stakeholders	Issues of interest in forest
Global and international	International agencies	Biodiversity conservation
	Foreign governments	Climatic regulation
	Environmental lobbies	Global resource base
	Future generations	
National	National governments	Timber extraction
	Macro planners	Tourism development
	Urban pressure groups	Resource and catchment protection
	NGOs	
Regional	Forest departments	Forest productivity
	Regional authorities	Water supply protection
	Downstream communities	Soil loss and degradation

Local off-site	Downstream communities	Protected water supply
	Logging companies and sawmills	Access to timber supply
	Local officials	Conflict avoidance
Local on-site	Forest dwellers	Land for cultivation
	Forest-fringe farmers	Timber and Non-Timber Forest Products
	Livestock keepers	Grazing and fodder
	Cottage industry	Cultural sites
	Women fuel collectors	

Source: Grimble *et al.*, 1994, *in:* Grimble & Wellard, 1997

In classifying stakeholders, it should be noted that people as individuals may fit into more than one interested group. For instance, consumers of timber may also be local forest dwellers who have an interest in the forest for their survival, but they may also be environmentalists.

For detailed information see Appendix 4.

6. Values

An economic value is the worth a product or service has for an individual or like-minded group. The combination of the various functions and the stakeholders for whom those functions are relevant determines the total economic value of a forest or nature area. The economic value assigned to the various functions of forests and nature areas thus depends on the groups of people or stakeholders that exert the claim, and is inherently highly anthropocentric by nature. In summary we can say:

Functions related to Stakeholders = Values

When assessing the total economic value of forests, it is therefore important not only to consider all the possible functions of a forest but also all the relevant stakeholders.

Confusion frequently arises as to the difference between *functions* and *values* and between *value*s and *prices.* The differences between these concepts are explained in Boxes 2 & 3.

Box 2. Functions and Values

Not infrequently, the function of timber production of a forest is mistakenly considered a value, while –on the other hand– the function of a forest is determined by the proceeds from selling a forest product.

The difference between functions and values can be explained by taking the example of a dollar. The banknote has the function of facilitating the arrangements between two people involved in a transaction. It serves as a reference to measure the worth (value for a stakeholder) of one good or service against the worth (value for the other stakeholder) of another good, in order to determine how much of one good should be traded for the other. The value of one good therefore depends on the personal preference of the stakeholder for that specific good.

To return to forests: the fact that a forest can produce wood or oxygen, or can provide specific fruits etc. is termed a production function of the forest. The need of a particular stakeholder (or group of stakeholders) to obtain that wood, or the importance the stakeholder places on the sequestration of CO_2 from the air, will determine the value this function has for that stakeholder. Values attributed by different stakeholders (in a negative and positive sense) can be added up to arrive at the total economic value of this particular forest, as long as no double counting takes place.

Box 3. Values and Prices

It would be wrong to consider the value of a good as the same as its price. If there were no market distortions –i.e. with an open market and sufficient producers and consumers– a good that has a market price would reflect the value of that good. The price is determined by the equilibrium in supply and demand. Some people would be willing to pay more than others, depending on their need for the product. This value of the number of people and their willingness to pay more than they have to is referred to as the consumer surplus. It is also known as the economic benefit that individuals receive. When markets are distorted, for whatever reason, the market price does not reflect the real price. Even if markets did not exist, economists would use shadow prices for their economic

Munasinghe (1992) has produced a classification of the major categories of value assigned to nature (Figure 1). This can be used as an analytical tool to determine the main values associated with certain functions of nature and to identify suitable valuation tools to assess their monetary value. Munasinghe (1992) divided the total economic value of nature into use and non-use values. The use values are divided into the direct use, indirect use and option values. The non-use values are divided into the existence and bequest values. Below each major value category, a short definition of its meaning and a few typical examples of the environmental resources underlying the perceived value are provided. "Option, bequest, and existence values are [linked with a dotted line in order] to caution the analyst concerning some of the ambiguities associated with defining these concepts. As shown in the examples, they can spring from similar or identical resources, while their estimation could be interlinked also. However the concepts of value are generally quite distinct" (Munasinghe, 1992).
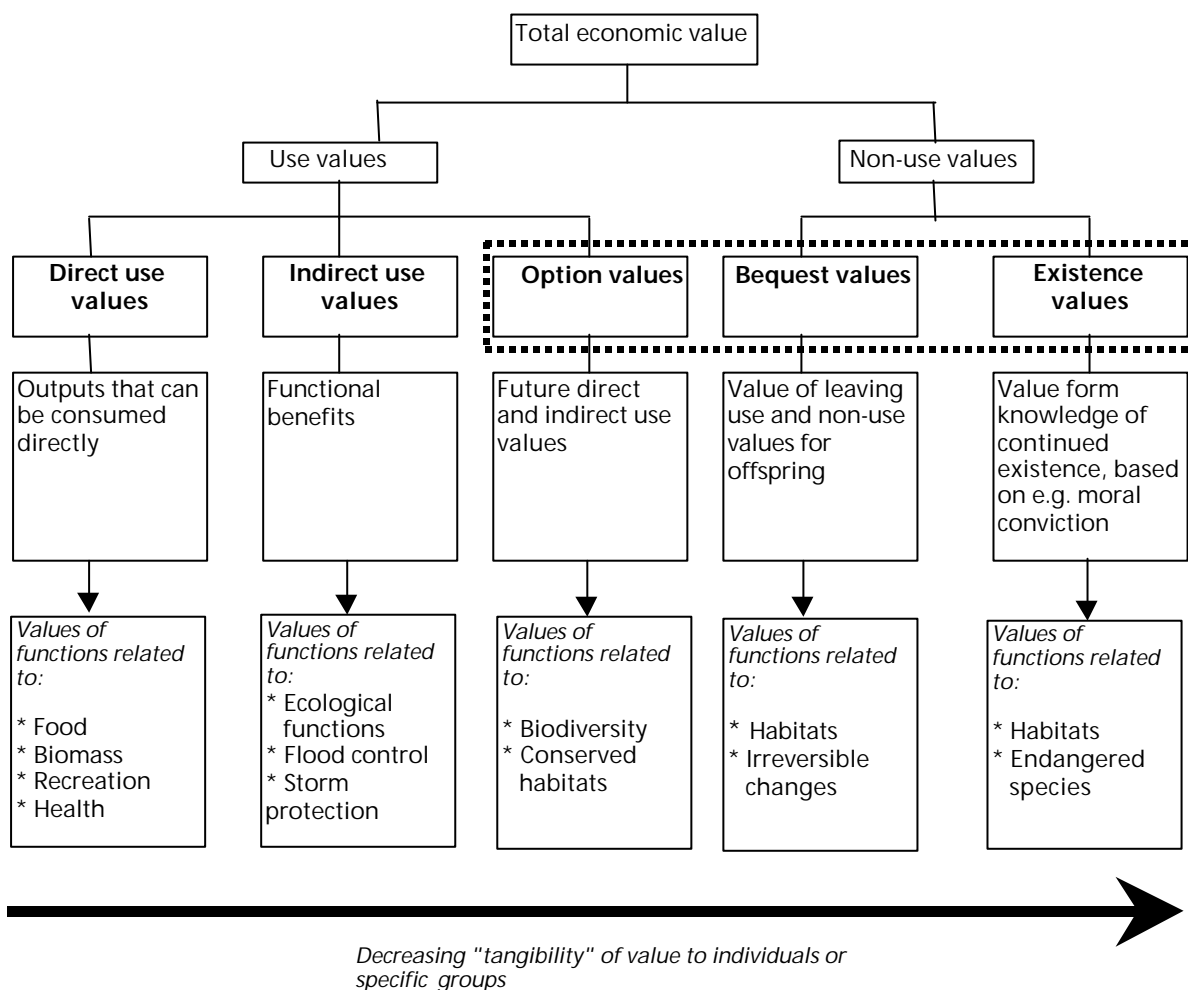
Figure 1. The total economic value of nature (Source: Munasinghe, 1992, adapted)

For detailed information see Appendix 5.

7. Economic valuation and decision-making

Decision-making means making choices between alternatives on the basis of the values attached to those alternatives. In all cases, the values associated with a proposed change need to be compared with the status quo. In other words, the comparison should be between the sets of values that would exist with and without the proposed change. In decision-making processes, the positive aspects (benefits) are weighed against the negative aspects (costs) related to alternative land uses (for example). The balance between these elements will influence the decision. The most useful common denominator for expressing the various different values is "translation" into monetary terms.

Decision-making depends on a large number of factors: the stakeholder, the decision context, personal preferences, or the existing institutional or administrative arrangements. Involving all relevant stakeholders is important because they are the ones who determine the value of forests and nature functions. Some stakeholders will perceive negative values (costs) and others positive ones (benefits) in relation to these alternatives. Different stakeholders assign different use values. Conflicting use by different parties raises questions of compensation: for example, should local users who suffer as a result of use by non-local people be compensated? If so, by whom and for how long? (Meijerink, 1997).

Functions of nature that are easy to quantify in monetary terms (production functions) and other less easily quantifiable functions (regulation, habitat and information functions) should be brought together in order to compare alternatives, weigh importance according to criteria and take a responsible decision.

For detailed information see Appendix 6.

8. Comparing costs with benefits

The most common method of comparing costs with benefits is the Cost-Benefit Analysis. Cost-Benefit Analysis compares alternatives based on the monetised advantages and disadvantages. Two main issues are essential in Cost-Benefit Analysis: the time factor and the principle of discounting (Box 4).

Box 4: The time factor and discounting

The value of USD 100 now is not the same as in one year's time. If someone gave you the option of receiving USD 100 now or waiting a year and then getting USD 100 in cash, which would you prefer? Ten to one you would opt for the USD 100 now! Generally, people would rather have something right away than wait for it. They are only willing to wait for something, if a bigger reward is promised. You might therefore opt for USD 200 in one year's time instead of the USD 100 now. This is the consumption side of time preference. There is also an investment side of time preference. This USD 100 can be invested and in one year's time a profit can be made. The rate of time preference, or discount rate, is often equated to the interest rate. But a discount rate can also be chosen, for instance, on the basis of a certain expected or required rate of return. Many economists use discount rates ranging from 8%-12 %.

Discounting is used in Cost-Benefit Analysis to compare costs and benefits over time. All (future) costs and benefits are "brought back" to "time zero". With rates of 8%-12%, a timeline of 25 years is usually applied. After this, the discounted costs and benefits have become so small that they do not add much weight to the scale. For example, a sum of USD 1000 discounted by 8% over 30 years will have shrunk to USD 99.40! This makes clear that discounting often works against the conservation of the environment, where benefits often appear over long time horizons. Some tropical hardwood trees take 80 years to mature. If such a tree produces USD 1000-worth of timber when mature, the current value of this timber would be worth roughly 2 dollars (at an interest/discount rate of 8%).

The formula for determining present value is:

$PV = FV[1/(1 + r)^t]$ *Where: PV= Present Value*
FV= Future Value
t= number of years
r= discount rate

(Sources: Meijerink, 2001; Callan & Thomas, 1996)

In Cost-Benefit Analysis, it is important to consider all the costs and benefits related to the proposed decision. This includes the consequences for all relevant stakeholders in the "with project" and "without project" scenarios. In order to be able to compare costs and benefits realised at different moments in time, all monetised values are discounted (brought back) to point "zero" in time and referred to as the Net Present Value. Of course, this can only be done when the costs and benefits can be quantified directly by means of cash flows in a traditional Cost-Benefit Analysis or indirectly by means of cash flows and valuation tools in an Extended Cost-Benefit Analysis.

This can be illustrated by a study performed by Beukering & Cesar (2001), who used an extended Cost-Benefit Analysis to value the benefits provided by the Leuser Ecosystem in Indonesia. They calculated the total economic value of this ecosystem under two different scenarios: conservation and deforestation. The conservation scenario can be regarded as the "without" project and the deforestation scenario as the "with" project situation. The study commenced by listing all the possible impacts of deforestation on the ecosystem functions and identifying all benefits provided by the ecosystem that are economically significant. The monetary value of these benefits was calculated for both scenarios for a time horizon of thirty years and with different discount rates. Some of the benefits, such as the provision of wood and Non-Timber Forest Products, were calculated on the basis of market prices while others, such as water supply and flood and drought prevention, were calculated with the help of valuation tools such as the *production functions approach* and the *human capital approach* (see also the boxes in section 9). The results of this study showed that during the first ten years the deforestation scenario produces higher returns, but after ten years the conservation scenario beats the deforestation scenario. Surprisingly, the Total Economic Value of the two scenarios depends to a great extent on the chosen discount rate, but the conservation scenario has the highest Total Economic Value at all the rates calculated. A more comprehensive summary of this study can be found in Section 3.

As this study illustrates, some of the functions of forests and nature can be valued by their market price or a shadow price. If there is no market, shadow prices can be calculated, assuming there is an actual market of supply and demand for a certain good. Most functions, however, are not traded in the market and should be valued with the help of valuation tools. These functions are referred to as non-marketed goods and services.

For detailed information see Appendix 7.

9. Valuation tools

In recent decades, various valuation tools have been developed to estimate the monetary value of non-marketed goods and services. Munasinghe's classification of major value categories has proved to be a useful analytical tool to link value categories and their underlying environmental goods and services with specific valuation tools as shown in Table 3. Only the most commonly used valuation tools are presented here.

Table 3. Example of links between value category, functions and valuation tools (After: Barbier, 1991, adapted).

	USE VALUES		NON-USE VALUES		
USE	**1. Direct use value**	**2. Indirect use value**	**3. Option value**	**4. Bequest value**	**5. Existence value**
FUNCTIONS	Wood products (timber, fuel) Non-wood products (food, medicine, genetic material Educational, recreational and cultural uses Human habitat	Watershed protection Nutrient cycling Air pollution reduction Micro-climatic regulation Carbon storage	Possible future uses of the goods and services mentioned in 1& 2 (Use Values) by actual stakeholders	Possible future uses of the goods and services mentioned in 1& 2 (Use Values) by the offspring of actual stakeholders	Biodiversity Culture, heritage Benefits to stakeholders of only knowing of the existence of goods or services without using them
	Tool to be used:	**Tool to be used:**	**Tool to be used:**	**Tool to be used:**	**Tool to be used:**
VALUATION TOOLS	Market Analysis Related Goods Approaches Travel Cost Method Contingent Valuation Method Hedonic Pricing	Restoration Cost Preventive Expenditure Production Function Approach Replacement Costs	Contingent Valuation Method	Contingent Valuation Method	Contingent Valuation Method

Some of these tools are dealt with briefly below, mainly as a means of illustrating their use. For a more extensive overview of the most common valuation tools, their applicability and limitations, we refer to Appendix 8.

The direct use value of goods and services traded on the market can be easily translated into monetary terms by taking their *market price*. However, there are a lot of other non-marketed goods and services which we perceive as having a direct use value. These functions can be better valued by means of valuation tools such as the Related Goods Approach, Hedonic Pricing or the Travel Cost Method.

The *Related Goods Approach* determines the value of a non-marketed good by using the price of another good for which the non-marketed good is exchanged through the process of barter (non-monetary trade). For example, if leafy vegetables harvested from a tropical rainforest are consumed locally and not traded on the market it is not possible to value these vegetables directly by assigning them a market price. However, if a basket of these vegetables is routinely exchanged for six eggs which are themselves sold for USD 1, we can assume that the monetary value of a basket of vegetables is USD 1.

The basic idea behind the *Hedonic Pricing Method* is that prices of land and property illustrate the valuation of environmental quality. For example, houses in natural surroundings generally command much higher prices than houses in city suburbs. The extra price paid is a proxy for the environmental value. Another valuation tool for obtaining a monetary direct use value is the *Travel Cost Method.* This tool estimates the value of recreational amenities by using the travel expenditure (in terms of time and money) needed to reach the recreational site. An example of the results of such a study is given in Box 5.

Box 5. The Travel Cost Method

Menkhaus & Lober (1996) used the Travel Cost Method to estimate the value that US ecotourists assign to Monteverde Cloud Reserve in Costa Rica. They arrived at a total annual US ecotourism value of USD 4.5 million. Values such as this can be used to calculate revised (higher) entrance charges that more adequately reflect the ecotourism benefit for the area. This study arrived at an average entrance charge of USD 40, which is considerably higher than the USD 5- 10 usually charged at national parks in Costa Rica.

Regulation functions of forests and nature from which we perceive an indirect use value can also be valued by various valuation tools, such as the Replacement Cost Technique and the Production Function Approach. The *Replacement Cost Technique* generates a value for the benefits of an environmental good or service by estimating the cost of replacing the benefits with an alternative good or service. The alternative should, as nearly as possible, produce the same level of benefits supplied by the resource or environmental function being valued. The *Production Function Approach* is a tool to capture the indirect use value of regulatory ecological functions of ecosystems through their contribution to economic activities. An example of a study in which this tool was used is given in Box 6.

Box 6 The Production Function Approach

Kramer et al. (1995) used the Production Function Approach in combination with other valuation methods to estimate the value of a national park currently being established in Madagascar. The establishment of this park benefits farmers in terms of reduced crop losses as a result of reduced flooding, due to the fact that deforestation in the park is prohibited. Deforestation rates in the Mantadia area were first estimated by using remote sensing data. Future deforestation rates were projected on the basis of the historical analysis. These land use changes were used to project effects on flooding. Finally, the predicted reductions in flooding brought about by the park and buffer zone were used to predict reduced crop losses; these were estimated and valued in economic terms.

The Contingent Valuation Method can only capture option, bequest and existence values. This is by far the most commonly used tool for estimating the monetary value of environmental amenities that are not traded in formal markets. The Contingent Valuation Method is a survey-based method which estimates people's Willingness-to-Pay for a specified good or service or Willingness-to-Accept compensation for losing it. This method is used in various applications. Box 7 summarises two case studies in which the Contingent Valuation Method was used to estimate people's Willingness-to-Pay for tropical rainforest amenities.

Box 7. Two applications of the Contingent Valuation Method

Hadker's study (1997) estimates Bombay residents' willingness to pay for the maintenance of Borivli National Park, which is located within the city limits of Bombay. The study arrives at a Willingness-to-Pay of 7.5 rupees per month per household. This amounts to a total present value of USD 31.6 million. This figure could be used to influence policy decisions, given that the National Park currently runs on a budget of USD 520,200. Another interesting finding for policy-makers was that businessmen are willing to pay significantly more than other professionals, as it is this group who may be able to finance environmental improvements.

Kramer et al. (1993) used the Contingent Valuation Method in a national postal survey to assess the value that US residents place on the protection of tropical rainforests. The survey was mailed to a random sample of 1,200 US residents. It asked them how much they would be willing to contribute to a hypothetical United Nations Save the Rainforest Fund. The researchers arrived at a mean Willingness-to-Pay of USD 24-31 per household. Taking into account all households with an income of more than USD 35,000 annually, this would apply for a one-time donation of USD 780 million to USD 1 billion for rainforest protection.

It must be emphasised that none of these valuation tools provides comprehensive answers. All of them value only part of the goods and services provided by forests and nature. They all have limitations and should be chosen and used with care. Using several valuation tools for a single

object case, such as in the studies by Kramer (1995) and Beukering & Cesar (2001) could contribute to a more complete valuation. Several case studies are summarised in section 3 in order to illustrate the use and limitations of various different valuation tools for different environmental goods and services in the tropics.

For detailed information see Appendix 8.

10. Including the non-monetary costs and benefits: Multi-Criteria Analysis

There will always be values, for example spiritual and intrinsic values, that cannot be expressed in monetary terms and which can therefore not be compared directly with other costs and benefits. This means that these aspects cannot be brought together under the same denominator, but that the different aspects can have their own justification and should be seen in relation to one other. In fact, one speaks about different objectives and different criteria that need be weighed against one another.

Multi-Criteria Analysis is a tool that can help in dealing with this problem. This tool has been developed "expressly for situations where decisions must be made, taking into consideration more than one objective which cannot be reduced to a single dimension" (Munasinghe, 1992). Its central focus is the quantification, display and resolution of trade-offs that must be made when objectives conflict.

A Multi-Criteria Analysis is usually clustered into three dimensions: the ecological, the economic and the social. Within these dimensions, the criteria are set and the decision-maker can weigh the importance of one element in association with the other elements, thus allowing more balanced decision-making. "However, the key question concerns whose preferences are to be considered. The method only aids a single decision-maker (or a homogeneous group). Various interested groups will often assign different priorities to the respective objectives, and normally it may not be possible to determine a 'single' best solution via the multi-objective models" (Munasinghe, 1992). This implies that decision-making is ultimately arbitrary and dependent on the decision-maker and his/her interpretations and norms. Still, the main added value in using these tools is the transparency it creates in decision-making and the possibility of communicating information on the nature of the problems.

Monetary values determined and estimated by means of an (extended) Cost-Benefit Analysis can be incorporated within the Multi-Criteria Analysis as one of the attributes, with their specific criteria to be weighed against all other attributes in decision-making.

Box 8 Combining a Cost-Benefit Analysis and a Multi-Criteria Analysis

Janssen & Padilla (1999) used a Cost-Benefit Analysis and a Multi-Criteria Analysis to value a mangrove forest in the Philippines. They compared the costs and benefits of mangrove preservation with those generated by alternative uses such as aquaculture and forestry. In addition to economic efficiency, equity and sustainability, objectives were taken into account and analysed according to the perspectives of the different types of decision-makers related to the alternative uses by means of a Multi-Criteria Analysis (an extensive summary of this case study can be found in section 3 of this document).

For detailed information see Appendix 9.

11. Concluding remarks

The first section of this document summarises very briefly the various different elements and the related logic involved in a proper valuation of forests and nature. Relating the functions and the stakeholders will produce the values. These values are expressed in order to compare the advantages and disadvantages of various different use options. The easiest way of bringing together the advantages and disadvantages is to simply calculate the inflow and outflow of money. It is not just the benefits but also the costs –all of them– that should be taken into account. But no matter how concrete this approach may seem, it is certain that in decision-making on

forests or nature some values will not be integrated (or not integrated adequately) into the analysis.

Including the intangible costs and benefits in decision-making by means of valuation tools and methods will express values in monetary terms. However, this can be arbitrary and biased. Appendix 8 (section 3) presents a list of advantages and limitations of the use of these tools. These methods have been criticised as being data intensive, making restrictive assumptions regarding consumer behaviour, and being sensitive to numerous sources of bias in survey design and implementation. A criticism of the Contingent Valuation Method can be found in Diamond and Hausman (1994).

None of the valuation tools provides comprehensive answers. All the tools value only some of the goods and services provided by forests and nature, including the traditional economic Cost-Benefit Analysis. All these valuation tools have their limitations and should be chosen and used with care. However, our argument in the present document is that by actively involving stakeholders in the process of valuation, a proper analysis can at least be made of all values (positive and negative) for all (relevant) stakeholders. This increases transparency, which is the main characteristic of democratic and participatory decision-making.

The use of different valuation techniques, and the summing up of these individual values in monetary terms has other interesting features as well. The imbalance between costs arising at the local level and benefits accruing at the national and international levels has raised questions as to whether people living in or near protected areas ought to be compensated for their losses, and if so, how such compensation should be made. Relevant aspects here are the potential and actual compensation of stakeholders for unequal access, benefit sharing or burden with respect to the natural resources. Valuation methodologies are useful tools to determine which stakeholder is benefiting most and which is benefiting less, or –in other words– "who is paying for whom". On this basis, further innovative financial mechanisms can be developed for forests and nature that take such equity issues into account.

The use of environmental economic tools is sometimes criticised by economists because of the major role attributed to the stakeholders in determining the values. In traditional economics, the marketing of a product is an important tool for producers (stakeholders, of course) to increase the sales of a particular product to consumers (who are also stakeholders). This usually contributes to economic growth. In terms of environmental economics, this can be compared to promoting the significance of forests and nature objects and their functions, something that will increase people's Willingness to Pay because of improved awareness and knowledge of the benefits. This demand is either translated directly into economic growth (by hotel owners, for instance, in the case of ecotourism) or exists in the form of a "hidden" capital in society that influences decision-making at policy and implementation level by weighing these factors in decision-making. Valuation tools are used to bring these different elements under one common denominator in order to make it easier to compare different values and improve decision-making.

Valuation tools and Decision Support Tools in general are tools to assist decision-makers. They can certainly not replace the decision-making process. In section 2 of this document, a checklist is provided which summarises the most important steps and elements in the decision-making process where valuation concepts may be integrated. By applying this checklist, the reviewer also has the final responsibility regarding the decisions to be taken and in the end is weighing the various elements according to his own norms and perceptions. All the tools can do is provide assistance to the decision-maker as a means of guaranteeing a more open approach.

It is also important to apply these concepts to nature management in Western Europe or the Netherlands. The different claims asserted to land use are competing to an increasing extent and transparency in decision-making is required by a society that is becoming ever more demanding. Today, it is impossible to base decisions only on the Cost-Benefit Analysis and many criteria have to be integrated into the decision-making process. The conversion of these "hidden" values of certain functions of forests and nature into financial support for maintaining those functions, and the problem of how the burden should be distributed between the stakeholders, are very interesting issues that should be investigated further.

Section 2. Checklist for integrating valuation concepts

1. Purpose and use of checklist

This checklist is meant for decision-makers in the field of international and national policy-making for natural resources management for effective use in working situations. It covers all the relevant issues and aspects relating to decision-making regarding alternative uses of natural resources from an economic perspective. It deals with these aspects in a logical, step-by-step manner and can be regarded as a summary of the information provided in this document. It is particularly appropriate to assessing proposals for projects involving alternative use of land, enabling the policy-maker to check whether all the relevant aspects of economic valuation and decision-making have been taken into account in the relevant proposals. This is of course a very general overview and –depending on the particular field in which the policy-maker is working– the steps can be made more specific. It must also be emphasised that the checklist should not be regarded as the sole tool for decision-making; the fact that other relevant issues such as gender, stakeholder analysis, participatory decision-making processes and conflict resolution are not dealt with here does not affect their importance.

2. Checklist

Problem definition

Identify the "desire to change" and define the activity proposed (or alternative/alternatives). A clear distinction should be made between the existing situation (the "without project" situation) and the desired or proposed situation (the "with project" situation).

The following two steps (Analysis and Valuation) should be followed for both situations:

Analysis

1. Is the area under study (subject area) properly defined? Define the logical boundaries (both physical and non-physical).

2. Are all functions (goods and services) properly identified in the forest or nature area in question?
   Define the functions:

   - Production functions
   - Regulation functions
   - Carrier/habitat functions
   - Information functions

3. Has the positive and/or negative involvement of all relevant stakeholders been identified in the subject area? Has a stakeholder analysis been performed?
   - Define all stakeholders (or as many as possible) in relation to the functions
   - Define stakeholders at various levels:
     By scale: local, regional, national, global stakeholders
     By time: current and future stakeholders
   - Define stakeholder groups according to interests, conflicts or perceptions.

<u>Valuation</u>

Are the stakeholder-function relations used to determine the most complete value of the functions (goods and services) provided by the subject area?

- Link stakeholders to functions;
- Which valuation tools (and how many of them) are used to estimate the monetary values of functions?
- Link functions to direct use, indirect use, option, bequest and existence values and valuation tools used to estimate the monetary values of functions.
- For goods and services traded on the market, use market price.
- For goods and services not traded on the market, use valuation tools to estimate their monetary value.[1]
- Some functions of nature cannot be expressed in monetary terms and must be valued qualitatively. Have these been integrated into the decision-making framework?
- Calculate the Total Economic Value of the subject area by means of an extended Cost-Benefit Analysis[2] using monetary values based on market prices and those estimated by means of valuation tools.

Be sure to include all the positive (benefits) and negative (costs) aspects for all relevant stakeholders when determining the effect of maintaining a required function or when calculating the impact on a function of a (proposed) change of use.

Finally, the decision-making process requires a decision to be taken in favour of either the "with project" or "without project" scenario.

<u>Decision-making</u>

- Have stakeholders been included in the decision-making process; to what degree are relevant stakeholders in charge of the final decision-making?
- Is decision-making based on a long-term perspective?
- Have relevant information networks been employed?
- To what degree have decision-making support tools such as Cost-Benefit Analysis, valuation tools, and tools such as Multi-Criteria Analysis been integrated effectively into decision-making?
- Will the final decision be taken in a transparent manner?
- Will the decision-makers be held accountable for their decisions?

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[1] The choice of a particular valuation tool depends on the function being studied. Using a set of different valuation tools can provide additional information and will lead to greater transparency regarding the value of the area under study. Avoid double counting.

[2] Using a Cost-Benefit Analysis allows the results to be manipulated by means of the discount rate chosen. A high discount rate will result in a strong preference for present consumption.

Section 3. Some case-studies on the economic valuation of natural resources

1. Introduction

This section summarises a number of case studies on the economic valuation of natural resources in tropical ecosystems. They have been selected in order to illustrate the applicability and limitations of certain valuation tools in various different tropical regions and ecosystems. Valuation tools such as the Contingent Valuation Method, Cost-Benefit Analysis, the Travel Cost Method and the Production Function Approach will be dealt with. The complementary value of Multi-Criteria Analysis necessary for more balanced decision-making is also illustrated by the case of Jansen & Padilla (1999). Regions in Africa, South America and Asia are included and valuation applies to tropical rainforests as well as to mangrove ecosystems. Most importantly, however, the policy implications of the results of the cases will be discussed; these are extremely important for policy-makers in the field of international natural resources management.

2. The Total Economic Value of the Leuser Ecosystem, Sumatra, Indonesia.

Method used: Extended Cost-Benefit Analysis

Description:
Formally, the forests of the Leuser Ecosystem on Sumatra (Indonesia) enjoy protected status. In reality, however, the system is under severe threat of deforestation. Two factors are accelerating the conversion of the protected Leuser Ecosystem. Firstly, conversion often results from lack of co-ordination between government agencies and a lack of knowledge of the legal status of land; these factors may lead to decisions that run contrary to decisions made by other government agencies. The second –and most common– factor is that the procedure for transforming the land-use status of a tract of land is not followed in full. The central problem is corruption, collusion and a lack of transparency within the government agencies responsible.

This study, carried out by Beukering & Cesar (2001), shows that conservation of the Leuser Ecosystem would be in the interests of the local population, local and national government, and the international community. In the long run, it is only the logging and plantation industries that benefit from deforestation, but the financial benefits they enjoy do not outweigh the losses sustained by the other stakeholders. This makes conservation of the Leuser Ecosystem efficient from an economic point of view.

Valuation method:
Beukering & Cesar (2001) calculated the Total Economic Value of the Leuser ecosystem under two different scenarios: (1) The conservation scenario, implying that the protected status of the rain forest is strictly enforced and that logging is therefore excluded as an economic activity. (2) The deforestation scenario, implying a continuation of the current trend towards clear cutting. The Total Economic Value was calculated using extended Cost-Benefit Analysis. Some of the costs and benefits were based on actual market prices and others were estimated by using an appropriate valuation tool (see Table 4).

The authors began their study by listing all the possible impacts of deforestation on ecological functions and services. Secondly, they identified the physical impacts that are economically significant. These effects were quantified in physical terms and the monetary value was then calculated. Because the study was conducted with a limited amount of data –this is often a problem with this kind of study– the authors also performed sensitivity analyses to check whether the results are robust to small changes in the parameters used to calculate them. The authors calculated the benefits provided by the Leuser Ecosystem that are listed in Table 4. A time horizon of thirty years was chosen, with the annual net benefits of both scenarios being calculated for that period.

Table 4. Benefits provided by Leuser Ecosystem, the impact of deforestation and the subsequent valuation tool.

Benefits provided by Leuser Ecosystem:	Impact of deforestation	Valuation tool
Water supply	Changes in water supply (household/industry) due to lower groundwater availability	production function & market price
Fisheries	Changes in fisheries catch due to destruction of breeding grounds	production function & market price
Flood and drought prevention	Damage to health and infrastructure due to increased flooding and drought	human capital approach & market price
Agriculture and plantation	Changes in agricultural production due to reduced water availability, increased erosion and reduction in pest control and pollination by the rainforest	production function & market price
Hydro-electricity	Damage to hydro-electricity due to increased sedimentation	production function & market price
Tourism	Changes in tourism due to degraded forests and rivers	Contingent Valuation & market price
Biodiversity	Reduction of biodiversity	Contingent Valuation & international funds
Carbon sequestration	Changes in sequestration of carbon due to reduced forest area.	IPCC standard values (USD 5 for one tonne of carbon dioxide)
Fire prevention	Damage to national and international economy due to reduced transportation, destruction of crops and timber, decline in tourism, additional health care costs etc.	human capital approach & market price
Non-timber forest products	Changes in production of NTFPs	(surrogate) market price
Timber	Changes in production of timber	(surrogate) market price

Besides the overall economic value, the distribution of that value between different stakeholders was calculated. Five stakeholders have been identified: (1) the local community; (2) local government; (3) elite (logging and plantation industry); (4) national government; (5) the international community.

Outcome
During the first ten years, the deforestation scenario generates higher returns, but after ten years the conservation scenario is superior to the deforestation scenario. By combining the individual benefits, it is possible to calculate the total economic value of the forest (Table 5). The Total Economic Value in the two scenarios is highly dependent on the chosen discount rate (see Table 6), but the conservation scenario has the highest Total Economic Value at all the rates calculated. At a zero percent discount rate, the Total Economic Value of the conservation scenario is estimated to be USD 17.2 billion or USD 5.8 billion more than the deforestation scenario.

Table 5. Average annual distribution of net benefits between goods and services provided by the Leuser Ecosystem (Beukering & Cesar, 2001)

	Deforestation		Conservation	
	Average net annual benefits (in millions of USD)	Proportion	Average net annual benefits (in millions of USD)	Proportion
Water supply	32	8.4%	93	16.8%
Fisheries	27	7.1%	35	6.3%
Flood prevention	106	28.2%	129	23.2%
Agriculture	140	37.2%	138	24.8%
Hydro-electricity	20	5.3%	41	7.4%
Tourism	7	1.8%	41	7.3%
Biodiversity	3	0.7%	37	6.6%
Sequestration	0	0.1%	17	3.0%
Fire prevention	8	2.1%	19	3.5%
Non-timber forest products	2	0.5%	6	1.1%
Timber	33	8.7%	-	0.0%
Annual average	378		556	

Table 6. Total Economic Value at various different discount rates for the whole Leuser Ecosystem (Present Value over 30 years in billions of USD) (Beukering & Cesar, 2001)

Scenario	0 %	3%	5%	10%
Deforestation	11.7	7.9	6.4	4.1
Conservation	17.2	10.5	7.9	4.4
Difference	5.8	2.6	1.5	0.3

Contrary to popular belief, the local community is at present by far the main beneficiary of the Leuser Ecosystem (see Table 7), receiving approximately 60% of the benefits. These benefits are mainly the result of support for agriculture and the prevention of flooding. Conservation will also benefit all categories of stakeholders except for the elite (logging and plantation industry).

Table 7. Distribution of Total Economic Value (TEV) among stakeholders (Beukering & Cesar 2001)

Scenario	TEV (in USD/ha)	Local community	Local government	Elite industry	National government	International community
Deforestation	1,667	59%	11%	20%	6%	4%
Conservation	1,823	62%	10%	11%	6%	10%

Note: Total Economic Value calculated as Net Present Value over the period 2000-2030 at a discount rate of 10%

Comments

The systematic approach taken by the authors to calculating the benefits and costs of both the conservation and deforestation scenarios makes this article an interesting one. The weak point, however, is that the two scenarios represent extreme situations, i.e. not very realistic ones. In reality, a mix of both scenarios is more likely. The Total Economic Value of such a mixed scenario will not necessarily be some weighted average of the Total Economic Values of the extreme cases. The Total Economic Value of a mixed scenario, with adequate forest management, may well exceed the value in the case of conservation. Moreover, the cost of forest management is not included in the study. The authors are currently calculating Total Economic Values for various different scenarios between the two extremes of deforestation and conservation.

Another strong point of this study is the differentiation between different stakeholders. The imbalance between costs arising at the local level and benefits accruing at the national and international levels has raised questions about whether people living in or near Protected Areas ought to be compensated for their losses, and if so, how compensation should be made. In this respect, the finding that it is the local community that benefits most from the conservation scenario is remarkable.

Cost-Benefit Analysis studies such as this usually show high benefits and low costs, which gives the impression that the authors wish to influence the final results. For example, the conservation scenario does not include management costs. Apparently, the authors consider these to be negligible. However, without a good management and control system, the conservation scenario is hardly realistic. In this respect, the discounting process plays an important role as well. As proved by the results, an increasing discount rate means a decreasing weight of future costs and benefits. Using a high discount rate makes alternative land uses relatively more attractive.

Another way to influence the results is to spread the benefits over time. Assuming that an environmental benefit, for example erosion reduction, accrues in the near future means that this benefit is discounted less than when it is assumed to happen later. Beukering & Cesar (2001) assume for the conservation scenario that the condition of the forest will remain the same as in the year 2000. It would be more realistic to assume that deterioration will slowly come to an end and will then be followed by stabilisation.

Another methodological shortcoming is the assumption that the benefits of aquaculture are totally dependent on the forest. Clean water is not the only input determining the benefits of aquaculture. For example, if deforestation ruins the aquaculture sector, the labour formerly used for aquaculture can be used for another purpose. This means that only part of the benefits of aquaculture can be ascribed to existing forests.

3. Willingness-to-pay for Borivli National Park, India.

Valuation tool used: Contingent Valuation

Description
Though largely an academic exercise in Contingent Valuation, Hadker's study (1997) provides some interesting insights into the practice of Contingent Valuation in a developing country. The focus of the study is the Willingness-to-Pay on the part of residents of Bombay for the maintenance of Borivli National Park, which is located within the city limits.

Valuation tool
In the course of the study, nearly 500 residents from around the city and from a variety of socio-economic backgrounds were interviewed. Interview material included a brochure informing respondents about the Protected Area, and giving a description of the valuable flora and fauna

and the management problems that the Protected Area currently faces. Respondents were guaranteed confidentiality and were given the prospect of making monthly payments over the next five years.

The first section of the interview was dedicated to obtaining information about the respondent's social, economic and demographic characteristics: their age, gender, occupation, education level, residential area, family size and income level. The second section of the interview tries to categorise the respondent as pro-conservation, pro-development or somewhere in between. The third section involved the presentation of the brochures and information about the Protected Area. Respondents were then presented with two scenarios, one in which the current detrimental trends would continue and another in which a management plan would be put in place to halt these trends. In the fourth section, respondents were given an "opening bid", representing their contribution to the implementation of such a management plan.

After being told that acceptance of the bid would mean they would be likely not to make alternative investments –in other environmental causes or goods or services– respondents were asked to accept the bid, reject it, or offer no response. Respondents accepting the bid were then asked it state the maximum they would be prepared to pay. Respondents were also asked whether they would be prepared to do voluntary work in the Protected Area. This question was intended to discover the Willingness-to-Pay of people who could not afford a monetary bid. The study found that time constraints limited respondents' ability to volunteer.

In designing the survey, the team attempted to:
1. make the objectives of the interview clear;
2. enable interviewers to record as many of the preferences expressed by respondents as possible;
3. account for, and manage, the numerous biases relating to a Contingent Valuation study; and
4. define the scenario as realistically as possible.

Outcome
The study shows that income, frequency of visits to the site, membership of an environmental organisation and preferences for environment-related activities are significant elements in identifying those respondents who assign higher values to the Protected Area. The latter factor – the "green" factor– is explained by economists by the term "embedding", where a person's response to a valuation is affected by their underlying value system. Interestingly, businessmen are willing to pay significantly more than other professionals. The authors suggest that this has important policy implications because this group may be able to finance environmental improvements. Indeed, it would seem logical for the Protected Area manager reviewing the study to pursue this avenue of funding.

Additionally, the study arrives at a Willingness-to-Pay of 7.5 rupees per month per household. This amounts to a total present value of 1033 million rupees (or USD 31.6 million). The authors suggest that this figure could be used to influence policy decisions, given that the Protected Area currently runs on a budget of 17 million rupees (USD 520,200).

This study is also interesting for its treatment of a number of biases, which it accepts may introduce an element of uncertainty into the valuation study. When an adjustment is made for this uncertainty, the estimated mean value for Willingness-to-Pay drops from 27.75 rupees (USD 0.85) per month to 7.5 rupees (USD 0.23) per month. Willingness-to-Pay is also broken down into groups of people who are defined as pragmatic (12.81 rupees or USD 0.39), "green" (with a very high level of 40.85 rupees or USD 1.25) and development-oriented (10 rupees or USD 0.31).

Comments
Although the study is largely dedicated to the development of Contingent Valuation Methodology for developing countries, it arrives at some interesting insights for policy and management scenarios, such as the idea of approaching businessmen for funding. Some aspects of the study, such as the idea of volunteering in lieu of a monetary payment, provide alternative solutions to problems that are likely to occur in developing countries (Philips, 1998).

4. International Ecotourism and the Valuation of Tropical Rainforests in Costa Rica.

Valuation Tool used: Travel Cost Method

Description:
This study, which was carried out by Menkhaus & Lober (1996), determined the value that tourists from the US place on Costa Rican rainforests as ecotourism destinations, using the Monteverde Cloud Reserve as a sampling site for tourism to Costa Rica's Protected Areas. The private Monteverde Cloud Forest Biological Reserve is one of the four major ecotourism destinations in Costa Rica, due to its unique flora and fauna, its impressiveness, its accessibility, and its tourist accommodation. The Reserve is one of the few remaining fragments of the tropical cloud forest, a rare type of ecosystem found in only a few places in the world. Located in the Tilaran Mountains of central Costa Rica, it is only a four-hour drive from the capital city of San Jose. It has high-quality visitor services in the form of numerous hotels, a visitor centre and the availability of guides.

Valuation tool:
The valuation tool used was the Travel Cost Method, a non-market valuation approach that uses travel expenditure as a proxy for the value of the park. Data were collected by a survey of 240 USA tourists over a three-month period from June to August 1990. In order to ensure a representative sample, sampling was random and took place at different times of the day and on all days of the week. In-person interviews were conducted with visitors, who were asked to provide information about their airfare and their in-country travel expenditure as well as socio-economic variables such as age, income and education. In addition, they were asked to indicate other destinations they had visited or would visit in Costa Rica.

A demand curve was then produced by evaluating the aggregate number of tourists (converted into a percentage) who demonstrated by their travel expenditure (airfare to Costa Rica plus in-country expenditure) that they were willing to incur travel expenditure up to at least a certain amount in order to visit the park. The sample of visitors to the Monteverde Cloud Reserve was then used as a proxy for those US tourists visiting all Costa Rican parks and reserves to produce a demand curve for visits to ecotourism regions in Costa Rica (avoiding the methodological issue of correctly allocating costs to several different sites). Of all tourists at Monteverde, 95% listed national parks and other natural scenic areas as their only additional tourist destinations. This indicates that ecotourism is their sole reason for travelling to Costa Rica (leaving aside the issue of multi-purpose visits and attributing the travel expenditure to different activities).

Outcome:
Consumer surplus was estimated to be approximately USD 1150, representing the average annual per person valuation of the ecotourism value of Protected Areas in Costa Rica for the sample. Multiplying the number of ecotourist visitors from the US by this consumer surplus gives a value of approximately USD 68 million for the entire US tourist population who visited Costa Rica's rainforests. The ecotourist value of Monteverde Cloud Forest Reserve was calculated by multiplying the number of US visitors to Monteverde (17,100) by the average consumer surplus, adjusted for the percentage of time in Costa Rica that was spent at Monteverde. This resulted in a total annual US ecotourism value of USD 4.5 million for the Monteverde Reserve.

Comments:
The authors suggest that ecotourism values should be used in policy-making. Firstly, they can be used in a Cost-Benefit Analysis of the Protected Area system in Costa Rica. The cost of preservation is typically to be found in the form of foregone development or resource extraction options. Estimates produced by means of the Travel Cost Method can be used to ensure that ecotourism benefits are included in any potential land management analysis. Secondly, international ecotourism values provide specific information regarding the role that foreign tourists play in utilising and valuing scarce tropical resources. This knowledge may facilitate the transfer of additional resources from wealthier to less wealthy countries for resource conservation. The results of the study can be used, for example, to calculate new, higher entrance fees that more accurately reflect the ecotourism benefit of the area. Based on the results of this study, this can be calculated by dividing the consumer surplus of USD 1150 by 29 (the number of parks and Protected Areas), suggesting an average entrance fee of USD 40 per park, considerably higher than the USD 5-10 usually charged.

The Willingness-to-Pay on the part of tourists was estimated by taking the cost of their airfare and in-country travel expenditure, which does not say anything about their true Willingness-to-Pay. For example, if airfare costs were 10% higher, the majority of the US tourists might still have visited Costa Rica but the results of the study would have been different. Besides, travelling may itself be part of the enjoyment gained from the visit.

Results of other Travel Cost Method studies in developing countries arrive at totally different values for the ecological amenities provided by Protected Areas in those countries. For example, Maille & Mendelsohn (1991) found a consumer surplus for ecotourism demand in Madagascar of between USD 276 and USD 360 per person. Brown & Henry (1989) found that 265,000 to 300,000 tourists on safari in Kenya in 1989 received a consumer surplus of USD 182-USD 210 million, or around USD 700 per tourist. These differences in value might be explained by many factors, for example the closeness of the destination, the time of year the survey was conducted, etc. This raises the question of whether the Travel Cost Method is an appropriate tool to determine the true value of the amenities provided. The results of the above-mentioned studies raise such questions as: Why should a Kenyan elephant be more valuable than a Madagascar lemur?

5. Valuation and Evaluation of a Mangrove Forest in the Philippines.

Methods used: Cost-Benefit Analysis and Multi-Criteria Analysis.

Description
The aquaculture industry was the single biggest threat to mangroves in the Philippines until conversion of the remaining mangrove stands was prohibited by law in 1981. However, the decreasing yield from capture fisheries is leading to pressure for the re-examination of this policy. To understand the importance of mangroves, insight was needed into the value of the products and services provided. Janssen & Padilla (1999) compare the costs and benefits of mangrove preservation with those generated by alternative uses such as aquaculture and forestry. Equity and sustainability objectives are taken into account, in addition to economic efficiency, and analysed according to the perspectives of the different types of decision-makers involved. The area under study consisted of the Pagbilao Mangroves in the southern part of Quezon Province on the island of Luzon, The Philippines. The Mangroves are named after a small municipality with a population of 41,635 (1990), many of whom are dependent on coastal resources for a living.

Valuation method
The article summarises the results of a study intended to support management decisions of a small mangrove forest in the Philippines (Janssen & Padilla, 1997a,b). The approach is a combination of Cost-Benefit Analysis and Multi-Criteria Analysis. To assess the opportunity costs of preservation and analyse the trade-offs to be made in deciding whether to preserve or convert, the following alternatives –ranging from preservation to intensive aquaculture– were identified: (1) preservation; (2) subsistence forestry; (3) commercial forestry; (4) aqua-silviculture; (5) semi-intensive aquaculture; (6) intensive aquaculture; (7) commercial forestry and intensive aquaculture; (8) subsistence forestry and intensive aquaculture.

Results from field surveys were used to estimate the production of goods and services linked to these alternatives. Calculations were made for the following categories of goods and services: (1) forest products; (2) capture fisheries; (3) aquaculture. The effects of the alternatives on emissions, soil accretion, shore protection, ecotourism and biodiversity were measured qualitatively. This resulted in an effects table of management alternatives for the Pagbiloa mangroves. Using market prices and shadow prices linked to substitutes, the effects table was converted into a valued effects table (annual values for the entire area). Alternatives were assumed to be sustainable and this implies that the time horizon can be assumed to be indefinite.

In order to maximise economic efficiency, social equity and environmental quality, the performance of the alternatives with respect to these three objectives was determined. Social equity was equated to the benefits for the local poor (forestry, on-site fisheries and 90% of off-site fisheries). Environmental quality was linked to preservation of environmental functions. Environment was defined as an index combining the effects on soil accretion, emissions, shore protection, biodiversity (relative weight ten times higher) and ecotourism. Three scatter diagrams were used to analyse the trade-offs and level of conflict between (1) efficiency and equity, (2) efficiency and environment, and (3) equity and environment. The scores were standardised

between 0 (worst management alternative) and 100 (best management alternative). The scatter diagrams can be used to rank the performance of the alternatives with respect to all three objectives.

Because different decision-makers will value the management alternatives according to their own objectives, the next step in the study was to carry out a Multi-Criteria Analysis. A connection was made between the different types of decision-makers in the management of mangrove forests, their objectives and their preferred management alternative.

The final section of the study analyses the performance of the management alternatives with respect to sustainability. The management alternatives were designed to be sustainable, with a number of conditions applying. These conditions were tested and the range of expected change in value was determined within a scenario in which all sustainability conditions failed simultaneously. The range was combined with the values of goods and services so as to calculate the value of total goods and services in three categories: A: total goods and services (min.) representing the pessimistic end of the ranges (-33%, -66%,-100%), B: total goods and services (max.) representing the optimistic end of the ranges (-0%,-33%,66%) and C: total goods and services (sustainable) representing sustainable conditions.

Outcome:
The totals of the effects valued (see Table 8) make clear that the aquaculture alternatives perform better than the forestry alternatives and preservation in terms of economic efficiency. It is interesting to note that Semi-Aquaculture performs better than Intensive Aquaculture. This is due to high development costs linked to intensive aquaculture and to the constraints set by sustainable management of the ponds.

Table 8. Annual values of alternatives for the Pagbilao mangroves. (Source, Janssen & Padilla, 1999)

	unit	PR	SF	CF	AS	SA	IA	CF/IA	SF/IA
Effects valued									
Subsistence forestry	1000 pesos		349						189
Commercial forestry	1000 pesos			416	217			229	
Fishponds	1000 pesos				5648	18801	9294	3417	3993
Fisheries	1000 pesos	165	161	161	124	8	8	40	40
Total value	1000 pesos	165	510	576	5989	18809	9302	3686	4222
Other effects									
Emissions	Tons/year				20	40	100	50	50
Soil accretion	Cm/year	1.00	0.34	0.42	0.22	0.10	0.05	0.13	0.15
Biodiversity	Index	1.00	0.61	0.39	0.16	0.14	0.06	0.15	0.23
Shore protection	Index	1.00	0.36	0.14	0.14	0.14	0.06	0.14	0.14
Ecotourism	Index	0.80	1.00	0.38	0.18	0.14	0.08	0.21	0.30

Alternatives: PR: preservation, SF: Subsistence Forestry, CF: Commercial Forestry, AS: Aqua-Silviculture, SA: Semi-intensive Aquaculture, IA: Intensive Aquaculture, CF/IA: combination of CF and IA, SF/IA: combination of SF and IA.

The performance of the management alternatives with respect to the three objectives: (1) efficiency, (2) equity and (3) environment is presented in Table 9.

Table 9. Performance of the alternatives with respect to objectives (Source: Janssen & Padilla, 1999)

	Unit	PR	SF	CF	AS	SA	IA	CF/IA	SF/IA
Efficiency	1000 pesos/year	165	510	576	5,989	18.809	9,302	3,686	4,222
Equity	1000 pesos/year	165	510	576	341	8	8	260	230
Environment	Index	12.8	7.8	4.8	-17.9	-38.2	-99.2	-48.0	-47.0

Alternatives: see Table 8

It can be concluded that none of the alternatives performs best with respect to all three objectives. The two forestry alternatives perform well where equity and environment are concerned. Preservation is inferior to subsistence forestry because it performs the same with respect to environment but worse where equity is concerned. There is also a clear conflict between the equity and environment objectives and the efficiency objective. Alternatives that perform well with respect to efficiency perform badly where equity and environment are concerned and vice versa.

The results of the Multi-Criteria Analysis are presented in Table 10. Because each decision-maker has his/her own objectives, he/she will use the information on the alternatives in a different way (as illustrated by the Multi-Criteria Analysis).

Table 10. Decision-makers, their objectives and their preferred alternatives. (Source: Janssen & Padilla, 1999)

Decision-maker	Objective(s)	Preferred Alternative(s)
Fishpond owner	Maximise profit	Conversion to semi-intensive aquaculture
Local government	Maximise net income of local government and the local population of the forest	Increase the licence fees for fishponds and convert to fishponds OR forestry and fisheries
Social planner	Maximise total benefits to the Philippines (efficiency) and more equal income distribution (equity)	Conversion to fishponds (efficiency) OR Forestry and fisheries (equity)
Sustainable planner	Maximise total benefits (equity) AND more equal income distribution (equity) AND maintain minimum level of relevant environmental stocks	Preservation to maintain a minimum level of mangrove ecosystems (minimum stock of habitat, biological and genetic diversity)
Sustainable world planner (UNEP/GEF)	Maximise global environmental benefits from mangrove forests	Pay a maximum of USD 614,748 per year to the Philippines OR Accept the loss of the Pagbilao forest

One can conclude from Table 11 that violating the sustainability conditions results in a lose-lose situation; the total value of all alternatives declines. Although the pattern of changes differs considerably between alternatives, the ranking of alternatives is relatively insensitive to the failure of these conditions. The rankings associated with total goods (max.) are the same as the ranking for sustainability, with semi-intensive aquaculture in first position and preservation last. However, if the pessimistic values (total goods min.) are compared with the ranking for sustainability, semi-intensive aquaculture and intensive aquaculture shift to last position. This is the disaster scenario for both alternatives, with pollution preventing operations completely. It is difficult to predict the most likely position between these extremes. Uncertainty centres on two questions: how much waste can the system manage without water quality declining and at what stage do the effects of declining water quality become irreversible?

Table 11. Change in net annual value if sustainability conditions are violated (Source: Janssen & Padilla, 1999)

	PR	SF	CF	AS	AS	IA	CF/IA	SF/IA
Total goods (min.)	111	227	249	4,044	3	3	1,789	1,775
Total goods (max.)	165	395	440	5,949	6,398	4,622	3,525	3,498
Total goods (sust.)	165	510	577	5,990	18,809	13,585	5,261	5,221
Total services (min.)	++	++	+	0	0	0	0	0
Total services (max.)	+++	+++	++	+	0	0	0	+
Total services (sust.)	+++	+++	++	+	+	+	+	+

Alternatives: see Table 8
Goods: Fisheries, Subsistence Forestry, Commercial Forestry, Aquaculture, Mangrove nursery
Services: Aquaculture, Damage Control, Ecotourism, Existence value, Information Value

Comments:

Although biodiversity is considered crucial to the decision to preserve the forest, the authors decided not to value biodiversity quantitatively. In their conclusions, they mention that they proved that it is impossible to put a monetary value on changes in biodiversity but in fact they made no attempt to value biodiversity quantitatively. The reason why they measured biodiversity qualitatively was because they hesitated to use valuation tools such as Contingent Valuation. The authors assumed that the importance of mangrove ecosystems means that the value of biodiversity is high. Valuation would involve a Contingent Valuation approach. Contingent Valuation raises the question of whose values should be included (local population, national population, world population). In addition, the authors questioned whether intrinsic values linked to biodiversity could be captured using valuation tools, especially where the loss of ecosystems is irreversible. Is it possible to value irreversible effects such as the loss of a way of life, the loss of ecosystems, the loss of species, the loss of works of arts, etc.? To emphasise the importance of biodiversity, the authors decided to assign it a weight in the environment index that was ten times higher than the other effects (soil accretion, emissions, shore protection and ecotourism). However, this weight might in reality be a thousand times higher. Assigning a weight is an arbitrary choice, and is based on personal taste rather than on scientific evidence.

Another crucial issue in the case of Pagbiloa is the distribution of wealth. The income from the fishponds goes to distant investors. The conversion to fishponds also creates areas that cannot be accessed by the local population. The equity issue cannot be addressed adequately using Cost-Benefit Analysis. The authors therefore performed a Multi-Criteria Analysis to supplement the Cost-Benefit Analysis. This proved to be useful and was able to include equity and environmental objectives. However, the authors did not perform a genuine Multi-Criteria Analysis in terms of

consulting the various different decision-makers and asking them to value the management alternatives. In reality, they invented an imaginary group of different decision-makers and speculated as to what their preferred management alternative would be. Nevertheless, the example they used is an illustrative one and is a basis for commencing a debate about the reallocation of costs and benefits. For example, if it is accepted that preservation of the mangrove forest is in the interest of the world community, it is not reasonable to make the Philippines pay the cost of preservation. If preservation of the forest is considered worthwhile, it is the Global Environmental Facility that should pay the incremental costs.

Although the study has its methodological shortcomings –for example arbitrary choices as to which data to collect and which not, which stakeholders to include and which not–, it shows that Cost-Benefit Analysis combined with Multi-Criteria Analysis provides a useful framework for including equity, environmental efficiency and economic efficiency in the valuation of ecosystems. In addition, this type of study provides concrete figures (which may not be entirely accurate due to methodological shortcomings) to kick-start the debate with policy-makers and international donor agencies about the value of tropical ecosystems and the distribution of the costs and benefits.

6. Valuation of tropical forests in Mantadia National Park, Madagascar.

Valuation Tools used: Contingent Valuation, Recreation Demand Analysis, Opportunity Cost Analysis & Production Function Approach

Description:
Kramer's study (1995) investigated the change in environmental values resulting from a National Park currently being set up in Madagascar. The creation of a national park can enhance or diminish a number of components of the forest's total value. If residents are prohibited from extracting minor forest products, this will diminish their use values. On the other hand, if the park has attributes that are desirable for tourists or preservationists, there may be offsetting increases in the recreation or existence values. Four tools were used in this study in order to empirically measure the change in environmental values resulting from the establishment of the park: (1) Contingent Valuation; (2) Recreation Demand Analysis; (3) Opportunity Cost Analysis; and (4) Production Function Approach.

The National Park studied is the Mantadia National Park, which is located near the popular Perinet Forest Reserve, approximately 3 hours drive from the capital. The park is thought to contain possibly 11 species of lemurs, including the Indri, one of the largest known lemurs in Madagascar. These presence of these animals may have a considerable impact on the area's attractiveness for tourists.

Valuation Tools:
The impact of the new Mantadia National Park was determined at two different levels. The impact on local villagers was estimated by means of a combined Contingent Valuation and Opportunity Cost Analysis survey and that on foreign tourism via a combined and Recreation Demand Analysis survey.

Impact on villagers:
Given the dependence of the local villagers on the forest for a significant portion of their livelihood, creating a national park out of a large tract of forest and imposing restrictions on future use places a considerable economic burden on the villagers. If one determines recent land use in and around the park and projects future land use changes if the part were not to be established, one can estimate the cost to villagers due to the lost opportunity to exploit the area for agricultural or forest products. The application of Opportunity Cost Analysis requires that cash-flow analyses be conducted for villages around the park in order to determine the inputs and outputs of household production functions. In addition, the volume of agricultural and forestry activity occurring inside and outside the park boundaries must be determined. This was accomplished by using data acquired by means of remote sensing. In the Contingent Valuation Method survey, 351 household members in 17 villages (within 7.5 km of the park boundary) were asked about their willingness to accept compensation for loss of access to the forest area contained within the park. The questions referred to compensation which would make the household as well off if the park were to be established as they would have been if they had

continued to have access to the forests in the park area. The measure used for the compensation mechanism was units of rice.

Impact on tourism:
Recreation Demand Analysis focussed on foreign tourists. The data collected included full vacation itinerary and travel cost data for 94 foreign visitors to Perinet Forest Reserve. The itinerary data include the distribution of time between activities for each individual and the cost of pursuing those activities. The questionnaires consisted of a series of questions on the cost of the respondent's current trip to Madagascar, details of previous international nature-related trips, the decision process determining the destination, and a series of socio-economic and demographic questions. The data were analysed using two different empirical models: (1) a Typical Trip Model, and (2) a Random Utility Model. The Contingent Valuation Method was used to estimate the total value of the park to the same 94 foreign tourists. These questions were phrased in terms of how much more the respondent would have been willing to pay for the trip if the new park were available to visit. The tourist survey was carried out in the nearby Perinet Forest Reserve.

Production Function Approach:
In addition, a Production Function Approach was used to measure the benefits to farmers of reduced flooding due to reduced deforestation resulting from the establishment of the park and buffer zone. The Production Function Approach for this study first estimates deforestation rates in the Mantadia area using remote sensing. Deforestation rates for the future are projected on the basis of the historical analysis. These land use changes are then used to project the effects on flooding. Finally, the predicted reductions in flooding brought about by the setting up of the park and the buffer zone are used to predict reduced crop losses, which are estimated and valued in economic terms.

Outcome:
Results of the Contingent Valuation Method, Recreation Demand Analysis (Typical Trip & RUM) and Opportunity Cost Analysis are presented in Tables 12 (impact on villagers) & 13 (impact on tourism).

Table 12. Estimates of economic losses to local villagers from establishment of Mantadia National Park (Kramer *et al.*, 1995).

Tool used	Annual Mean Value per Household	Aggregate Net Present Value*
Opportunity Cost	USD 91	USD 566,000
Contingent Valuation	USD 108	USD 673,000

*Assuming a 10% discount rate and a 20-year time horizon

Table 13. Estimates of international tourists' benefits from establishment of Mantadia National Park (Kramer *et al.*, 1995).

Tool	Mean increase in consumer surplus per tourist	Total annual increase in consumer surplus	Discounted present value*
Typical Trip	USD 45	USD 174,720	USD 1,700,000
RUM	USD 24	USD 93,600	USD 936,000
Contingent Valuation	USD 65	USD 253,500	USD 2,530,000

*Assuming a 10% discount rate and a 20-year time horizon

The Production Function Approach provided the following results:
1. on the basis of topographical maps and satellite images, the deforestation of the study area was estimated at an annual rate of 2.17% for the study area. Given this rate and a "without park" scenario, the park and buffer zone will lose all of their primary forest cover within approximately 45 years.
2. Effects of flood damage on the principal crop (rice paddy) are presented in Table 14.

Table 14. Net Present Values of Flooding Damage (Kramer *et al.*, 1995).

	Net present value of 1 year's total expected loss	Aggregate net present value of total expected loss*
without park	USD 51,691	USD 547,176
with park	USD 50,787	USD 475,620

* Assuming a 10% discount rate and a 20-year time horizon

Impact on villagers (based on Contingent Valuation Method & Opportunity Cost Analysis):
The Opportunity Cost Analysis was used to provide baseline estimates of the economic losses sustained by villagers as a result of the establishment of the park. The analysis relied on cash-flow models constructed using detailed input and output data collected from the 351 village households. The analysis provided considerable insight into the differential impacts in the various regions around the park. It has potential as a means of involving people in the management of programmes. It is also a powerful tool for understanding the interrelationship between microeconomic factors relating to use and management of parks. The compensation costs (approximately USD 100 per household) 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 of local residents, and their active co-operation, natural resource management projects are likely to fail. The Opportunity Cost Analysis (or market-based approach) and the Contingent Valuation Method provided strikingly comparable estimates of the costs borne by villagers.

Impact on tourism (based on Contingent Valuation Method & Recreation Demand Analysis):
When conservation projects provide increased opportunities for nature tourism activities, non-market valuation tools such as Recreation Demand Analysis and the Contingent Valuation Method can provide estimates of potential economic benefits. Studies of this type bode well for both ex-ante project evaluation efforts as well as project planning, implementation and management. Although the estimated tourism benefits are only one part of the total value of the new National Park, the results show that tourism can be a significant source of benefits when parks are created in a tropical country, even one attracting only a modest number of international visitors. Clearly, the potential nature tourism benefits should be included in any reasonable Cost-Benefit Analysis for project evaluation. However, non-market studies of this kind may prove even more beneficial in maximising project revenues and benefits through improved planning and management efforts. Governments may wish to use tourism taxes, user fees, and similar revenues to capture some of the Willingness-to-Pay in order to finance conservation activities.

Production Function Approach:
The deforestation-flooding component of the study illustrates the complexities of combining a number of disciplinary approaches in order to implement the Production Function Approach to valuing environmental changes. A remote-sensing expert conducted extensive analysis of maps and satellite images in order to estimate deforestation rates. A hydrologist/soil scientist analysed data on small watershed runoff and river basin flow rates to provide input on the effect of deforestation on flooding in the Mantadia area. Finally the information on flooding was combined with agronomic information on crop yields and flooding in order to estimate the agricultural impact of additional deforestation in the absence of the park. Because the point was to measure the benefits of the park, only those crop losses resulting from changes in flooding in the vicinity of the park and buffer zone were analysed. As shown by Table 14, this impact is modest, but the analysis may underestimate the total watershed protection benefits of the projects. It is important to note that the benefits and costs of watershed protection are not borne by the same individuals. While reduced flooding benefits farmers who grow paddy rice in river bottoms immediately downstream, the costs involved in establishing the park are borne by residents living around the park who formerly used the area to collect forest products and practice swidden agriculture. Notwithstanding the data limitations, the Production Function Approach is a useful tool with which to estimate environmental benefits and may have implications for policy regarding the reallocation of the costs and benefits of watershed protection.

Total study
This study examined the economic impact of a new national park on a variety of stakeholders. The work suggests that, with proper adaptation to local conditions, environmental valuation methodologies can be useful in assessing resource value changes in developing countries. The results of these valuation efforts can be incorporated more fully into the Cost-Benefit Analysis of projects, including conservation components, in order to determine the project's economic viability. Using a variety of valuation tools and multidisciplinary research, as this particular study did, gives insight into the different values linked to the various goods and services provided by a tropical forest. This study also assessed the impact of a new national park on two different groups of stakeholders: local villagers and foreign tourists. The results show that the costs involved in preserving the forest are borne by the local community, while the benefits (as indicated by

Willingness-to-Pay) accrue to the foreign tourists. A study such as this can therefore be useful as a means of instigating debate on the reallocation of costs and benefits.

7. Valuing tropical rainforest protection as a global environmental good.

Valuation Tool used: Contingent Valuation Method

Description:
Voluntary contributions to nature conservation organisations and public opinion polls provide evidence of substantial public support for biodiversity conservation. Another means to estimate public opinion about biodiversity conservation is the Contingent Valuation Method. In a study carried out by Kramer *et al.* (1993), the Contingent Valuation Method was used in a national postal survey to assess the value that residents of the United States place on rainforest protection. The purpose of the survey was (1) to measure the Willingness-to-Pay of residents of the United States for preserving a portion of the world's tropical forests, and (2) to determine their attitudes towards issues concerning tropical rainforest preservation and management.

Valuation tool:
The Contingent Valuation Method model was based on two different approaches. The sample was randomly divided into two groups for experimental treatment. Half the sample were presented with a referendum-style question. The application of referendum Contingent Valuation Method questions requires there to be a discrete number of sub-samples. Each sub-sample are asked whether or not they would be willing to pay a specified amount for the particular non-market good and are required to answer either "yes" or "no". The probability that an individual's Willingness-to-Pay is greater or less than the offered bid amount is estimated by means of a logit regression model. The logit model creates a function that depicts the probability that Willingness-to-Pay values will exceed offered bid amounts. The total Willingness-to-Pay is then estimated as the area of the diagram under the probability functions. By including other explanatory variables in addition to the offered bid in the logit model, one can determine how income and other explanatory variables influence the demand for rain forest protection.

The other half of the sample were presented with a "payment card" type of question. In this approach, each respondent is presented with an array of different dollar amounts, starting at zero, and is asked to circle the amount closest to their Willingness-to-Pay. A censored regression model was used, from which a mean predicted Willingness-to-Pay could be calculated. As with the logit analysis of the referendum responses, explanatory variables can be included in order to identify demand shifters.

After extensive discussions with members of a focus group and Contingent Valuation experts, contribution to a hypothetical United Nations Save the Rain Forests Fund was defined as the payment vehicle. A pre-test was carried out by means of a national postal sample of 100 households. The final version of the survey was mailed to a random sample of 1,200 US residents between April and June 1992. The relevant mailing list was purchased from a commercial marketing firm. After several follow-up mailings, 542 surveys were returned.

Outcome:
Table 15 shows the percentage of respondents answering "yes" and "no" to some general questions about rainforests.

Table 15. Percentage of respondents answering "yes" or "no" to questions about knowledge of, visits to, and obligations to pay for rainforests (Source: Kramer *et al.*, 1995).

	YES	NO
Did you have any knowledge of rainforests before this survey?	91%	9%
Do you have any knowledge of causes of deforestation?	81%	19%
Did you previously visit a rain forest?	11%	89%
Do you plan to visit a rainforest?	8%	61%[a]
Should industrial countries help developing countries pay for preserving their rainforests?	67%[b]	33%

[a] 31 percent were uncertain whether they would visit a rainforest in the future.
[b] For those responding "yes", the percentage stating that industrialised countries should pay ranged from 1 to 100 percent, with a median of 41 percent.

The respondents were encouraged to weigh tropical deforestation against other environmental concerns by asking them to rank a variety of environmental problems. The rankings available ranged from 1 to 6, with 1 indicating the greatest importance. The highest rankings were assigned to air (2.63) and water pollution (2.73). This is not surprising, given that the local effects of these problems are more pronounced than those of the other problems presented, and there may be a greater perceived link with the health of respondents and their families.

Next in average order of importance were two international environmental problems that have received extensive media attention, namely atmospheric ozone depletion (3.47) and global warming (3.65). Considerably lower rankings were assigned to the other problems on the survey list: tropical deforestation (4.52), acid rain (4.60), and the harvesting of old-growth forests in the north-western United States (5.37). It is interesting that deforestation in the tropics was viewed as a more serious problem than deforestation in the US Pacific Northwest.

In order to examine factors affecting Willingness-to-Pay for rainforest protection, the Contingent Valuation responses were regressed against a number of socio-economic and attitudinal variables. In both models, income has a positive effect on Willingness-to-Pay. As incomes rise, there is a shift in the demand for this environmental good. Political affiliation has no significant effect in the payment card model, but in the referendum model Republican affiliation has a negative association with the acceptance of offered bids. A dummy variable for whether or not respondents made charitable contributions has a significant and positive coefficient in both models. A dummy variable which reflects past or planned visits to a rainforest increases the Willingness-to-Pay in the referendum model. The ranking assigned to deforestation as opposed to other environmental problems was also included as an independent variable. As expected, the higher the ranking, the higher the Willingness-to-Pay in the payment card model. Respondents who said that industrialised countries should help pay for rainforest protection expressed a higher Willingness-to-Pay in the payment card model and were more likely to accept offered bids in the other model. Finally, family size had a positive relationship with Willingness-to-Pay in the payment card model, perhaps indicating a bequest or intergenerational equity motive.

The estimated Willingness-to-Pay is shown in Table 16. The referendum format yields a mean Willingness-to-Pay per household of USD 24, while the payment card format gives a mean Willingness-to-Pay of USD 31 per household. Aggregating over the 91 million households in the US, this gives a total Willingness-to-Pay of USD 2.18 billion and USD 2.82 billion for the two methods. This is a large amount of money and can be thought of as a revolving fund that would be used over a number of years to finance tropical forest programmes. If one makes the more conservative assumption that only households with at least USD 35,000 in annual income would actually donate to the fund, then the aggregate Willingness-to-Pay would be USD 1 billion.

Table 16. Willingness-to-Pay (WTP) estimates for tropical rainforest preservation (Source: Kramer *et al.* 1995)

Type of question format	Mean WTP (USD /household)	Total WTP (all households)[a]	Total WTP (income> USD 35,000)[a,b]
Referendum	USD 24	USD 2,184,000,000	USD 780,000,000
Payment Card	USD 31	USD 2,821,000,000	USD 1,007,000,000

[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)

Comments

This study represents one of the few applications of non-market valuation tools to a global environmental good. Although there has been a lot of general criticism of the Contingent Valuation Method, the strength of this particular study is that it estimates the Willingness-to-Pay for the conservation of tropical rainforests of people who are not explicitly interested in tropical rainforests compared, for example, to respondents in a Travel Cost Method. In a Travel Cost Method for a tropical destination, the researcher knows beforehand that the respondent has a certain interest in the tropical rainforest, otherwise he/she would not have bothered to go on a trip (usually an expensive one) to that particular destination. The bid is therefore likely to be higher than an average person from an industrialised country would offer.

Perhaps the most interesting policy finding of this study is that two thirds of the households said that industrial countries should share the costs of protecting the remaining rain forests. The Biodiversity convention signed by most countries attending the Rio Conference was based in part on the principle of costs being shared between beneficiaries in industrial countries and less developed countries. The US public seem to support this international financing approach. For the study sample, tropical deforestation ranked below most other environmental problems, perhaps reflecting a higher priority for domestic environmental issues. Despite this low relative ranking,

households are willing to contribute an average of USD 24 to USD 31. If households in other industrial countries are willing to make similar-sized donations, this could create a substantial global fund.

Glossary of economic valuation terms

Barter Exchange Approach
Determining the value of a non-marketed good by using the price of another good for which the non-marketed good is exchanged through the process of barter.

Bequest value
The value attached to the knowledge that others might benefit from natural resources in the future.

Carrier or habitat functions
Functions provided by ecosystems through space and a suitable substrate or medium for the system itself as well as for many human activities.

Compounding
A system for measuring present cost and benefits in terms of their future value.

Constructed Market Techniques
Hypothetical markets for environmental and other non-marketed benefits in which respondents are asked to state their Willingness-to-Pay for the benefit or their Willingness-to-Accept compensation for no longer receiving it.

Consumer surplus
The additional utility to a consumer above the market price: this is the difference between someone's Willingness-to-Pay for something and what they actually pay for it.

Contingent Ranking Method
In this survey method, a range of amenities is presented to respondents. These are ranked and scored relative to each other, with one of the amenities serving an the anchor. The respondents' Willingness-to-Pay for the anchor is then elicited and used in order to infer their Willingness-to-Pay for the other amenities.

Contingent Valuation Method
This survey method is used to estimate a consumer's Willingness-to-Pay for a specified good or service or their Willingness-to-Accept compensation for receiving an unwanted good or service.

Cost-based Valuation
A method to assess the costs of different measures that would ensure the maintenance of the benefits provided by the environmental good or service that is being valued. These cost estimates are used as proxies for unknown environmental benefits.

Cost-Benefit analysis
Comparing alternative uses based on the present and expected monetised advantages and disadvantages related to these alternatives.

Direct Substitute Approach
Estimates the value of non-marketed goods (such as fuel wood) by taking the market price of similar goods (such as fuel wood purchased from another area) or the market price of the next-best substitute good (such as kerosene or charcoal).

Direct use values
Benefits that accrue directly to the users of natural areas, whether extractive (e.g. timber and NTFPs) or non-extractive (e.g. recreation).

Discounting
A system for measuring future costs and benefits in terms of their present value, based on the concept that it is better to have money sooner rather than later since it can be invested and generate income.

Discount rate
An inverse interest rate that measures the rate at which future values decline in terms of present values. A high discount rate reflects a strong preference for present consumption.

Double counting
Calculating the total monetary value of a given area or ecosystem by erroneously adding up values based on different functions although the value calculated for a particular function has already been partly included when calculating another.

Economic valuation
A tool that can provide decision-makers with useful information with which to decide between alternatives or in favour of preferred combinations of possible interventions.

Economic value
Economic values are values to which we assign some monetary measure, whether derived through market transactions or by other means (what economists call "shadow pricing").

Existence value
The value placed by non-users on the fact that something exists; its intrinsic value.

Extended Cost-Benefit analysis
Cost-Benefit Analysis based on direct costs and benefits of marketed goods and services and indirect costs and benefits of non-marketed goods and services estimated by valuation methods.

Externality
An unintended cost or benefit of production or consumption that affects someone other than the producer or consumer, and which does not enter the market or is external to it.

Financial value
Financial values refer strictly to market-priced goods and services.

Flow value
Values associated with the flow of goods and services provided by ecosystems, such as fruits and nuts.

Functions of nature
The possible use of the environment for human beings or the goods and services generated by nature.

Hedonic Pricing Method
The basic idea behind this method is that prices of land and property illustrate the valuation of environmental quality. For example, houses in a natural environment usually command much higher prices than houses in city suburbs. The extra price paid is a proxy for the environmental value.

Incremental cost
The change in explicit and implicit costs arising from an environmental policy initiative.

Indirect Opportunity Cost Method
Method of estimating the value of non-marketed environmental goods when individual labour is involved in harvesting or collecting them. The basic assumption of this technique is that the decision to spend time on collecting or harvesting goods, for example NTFPs, is weighed against alternative productive uses of labour.

Indirect use values
Benefits that accrue indirectly to users of natural areas, primarily ecological or environmental services.

Indirect Substitute Approach
Estimates the value of non-marketed goods indirectly, by analysing the change in value of economic output caused by a change in the use of a substitute good as an input into production.

Information functions
Functions which do not involve a physically measurable effect or output from an ecosystem, but contribute to human well-being by their importance for religion, culture or individual well-being.

Internal rate of return
The discount rate which causes the net present value to be zero; this can be thought of as the return to capital or financial yield of a project.

Market failure
A situation in which markets are absent or highly imperfect, meaning that prices are a poor guide to resource scarcity and consumer utility.

Net present value
The present value of benefits less the present value of costs following the use of a discount rate.

Opportunity cost
The value of something that has to be given up to achieve something else, or –more specifically with reference to resource allocation– the foregone net benefit from the best alternative use of the resource.

Option value
The amount that individuals would be willing to pay to conserve a natural resource for future use.

Policy failure
Policies that either provide a disincentive to sustainable natural resources management or that fail to correct for market failure.

Preventive/defensive expenditure approach
The value of an improvement in environmental quality can be estimated directly from reductions in expenditure on defensive activities.

Production Function Approach
A method of capturing the indirect use value of regulatory ecological functions of ecosystems through their contribution to economic activities.

Production functions
Functions that are based on the provision by nature of a variety of resources.

Regulation functions
Functions that are provided by the capacity of ecosystems to regulate essential

ecological processes and life support systems.

Related Goods Approaches
The price of a marketed good or service is used to determine the value of a related non-marketed good or service.

Relocation Cost Technique
This technique involves estimating how much it would cost to relocate (and re-equip) communities in order that they may obtain a level of benefits in their new location similar to those derived at their original site.

Replacement Cost Technique
This technique generates a value for the benefits of an environmental good or service by estimating the cost of replacing the benefits with an alternative good or service.

Restoration Cost technique
This technique estimates the value of environmental goods and services provided by an ecosystem by estimating what it would cost to re-create the original ecosystem if it were to be exploited within a destructive alternative land use.

Shadow price
In the case of goods with national or international markets, which are less imperfect than a local market, it is a price based on those markets; in the case of labour, it refers to the opportunity cost of time.

Stakeholder
Individuals or –usually– groups of people, organised or unorganised, who have a share, interest or stake in a particular issue or system.

Stakeholder analysis
The process of determining all relevant stakeholders in relation to the functions provided by an ecosystem being studied so as to involve them in decision-making procedures regarding the use of this ecosystem.

Stock or capital value
The value associated with a stock of natural resources, based on the concept that a stock is necessary for the continued production of goods and services. For example, when a forest is overexploited or depleted it cannot produce flows of timber, fruits, nuts or other products any longer. Maintaining a stock

ensures continued production and thus represents a value.

Surrogate market
The same as a substitute or proxy market: when two products are substitutable, the market value of one can be used as a means of valuing the other.

Total economic value
The total value of the forest resource, comprising direct, indirect and non-use values.

Trade-off
A situation in which meeting one objective means that another objective (or other objectives) cannot simultaneously be met to the same degree.

Travel Cost Method
This method estimates the value of recreational amenities by using the travel expenditure (time and money) needed to reach the recreational site.

Value-in-exchange
Market price of market-traded goods and services.

Value-in-use
Consumer value estimates for non-marketed goods and services.

Valuation methods
Methods to estimate or determine the monetary value of non-marketed environmental goods and services.

Values
A value is the worth of a product or service to an individual or a like-minded group in a given context.

Willingness-to-Accept
The amount of money or payment-in-kind that people are willing to accept as compensation for the loss of environmental goods and/or services in a Contingent Valuation survey.

Willingness-to-Pay
The amount of money or payment-in-kind that people are willing to pay to receive environmental goods and/or services in a Contingent Valuation survey. It is also used more generally to refer to the true "value in use" of something, i.e. including consumer surplus.

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SOME USEFUL WEBSITES AND CONTACTS ON ENVIRONMENTAL ECONOMICS

1. WEBLINKS with CONCEPTUAL OVERVIEW

The Biodiversity Valuation Collection of the Biodiversity Economics Library
http://biodiversityeconomics.org/valuation/
IUCN The World Conservation Union

Ecosystem Valuation
http://www.ecosystemvaluation.org/
Site developed and written by the University of Maryland (Dennis M. King) and the University. of Rhode Island (Marisa Mazotta)

2. CONVENTIONS and AGREEMENTS

Convention on Biological Diversity
http://www.biodiv.org/

The Ramsar Convention on Wetlands
http://ramsar.org/

United Nations Framework Convention on Climate Change
http://www.unfccc.int/

Convention to Combat Desertification
http://www.unccd.int/

United Nations Forum on Forests
www.un.org/esa/sustdev/forests.htm

3. INTERNATIONAL CONTACTS ON ECONOMIC VALUATION

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Website: http://www.cifor.cgiar.org/

FAO
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Viale delle Terme di Caracalla
00100 Rome, Italy
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Website: http://www.fao.org/forestry/Forestry.asp

IUCN – The World Conservation Union
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Appendices

Appendix 1.: Policy and scientific context of valuation of functions of forests and nature

Intergovernmental Panel on Forests
International interest in the valuation of forests and nature has intensified during the international forest policy process of the Intergovernmental Panel on Forests. This was an ad-hoc panel installed by the Commission on Sustainable Development of the Economic and Social Council of the United Nations and operated from 1995 until 1997. One of the issues dealt with during the Panel's third session in Programme Element III.1 (b) was "Measuring and capturing forest values: issues, policies and challenges". The report for the Panel stated that "rent-seeking behaviour by powerful interests associated with the industrial logging and processing sector, and the exclusion of other interest groups from effective participation in forest management, is leading to the ignoring of the many forest values –values that are often significant, including non-timber forest products, biodiversity benefits, on-site and off-site soil and water impacts, and carbon sequestration" (IPF, 1996a). Moreover, it became clear that "in cases where forest depletion is observed, it is usually not true that those responsible were acting in an inefficient or wasteful manner. Indeed, in most cases they can be shown to operate quite efficiently in a commercial sense, based upon the market and price signals they are receiving. To the extent, however, that those signals are wrong (in that they are not reflecting the real value of the resources involved, and the degree of scarcity that is implicit in their continued supply), the users will be inefficient and wasteful from a public and societal point of view."

Intergovernmental Forum on Forests & United Nations Forum on Forests
The same programme of the Intergovernmental Panel on Forests also produced a report on "Methodologies for proper valuation of the multiple benefits of forests". This report already describes the context of forest valuation and the different methodologies and techniques used but also the advantages and disadvantages of various different valuation tools in forest land-use appraisal (IPF, 1996b). The Intergovernmental Panel on Forests made recommendations to the General Assembly of the United Nations in June 1997 to continue this international forest policy dialogue and to implement its proposals for action. This resulted in the international sessions of the Intergovernmental Forum on Forests in the period 1997–2000. In 2001, the United Nations Forum on Forests was established to implement the proposals for action of the Intergovernmental Panel on Forests and the outcome of the deliberations of the Intergovernmental Forum on Forests. In the report of the Intergovernmental Forum on Forests that serves as a basis for the Work Programme of the United Nations Forum on Forests, "valuation of forest goods and services" is stated to be one of the issues that require further clarification. The report concludes that the development of forest valuation tools and methods is an ongoing process and reiterates their relevance and validity. The Forum stresses that the deficiencies in valuation in economic terms of social and ecological values, for example, does not imply that these values are considered less relevant. The Forum identifies a need for simplified, rapid cost-effective valuation methodologies to suit the specific circumstances of individual countries. Furthermore, it considers that valuation estimates provide important inputs to forest policy development and to the formulation and implementation of national forest programmes.

Another important conclusion of the Intergovernmental Forum on Forests was that the scope of valuation of forest goods and services needs to extend beyond the limits of the forest sector and include, for example, consideration of alternative land-use options of significant social or economic value, forest products pricing, and the ecological impact of substitute materials. A method is needed for identifying both the costs and benefits of sustainable forest management and ways to encourage countries to internalise externalities. Enhanced international co-operation is required, with special attention being paid to capacity building for the development and application of forest valuation in order to make possible informed policy and decision-making, as well as enhanced programme formulation in developing countries. Furthermore, there is a need for enhanced co-operation and co-ordination on forest valuation matters with other forums dealing with such issues as climate change, international trade, desertification and biological diversity (IFF, 1997).

The Intergovernmental Panel on Forests, later endorsed by the Intergovernmental Forum on Forests and the United Nations Forum on Forests, called upon countries and relevant international

organisations concerned with forestry and trade to explore ways and means to establish full cost internalisation of both wood products and non-wood substitutes, and to undertake market and economic analyses of their implications for forest management and development costs and for Sustainable Forest Management. Such analyses should also examine the potential cost and benefits of improved efficiency and sustainability at all levels of the forest industry.

More specifically the Intergovernmental Forum on Forests:
(a) urged Governments to improve the collection of quantitative data to enumerate and develop physical accounts of the full range of forest goods and services, including inventories of timber and other goods and services, and the impact of changes in forest use on the environment. This should also be done for substitute non-wood materials;
(b) encouraged further development, by countries and international organisations, of rapid and low-cost valuation tools (including a focus on the development of approaches which incorporate a wide range of values, reflect the overall value of forest ecosystems, as appropriate, and identify the costs and benefits of Sustainable Forest Management) and ways to internalise externalities;
(c) requested relevant international organisations to develop and test rapid valuation tools that are policy-relevant and efficient and that reflect regional and national characteristics and requirements, and to develop approaches for the identification of the costs and benefits, including incremental costs and benefits, of Sustainable Forest Management which can be employed for a cost-efficient use of investment funds for forests;
(d) requested countries and international organisations to assist developing countries in building and promoting capacity for the development and application of forest valuation tools. (IPF, 1997c)

In short, the work of the Intergovernmental Panel on Forests / Intergovernmental Forum on Forests and the United Nations Forum on Forests is encouraging countries, in collaboration with international organisations, to make use of available methodologies to provide improved estimates of the value of all forest goods and services and to allow for more informed decision-making on the implications of alternative proposals for forest programmes and land-use plans, taking into account the fact that the wide range of benefits provided by forests is not adequately covered by present valuation methodology, and that economic valuation cannot become a substitute for the process of political decision-making, which includes consideration of wide-ranging environmental, socio-economic, ethical, cultural and religious concerns.

New forest valuation methodologies should take into account the following criteria: neutrality and scientific validity, practical applicability, simplicity and clarity, multidisciplinary, cost-effectiveness, and orientation towards currently non-marketable goods and services (IFF, 2000).

Convention on Biological Diversity
Parallel to the work of the Intergovernmental Panel on Forests / Intergovernmental Forum on Forests / United Nations Forum on Forests, the issue of the valuation of forests and biodiversity has been subject to discussion within the context of the Convention on Biological Diversity. The Convention on Biological Diversity is one of the global conventions on environmental conservation that also resulted from the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, Brazil. To achieve its objectives, the Convention on Biological Diversity includes 42 articles, each dealing with specific aspects of biodiversity conservation, sustainable use and equitable benefit sharing. As Emerton (2000) explains, "almost all of the objectives and articles require the understanding and use of economics for their implementation. Perhaps most importantly, economics is crucial to biodiversity conservation because unless it makes demonstrable economic and financial sense for people to conserve biodiversity, it is unlikely that individuals, households, industries, companies or governments will take action to do so. People will continue to degrade and deplete biodiversity in the course of their activities because they feel that it is more profitable and economically desirable to do so."

Because of the importance of economics to biodiversity conservation, there are references to it throughout the Convention on Biological Diversity. According to Emerton (2000), however, the most important of these where economic valuation is concerned is to be found in article 7, although implicitly so. "This article (identification and monitoring) implies the importance of economic valuation of components of biological diversity important for its conservation and sustainable use." Decision 7 of the Fourth Conference of Parties (COP-4) to the Convention on Biological Diversity explicitly mentions as one of the proposed activities "developing assessment and valuation methodologies for the multiple benefits derived from forest biological diversity" (CBD web page). Furthermore, in Decision IV/10 (part A, Incentive measures) indicating the

measures for implementation of the Convention on Biological Diversity, it is recognised that "economic valuation of biodiversity and biological resources is an important tool for well-targeted and calibrated economic incentive measures", with explicit encouragement being given to taking into account "economic, social, cultural and ethical valuation in the development of relevant incentive measures". It is expected that "Valuation of Forest Biological Diversity" will be an important issue during the COP-6 scheduled for April 2002 in The Hague, The Netherlands.

Kyoto Protocol
It is not yet entirely clear what role of economic valuation will play within the context of the development of the Framework Convention on Climate Change, but in all discussions on the development of the Kyoto protocol it is obvious that the eventual inclusion of forests as sinks for carbon sequestration will become more important. This is a function of the forest that has only recently been identified as valuable; formerly it was never considered as being of any economic value. This document demonstrates clearly that although the function of carbon sequestration has always existed, the value of this function is determined by the interests of the stakeholders and can change over time. The economic value of carbon sequestration should be integrated into the total value of forests, even if there is no market on which to trade the benefits. It is assumed that an international market may be initiated for this specific function by trading emission rights (which would pay for the carbon sequestration function).

Scientific research on valuation of functions of forests and nature
The relevant literature shows that a great deal of work has been carried out on the valuation of the environment, forests, nature, wetlands, etc. Ever since the work of J.T. Winpenny for ODI (Values for the Environment: A Guide to economic appraisal) in 1991, and of D.W. Pearce (various publications on Environmental Economics) for IIED in the years from 1989 on, the number of books and articles on environmental valuation and the value of biodiversity, etc. has increased enormously. Special reference should be made to the documents produced by H.M. Gregersen, *et al.* (1995, Valuing forests: Context, Issues and Guidelines) and S. Kengen (1997, Forest Valuation for Decision-making; Lessons of Experience and Proposals for Improvement) and the work of Munasinghe of the World Bank (1992, Environmental Economics and Valuation in Development Decision making, 1993, Environmental Economics and Natural resources Management in developing Countries).

Among the international NGOs, special reference needs to be made to the IUCN for the numerous books and articles on economic valuation it has produced. The IUCN's extensive bibliography includes many of the relevant titles, especially relating to the protection of biodiversity and the involvement of the rural population.

Appendix 2.: Causes and effects of undervaluation

Causes of undervaluation

Market failure
In an ideal situation (one which does not exist), the worth of goods and services is determined in a free market. In such a market, the price creates a balance between demand and supply and equals the worth of the traded good or service. In reality, however, market failure occurs as a result of malfunctioning, distorted or absent markets. There are several market failures in the area of forestry. Firstly, there is hardly any market for certain forest functions, for example carbon sequestration, maintenance of biodiversity and watershed protection. The only markets are for some of the production functions of nature, such as for timber, fuel wood and non-timber forest products. If there is in fact a market, that market either does not determine the price of the good concerned or the price does not reflect the real value (i.e. is too low). There are also methodological problems in assigning monetary values to indirect use and to option, bequest and existence values. In turn, this implies that alternative land uses become more economically attractive, leading to the disappearance of forests.

The second market failure is to be found in the existence of externalities. Those are the benefits and costs enjoyed or borne by persons or bodies not directly involved in the activity. For example, a timber company that fells an area of tropical forest along a river may cause flood damage to the crops grown by local people living downstream. The costs associated with this flood damage are usually borne by these local people, who did not cause the damage.

The third failure is that difficulties also arise in the case of conflicting use by different parties. This raises questions of compensation, for example of whether local users who suffer as a result of use by non-local people should be compensated. If so, by whom and for how long? (Meijerink, 1997)

Policy failure
Where the market fails, as in the case of the functions generated by forests, the government can adjust and influence markets to create an environment in which the interests of society as a whole are guaranteed. In some cases, government policies may even exacerbate the market failure. There are several ways in which governments fail in this respect. Firstly, governments are influenced by pressure groups, especially the very powerful lobbies in the agricultural and industrial sector, which are often involved in environmentally damaging activities. Secondly, although the government may be well intentioned, it may have difficulty in obtaining the right information (e.g. about the environmental situation) and in monitoring the actual outcomes of policy interventions, which may be quite complex. Moreover, politicians often do not take into account the possible detrimental environmental impact of the external effects of action taken in other areas. Thirdly, bureaucracy may hamper the implementation of the government's good intentions as reflected in the framework of environmental legislation and policy. Responsibility for forests is often spread across numerous agencies, institutions and departments, making co-ordination difficult. Fourthly, a lack of institutional capacity and expertise, plus inadequate funding and staffing, also inhibits the implementation of effective natural resources management (Meijerink, 1997).

Short time horizon
The sustainable use of any natural resource implies that nothing should be done in the short term that reduces the ability of the resource to provide services in the future. However, classical economic methods of evaluating projects tend to favour the destructive exploitation of nature. Cost-Benefit Analysis, for example has a short time horizon of at most 30 years. Cost-Benefit Analysis requires the deduction of all discounted investment and operation costs that occur over a given planning horizon from all discounted benefits. Discounting cash flow from ecological investments that have long-term and uncertain benefits and high and short-term costs reduces the net present value of those investments and results in under-investment in ecological protection or restoration (Prato, 1999). Competition in markets also shortens time horizons. For example, competitive forces in agriculture may induce farmers to choose short-term perspectives for financial survival. Farmers must maintain yields and cash flow and this has led to the adoption of high-yield crops, monoculture farming, and a reduction in genetic diversity (Norgaard, 1988, in Edwards & Abivardi, 1998).

Ignoring costs associated with ecosystem degradation

The value of production stemming from natural resources is generally calculated in national income accounts without deducting the cost associated with the depletion or degradation of the resources. As a result, when forests are cleared, for example, no depreciation that would reflect their decreasing productive capacity is recorded. The resource itself is treated as a free good, which is clearly a measurement failure. By including only the value of production without netting out the value of natural resources inputs, national income accounts overestimate the income generated and provide wrong signals for decision-making. Policies that deplete forests or degrade the environment and decrease future productive capacity may appear to be desirable activities (Gregersen *et al.* 1995)

Single attribute

Most of the tools for valuing the non-marketed costs and benefits of nature are single-attribute valuation tools, and as such are poorly suited to evaluating the multifaceted ecological impact of resource management decisions (Kahn, 1996). For example, the applicability of the Travel Cost Method is limited to the recreational value of specific sites, and only values the recreational value for the visitor. However, these are only single attributes of the complexity of forests and nature. It is therefore very important to use a mixture of different and appropriate valuation methods.

Insufficient knowledge

Another problem is that economic value measurements will probably always understate the true economic value of forests and nature because of our lack of knowledge of the role of particular species or habitats in providing life support functions. In part, this is a limitation of our existing knowledge: we have a very imperfect understanding of the role particular species play in ecosystems and are not in a position to assign a precise value to them. More importantly, there are things we can never know. How important will the existence of certain species be for the stability of an ecosystem under unknown conditions in the future? This type of economic value is impossible to quantify because it is unlikely to be recognised until some disastrous event has taken place, for example landslides caused by deforestation. The value of the forest is probably not equal to the cost of restoration after degradation, but we are not able to prove this because of a lack of knowledge. In other words, undervaluation can lead to irreversible damage to forest ecosystems.

Relevant stakeholders not involved

Involvement of stakeholders at the level of international, national, regional and (especially) local communities is crucial to the successful implementation of policies regarding natural resources. If there is insufficient interaction between these levels with respect to the protection of forests in certain areas, the result is usually encroachment on the forest areas concerned. For example, the implementation of biologically-focussed and/or legally focused approaches to conservation and the existence of pressures from politically powerful vested interest groups have contributed to the cultural and socio-economic marginalisation of many people living within or close to Protected Areas. As a result of these resource use conflicts, many Protected Areas around the world suffer from encroachment by the people living near them (Tacconi, 1997). This illustrates the need for co-operation between all parties involved and the relevance of the participation of local communities in the valuation process. An appropriate policy environment such as a democracy is one of the key conditions for the success of valuation processes.

Failures in property rights

According to traditional economics, when a resource is not individually owned, there is no individual interest in maintaining or improving that resource. It should be added that considerate management of natural resources is not necessarily impeded by the absence of private ownership, including efficient forms of collective (e.g. tribal) ownership (Berkes, 1989 in Edwards & Abivardi, 1998). The traditional economic view that there exists either open access (and thereby overuse) or private ownership (and thereby rational management) ignores collective arrangements that do in fact function effectively. Where property rights are not well defined, or where –because of political instability, for example– an owner cannot expect to enjoy the benefits over an extended period, there is a strong tendency towards the destruction of potentially sustainable ecosystems. This issue is of relevance because for many traditional forest communities the forest is a common pool resource. A more subtle and complex problem relating to ownership is that biodiversity often benefits society as a whole, while the costs of preserving it are borne by the individual (Edwards & Abivardi, 1998).

Effects of undervaluation

Degradation of natural and forest resources
Inadequate recognition and underestimation of the value 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 the failure of SFM, perhaps even contributing to deforestation, forest degradation and the transfer of forests to other land uses. Some authors, for example Richards (1994), argue that the major single cause of deforestation is the fact that forest resources are underpriced and therefore undervalued by society as a whole.

However, evidence suggests that valuation *per se* does not seem to be able to halt the conversion of forest land to other uses. Despite the importance of forest valuation in the decision-making process, it is not a solution *per se* to all forest-related problems and not, therefore, 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. 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 (1) there are many issues that cannot be addressed through monetary values; (2) decision-makers often do not require fine-tuned figures but simply an indication of orders of magnitude or even no quantitative information at all; (3) in many cases, a decision-maker may only need qualitative information, for example 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 regarding a particular forest (Kengen, 1997).

Equity problems
Undervaluation of forest resources may also lead to intra-generational and inter-generational equity problems. In many cases, those who profit from forest services are not the ones who bear the cost and make the investment needed to manage the forest. This means the costs and benefits are not in the same hands. Cost-Benefit Analysis does not consider the intra-generational and inter-generational fairness of the distribution of gains and losses because it is primarily a criterion of economic efficiency (Prato, 1999). Due to the discounting process, Cost-Benefit Analysis fails to account for the interests of future generations (Tacconi, 1995). Cost-Benefit Analysis permits collective action that is harmful to individuals and is indifferent to whether those who gain are already well off or those who lose badly off, or vice versa.

Appendix 3.: Functions

Why do we need to define the functions of forests and of nature?
Functions are defined as the possible uses of the environment for human beings (Hueting, 1994) or the goods and services generated by nature. Discussions on "the importance of nature" can be made clearer and more specific if it is known just what makes nature so important. The importance of nature can best be demonstrated by describing its various functions. Expressing the importance of nature by its functions also facilitates its economic valuation. It is much more difficult to say how much a forest is worth in the form of a sum. It is more practical to first list its functions and to try to value each of them (Meijerink, 2001). However, a lack of scientific information means that it is very difficult to list those functions. In fact, the knowledge and understanding of how tropical forests function, for example, is still severely limited. There remains considerable uncertainty as to the dynamics of the forest ecosystem, particularly where 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 (Kengen, 1997). Moreover, a forest must be considered as more than merely a collection of functions. Many functions are interdependent or interrelated. Valuation of nature and forest functions is therefore an extremely complex process (Meijerink, 2001).

Categories of functions
De Groot (1992) established a classification of major functions of nature; these are described below. Examples of these functions can be found in Table 1 of Section 1.4. of the main document.

Production functions: Functions that are based on the provision by nature of a variety of resources.
Regulation functions: Functions that are provided by the capacity of ecosystems to regulate essential ecological processes and life support systems.
Carrier functions (also known as habitat functions): Functions that are provided by ecosystems through space and a suitable substrate or medium for the system itself as well as for many human activities.
Information functions: Functions which do not involve a physically measurable effect or output from an ecosystem but which contribute to human well-being by their importance for religion, culture or individual well-being.

Characteristics of functions
The characteristics of functions are important in economics. The value of a function depends largely on the value of its possible use for human beings. If a function is important to us, it has a high value. In economics, it is not only the possible use of a functions that is important but also its scarcity. Oxygen, for example is very important for humans, but it is not scarce and therefore has no price. In economics, it is important to distinguish between value and price. Oxygen is extremely valuable to us, but its price is zero. Besides possible use by humans and scarcity, other characteristics of functions are important in economics.

One of these characteristics is *tradability*. In other words: can the function be traded in a market? If so, it can be considered to be a private good, or (user) rights can be assigned to it; if not, it can be considered to be a public good and (user) rights are difficult to assign. Timber, for example, is tradable but watershed management hardly at all. Private goods that can be traded receive their price on the market. However, this may not always be the value of the function. In valuing forests and nature, we usually try to capture the value of a function.

The *substitutability* of a function is also relevant. Can the function be substituted for by a man-made function? A metal and plastic table, for example, could be substituted for a wooden one.

The *sustainability* of a function is the use of a function without its being depleted. The nutrient contents in the soil are limited, for example, so that if the soil is mined through continuous harvesting, nutrients need to be replenished by the addition of fertiliser. But a function such as aesthetic information, for example a beautiful landscape, is not diminished if someone looks at it.

Whether the use of a function conflicts with other functions is also important. Will the use of one particular function lead to a deterioration in the quantity and/or quality of other functions? An example of this is the harm or damage to biodiversity in a nature reserve caused by intensive tourism (Meijerink, 2001).

Appendix 4.: Stakeholders

The uses of functions are very important in decision-making procedures regarding natural resources. It is extremely important to know who uses the functions concerned. Different functions are used by different groups composed of different stakeholders.

Stakeholders are individuals or –more usually– groups of people, organised or unorganised, who have a share, interest or stake in a particular issue or system. The key –and often neglected– stakeholders in the context of natural resources management are subsistence farmers and other small-scale resource users, but stakeholders may also include policy-makers, planners and administrators in governmental or other organisations, commercial bodies, and more nebulous categories such as "future generations", "the national interest" and "wider society". The exact identification of all stakeholders is an extremely difficult task. Given that the composition of the stakeholders varies from case to case, stakeholder identification cannot be pre-determined.

Stakeholders can be distinguished by scale –local, regional, national and international– and time, for example current stakeholders (ourselves) and future stakeholders (our children and future generations). Another fundamental division between stakeholders is between those who affect (determine) a decision or action, and those affected by it (whether positively or negatively); these groups may be termed active and passive stakeholders.

Different groups of stakeholders are affected by a proposed change in forest use in different ways (Gregersen *et al.,* 1995). Some stakeholders will perceive negative values (costs) and others positive ones (benefits). The scale of a proposed change also determines to some extent the level at which stakeholders are effectively involved. "As a first step, we have to identify the various stakeholders (interested groups) involved in or affected by a proposed change and then define their various value perspectives that need to be reconciled in the decision process. To what extent are the various perspectives complementary? To what extent do they conflict?" (Gregersen *et al.,* 1995).

Groups assess the level of benefits they want to obtain from the forest or nature area by comparing those benefits with the quantity of scarce resources (land, labour, capital or biodiversity) that they will have to surrender in order to obtain the benefits. However, different resources are scarce for different groups and forests are not unique in terms of having conflicting values attached to them (and their uses). Different persons attach different values to different resources, goods and services. Box 8 (from Gregersen *et al.,* 1995) provides an example of the multiple value perspectives that can be associated with a given forest

Box 8. Same Forest, different use values
The same piece of forest land may be viewed by different people as:
• *a source of foreign exchange;*
• *a place to hunt wild animals for food;*
• *a site for recreation and education;*
• *space for a large plantation;*
• *protection for a watershed;*
• *a site for new settlements;*
• *a forest reserve for natural regeneration;*
• *a potential ranch for grazing animals;*
• *a place to find new species;*
• *a source of raw material for industry;*
• *a source of firewood, forage, medicines, etc.*
-
(Source: Gregersen et al., 1995)

Gregersen *et al.* (1995) classifies stakeholders in four main groups, each with different interests in natural forest values:
- Groups with **commercial interests** in specific parts or aspects of the forest. These groups are interested in the market or barter values associated with the uses of certain parts of the forest, for example timber industries and consumers of commercially sold timber;
- **Local forest dwellers** with an interest in livelihood/survival values. These groups are interested in the forest as their living environment and as a source of sustenance and livelihood, for example indigenous tribal groups;

- **Environmental advocacy groups** and non-consumptive users. These groups are interested in the forest as an ecosystem or in saving particular species or groups of species. They also are interested in the educational, recreational, and spiritual values associated with forest preservation. They may be local, national, or international;
- Migrant farmers, ranchers, and **others with an interest in the land under the forest**. This group may assign a negative value to the trees and animals of the forests they wish to clear, i.e. they would like to see them gone. To these groups, the forest is a nuisance: letting it stand involves a cost; it harbours dangerous animals; it is the home for animals and insects that attack their adjacent agricultural crops; it hinders travel and road construction, etc. (Gregersen *et al.*, 1995).

In classifying stakeholders it should be noted that people as individuals may fit into more than one interested group. For instance, consumers of timber may also be part of the groups of local forest dwellers that have an interest in the forest for their survival, but they may also be ardent environmentalists. These conflicting interests apply to different areas of forest or different aspects of forest use. The two value frameworks are consistent from a valuation point of view. This means that a person will be identified with one value perspective or another, depending on the specific forest area and situation being addressed

Appendix 5.: Values

Economic values and ecological values

The functions of nature can be categorised according to different types of values. A value is the worth of a product or service to an individual or a like-minded group in a given context (Brown 1984 in: Kengen 1997). Economic values are anthropocentric by nature, i.e. they are human-oriented and human-assigned. The element "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 organise its constituent elements in different ways. Even people with identical values do not necessarily behave identically: their values are operationalised under different sets of constraints. In other words, there is no 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 in Kengen 1997). Hence the results of a valuation should be attributed only to the group of stakeholders and shareholders studied.

In the work of Ruijgrok (1999), the economic and therefore anthropocentric interpretation of the term "value" is contrasted with the ecocentric interpretation. In this view, ecological values should reflect the extent to which ecosystems function effectively from an ecocentric perspective. Although this approach, which deals with the health and ecological integrity of an ecosystem, provides another dimension to the types of value, we (HL/HdB) feel that this intrinsic value of nature is incorporated in the value that society attributes to nature. Apart from economic and ecological values, Ruijgrok (1999) also distinguishes psychological values. Psychological values are related to the benefits that one perceives as accruing from the object of value. Objects may be valued because they are perceived to enhance personal well-being. (Hein and De Kruijf, 1997).

Classification of values

Munasinghe (1992) established a classification of major categories (types) of values of nature (Figure 1, Main Document). He divided the total economic value of nature into use and non-use values. Use values are divided into direct use, indirect use and option value. Non-use values are divided into existence and bequest value.

The *direct use value* is the value assigned to products that are consumed directly or products that are traded in formal markets (including tourism and recreation). These values correspond with the production and carrier functions.
The *indirect use value* includes the benefits that are basically derived from functional services that the environment provides to support production and consumption. Environmental resources often provide value without being consumed, traded in a market place, or reflected in national income accounts. These values correspond to regulation and carrier functions.
The *option value* is defined as the amount that individuals would be willing to pay to conserve a natural resource for future use. Given that the future use of natural resources is in many cases uncertain, people may be willing to pay to retain the option of having future access to a species or a natural area, for example. The option value corresponds to the information functions of nature.
The *bequest value* is the benefit that an individual obtains from the knowledge that others may benefit from a resource at some point in the future. The bequest value is related to the information function of nature.
The *existence value* (or intrinsic value) is the value people attach to nature without considering its benefits or use. The character and magnitude of the existence value is determined by religious and cultural perspectives. People may find satisfaction in knowing that certain ecosystems or species exist, even though they do not intend to visit or otherwise use them. The existence value is related to the information functions of nature.

Characteristics of values

Like the functions of forests and nature, values have particular characteristics, which are important from the pint of view of economics.

Financial values and economic values
Financial values refer strictly to market-priced goods and services. Financial values are always looked at from the perspective of a particular person or other unit. For that unit, therefore, financial costs represent outflows of money/resources, while financial returns are inflows of money to the unit. Economic value is a much broader concept. Economic values are values to which we assign some monetary measure, whether derived through market transactions or by other means (what economists call "shadow pricing"). All the values presented in Figure 1 (Section 1) are economic values, while only a certain number of the use values (those goods and services traded in the market) are financial values. In general, values should not be confused with prices.

Positive and negative values associated with the same good
Goods and services can be associated with negative monetary values (costs) or positive values (benefits). It all depends on who is considering them. To a worker, for example, a wage is a benefit with positive economic value; it is an income. From the perspective of the forest company hiring the worker, the wage is a cost and takes on a negative value in the company's calculations. At the same time, it should be borne in mind that valuation involves attaching positive values to goods and services. They become "costs" when we have to give them up. They are assigned a plus sign and become "benefits" when we obtain them. For example, even though we may use any number of proxy measures to estimate the cost of pollution, it is basically equivalent to the positive value of the health benefits we give up as a result of pollution. Opportunity cost is nothing more than a reflection of the value of the goods or services lost when a resource is diverted from one use to another (Gregersen *et al.* 1995).

Stock values and flow values
Biological resources have both flow and stock (capital) values. Forests, for example, contain a standing stock of trees that can produce flows of timber, fruits, nuts and other products. Both sets of values are relevant in considering proposed changes in forest use. Flow and stock value relationships lie at the heart of debates about the sustainability of biological resource systems. In fact, much of the argument for the introduction of natural resources accounting, or for taking changing stocks of natural resources into account in national accounts, relates to this point. Recently, there has been a growing interest in developing such natural resources accounts associated with forests and other natural resources. To a great extent, this is due to an anomaly in national income accounts that leads to the overestimation of the value of income generated by natural resources because nothing is deducted for depreciation. Depreciation is an imputed cost that reflects both the declining productive capacity of a human-made asset (building, factories, equipment) and the investment that is necessary to sustain a certain level of productive capacity over time (Gregersen *et al.* 1995).

Current value and future value
Costs and returns, or benefits, occur over time and not all at the same time. Project costs and benefits which occur at different points in time (in different years) cannot be compared directly. This is because value is intimately associated with time. To be able to compare values that occur at different times, they need to be brought back or forward to some common point in time. This can be done by either bringing future values back to the present ("discounting") or bringing present values forward to some future date ("compounding"). When discounting or compounding, one needs to select an interest rate. This is relatively easy when an amount of cash flow for some business project needs to be discounted. Let us assume that the interest one can get on a bank account is 8%. USD 100 received today would be worth USD 108 in a year's time. Conversely, USD 100 to be received in a year's time would be worth only USD 92 today. However, choosing the interest rate for an environmental project is more difficult. A high discount rate usually works against the conservation of nature, as is explained in Box 4 (Section 1).

Value in exchange and value in use
It is important to distinguish between value in use (consumer value estimates) for some non-market goods and services and value in exchange (market prices) for market-traded goods and services. One should not therefore compare market-priced values for timber, for example, with estimates of its value in use for recreation. The two represent different concepts and often differ.

Consequently, the market price paid (value in exchange) for an ecotourism trip to a Kenyan game park, for example, may be far below what a particular consumer is actually willing to pay (value in use) for the trip (Gregersen *et al.* 1995).

Appendix 6.: Economic valuation and decision-making

Everybody makes decisions every day, whether they be conscious or unconscious. The type of decision made will depend on the stakeholder, the context in which the decision is made, the alternatives open to the decision-maker, his/her personal preferences, the personal or contextual history of decisions related to the decision to be taken, or the institutional or administrative arrangements that have been established in order for a decision to be taken by more than one individual. Many more aspects can be considered. Many of these factors will not be dealt with in this document because the focus here is on economic decision-making. However, it is worth remembering the many variables that influence a decision. When pondering a decision –at least a responsible one–, the decision-maker always weighs the positive aspects (benefits) against the negative aspects (costs). The main factor is that these positive and negative aspects should be brought together in order to see whether the balance turns more to the positive or the negative side. The most usual common denominator is to translate all aspects and (possible/future) effects of decisions –and thus of changes– into monetary terms. However, this is not always possible, simply because not all aspects can be converted into monetary terms. In such cases, weighing up the various different factors requires the use of tools other than valuation tools, for instance Multi-Criteria Analysis.

Decisions are taken in order to solve problems. For this to be done, the initiative needs to be taken by at least one stakeholder who feels the need to change an unwanted situation, who is dissatisfied in some way, or who is involved in a conflict. Of course, the resulting decision may be to continue with the current practice because the alternatives are not much better or are not realistic, but the decision to review the current situation is also a decision. In short, for decision-making one needs a decision objective.

It is important in decision-making processes to have a clear idea of the existing situation and the alternatives that are under consideration. Depending on the decision-making context, it is important to include all the relevant stakeholders. Decision-makers (and all stakeholders) need to have the relevant, essential information on time, and in an institutional context existing procedures should be taken into account as much as possible. All these factors are commonly understood, but should be analysed again and again when dealing with decisions. For the purpose of this document we will not dwell too much on these factors, but will emphasise –with Gregersen *et al.* (1995)– the fact that it is "important to understand the decision context before moving on to try to measure or estimate economic values". "The values needed and the best way to estimate them will vary with the decision context. In all cases, the values associated with a proposed change should be compared with the status quo, i.e., the comparison should be between the sets of values that would exist 'with and without' the proposed change." To define the decision context for a proposed change, Gregersen *et al.* (1995) suggest the following:

- define the policy context as clearly as possible;
- define the administrative context in terms of what decision criteria are acceptable;
- limit the number of value perspectives considered;
- consider context broadly enough to include the main external effects of a decision on value measures;
- define and achieve consensus on economic trade-off criteria for decisions, since they influence the valuation approaches chosen; and
- use the "with and without" principle.

The policy context of a decision-making process defines the nature of the decisions to be made, and thus the value information needed (Gregersen *et al.*, 1995). The overall choices in the decision-making process will sometimes already have been made by a higher-level political authority (legislature, minister, etc.). In such cases the decision-maker should concentrate on managing the values on the cost side, since a judgement on the overall costs-benefits is no longer necessary. The administrative context refers to the practical implications some valuation tools may have in the real world. The technical considerations should be weighed against the decision-maker's considerations (Gregersen *et al.*, 1995). It is frequently the case that "decision-makers accept value measures that are less theoretically and conceptually sophisticated than others, but more logical and defensible to use in a practical administrative context as proxy measures of value". Some problems that occur in this respect concern time constraints, lack of confidence in people (resulting in feasible suggestions being ignored) and decisions that are made on the basis of

aggregate values of all the functions of the forest for all stakeholders. In the latter case, however, not all values may be quantified with sufficient confidence, but decision-makers do not have the time to wait until researchers have developed these values. Trade-off criteria are criteria against which the stakeholders judge alternate uses of the scarce resource.

Once the context has been defined, identification of the stakeholders should take place (part of a vicious circle, because this may also be part of the context). The decision-making process is dependent on those who participate in it, and an optimum level of participation is necessary in order to arrive at sustainable decisions. Excluding the relevant stakeholders in the decision-making process on the establishment of a PA in Vanuatu, for example, resulted in encroachment on this area by the local people (Tacconi, 1997).

Involvement of the stakeholders is essential in decision-making processes because it is they who define the values related to the functions of the forest or nature areas concerned. Functions of nature which are easy to quantify and other less easily quantifiable functions should be brought together in order to compare alternatives, weigh importance according to criteria and take a responsible decision.

The functions of nature that are easy to quantify are its production functions, which are traded in formal markets. Those goods and services are quantified in monetary terms. The other functions, such as the buffering of CO_2 by forests and coral reefs (regulation functions), or the spiritual information people may gain from natural resources (information function) are not traded in formal markets and are not directly convertible into monetary terms. Comparison of the values of production functions with values for the regulation, carrier and information functions of nature is therefore very difficult and it is difficult to equally weigh these values in decision-making procedures.

In the context of valuation processes, we usually deal more with economic analysis than with financial analysis. Valuation should be regarded more in the context of economic analysis, because financial analysis is always carried out more in direct monetary terms (flows of money), while the valuation of the indirect monetary costs and benefits has to do more with the macro-economic level. Economic valuation is based on economic values and measures the marketed and non-marketed values that people hold regarding natural resources. Financial analysis is a subset of economic valuation and measures the flow of money through this natural resource.

Appendix 7.: Comparing Costs with Benefits

In order to make decisions, it is necessary to weigh the benefits against the cost of the impact of a certain activity. This means that the decision-maker is comparing the original situation with the desired situation, in this case two alternatives he or she has to choose from. A new desired situation (alternative) is compared to the existing situation, which is usually worked out in the form of a project. Economic (and financial) analyses are carried out on the basis of the "with" and "without" scenarios (see Section 1.7 of the main document). However, the impact of this proposed alternative may be desired or undesired. Both elements should be analysed. The most common methods of comparing costs with benefits are either Cost-Benefit Analysis or Cost-effectiveness Analysis. The former is used when benefits can be valued and when the best of a number of alternatives has to be selected. Cost-Benefit Analysis is sometimes called Benefit-Cost Analysis, because of the B/C ratio that places the benefits at the forefront.

Cost-Benefit Analysis compares alternatives on the basis of their monetised advantages and disadvantages. Two main issues are essential in Cost-Benefit Analysis: the factor of Time (time preference) and the principle of Discounting. For Cost-Benefit Analysis it is important to consider all the costs and benefits related to the proposed decision. This includes the consequences for all the relevant stakeholders in the "with project" case and the "without project" case. In order to be able to compare costs and benefits that are realised at different moments in time, all monetised values are discounted (brought back) to point "zero" and then referred to as the Net Present Value. This can only be done, of course, if the costs and benefits can be quantified in a direct (cash flows, traditional Cost-Benefit Analysis) or indirect manner (by using valuation tools in an Extended Cost-Benefit Analysis).

The phases of the Extended Cost-Benefit Analysis include:
- estimating the cost of an environmental decision, using tools such as econometric and engineering models or cost-effectiveness analysis;
- estimating impacts, using tools such as socio-economic impact assessment and integrated impact assessment;
- valuing impacts (examples of tools are Contingent Valuation and Ranking).

Although values expressed in monetary terms facilitate comparison, they should be used with care as they may provide only a partial analysis and be misleading in decision-making (IPF, 1996 b).

"The Net Present Value is the sum of all discounted costs and benefits. This sum reflects how much a proposed project will earn. If the Net Present Value is negative, clearly the costs outweigh the benefits and the project is not economically feasible.

Another way of analysing costs and benefits of a project is calculating its Internal Rate of Return. The Internal Rate of Return is the rate with which the discounted costs equal the discounted benefits. The Internal Rate of Return can then be compared with a base line, for example the current interest rate, or a certain minimum rate. If the current interest rate is 5% and a project's Internal Rate of Return is 3%, it would perhaps be wiser to put money in the bank!" (Meijerink, 2001).

The Cost-Benefit Analysis is important for the valuation of functions of forests and nature areas because when using this Decision Support Tool, those functions are quantified that in a traditional Cost-Benefit Analysis would be omitted. This leads to an increase in value for the functions of forests and nature areas assigned by the stakeholders, making the Cost-Benefit Analysis more complete and increasing the visibility of the "fuller" value of the natural resource base.

Appendix 8.: Valuation tools

Functions of forests and nature areas that are easy to quantify, that can be traded and that have a price on the market are most easily situated within the Decision Support Tool of Cost-Benefit Analysis. Valuation is carried out here according to their market price. Those functions of nature that are not easy to quantify and do not have a market price can be valued by using other tools which we refer to as "valuation tools". It is necessary to take into account here that not all non-market benefits of nature can be valued by these surrogate market techniques (valuation tools). For example: moral and ethical problems associated with valuing the existence value of certain species from the perspective of a human being. In the following section we present a number of valuation tools, starting with the most direct one, namely market price, (mainly taken from IPF, 1996b).

Market prices (for traded economic goods and services)

Market prices are the result of an interaction between consumers and producers with regard to the demand and supply of goods and services. If this transaction is carried out using currency, the value established within the market is the market price. The underlying assumption is that these prices reflect economic scarcity and hence are economic efficiency prices. However, this is not always true. Generally, there are distortions in the market prices. These distortions can be attributed to taxes, subsidies, exchange rates and so on. When this exists, appropriate adjustments are required

Efficiency (or shadow) prices (for effective/efficient resource allocation)

The market price does not necessarily mean the "proper" price and/or reflect the true economic efficiency price. There are market and policy failures that can distort market prices. Market failures concern the inability of market prices, under certain conditions, to reflect accurately the value of environmental goods or services; for example, an upstream polluter has no incentive to account for the costs he imposes on a downstream user of the river. Policy failures concern instances where government policies have unintended effects, or sometimes even side effects or cause resource-use behaviour which is inappropriate from a societal perspective (for example, when government subsidies for the use of resources that lead to or encourage resource overuse).

Shadow prices should be used cautiously because:
  (a) Market prices are often more readily accepted by decision-makers than artificial values derived by the analyst;
  (b) Market prices are generally easy to observe, both at a single point and over time;
  (c) Market prices reflect the decision of many buyers, whereas calculating shadow prices often relies on the objectivity of the analyst's judgement;
  (d) The procedures for calculating shadow prices are rather imperfect and therefore estimates can, in certain cases, introduce larger discrepancies than even the simple use of imperfect market prices.

Hedonic Pricing Method (for non-marketed goods and services)

The Hedonic Pricing Method is one of the systems that use a surrogate market to input the value of non-marketed goods and services; for example, the market value differences for similar features of forests are used to reflect the value of a number of environmental services or costs that varies according to the features. For example, houses located in a natural environment usually command higher prices than houses in an urban setting. The additional price paid for the house in the natural environment does reflect the value of the amenities provided by the natural surroundings. There are some limitations to this method, so that it has to be applied with caution. One of these limitations involves the fact that there is little evidence to date to indicate that land, labour or other market prices are sensitive to the environmental amenities provided by forests. Furthermore, its data requirements are substantial and the forest resource, function or attribute being valued needs to be familiar and easily measurable.

Travel Cost Method (effort/cost for consumers to obtain goods/services)

This tool recognises that for some goods or services the consumer may have to incur substantial cost (in time or money) to obtain a particular good or service. It assumes that the value to the consumer is at least equal to the travel costs the consumer is willing to incur to obtain the desired good or service. For example, a recreational experience may involve significant expense for travel, while gathering free fuel wood may require a considerable amount of time. This tool has been used extensively in developed countries, especially in the United States, since the 1950s and 1960s to value recreational goods and services. More recently it has also been applied in some

developing countries. However, despite the improvements in this tool effected since its early application, its usefulness in valuing alternative recreational uses is still constrained by a number of factors. These factors are mainly the large amount of data required, the restrictive assumptions about individuals' behaviour and the sensitivity of the results to the statistical tools used to specify the demand relationship.

Production Function Approach (to capture indirect values, for example ecological ones)
The Production Function Approach to valuation may be used to capture the indirect use value of regulatory ecological functions of tropical forests through their contribution to economic activities. This approach consists of a two-step procedure. First, the physical effects of the environment on economic activity are determined. The second step consists of estimating the monetary value of the ecological function. For example, the cost of siltation of irrigation canals can be expressed in terms of reduced availability of water for crop production. A loss of net farm income thus defines the extent of the damage imposed by upstream erosion. As another example one might consider windbreaks: these can increase the value of crops grown behind them, and the increased value can be taken as a proxy measure of the minimum value of the benefits from the windbreak (there may also be others, such as fodder, shade for cattle, etc.). In its most straightforward applications, this tool uses actual market prices – or, when distortions exist, appropriately modified market prices – to value economic production. Applying this approach to the various indirect uses of forests is a useful method of estimating these non-marketed, but often significant, economic values.

Related Goods Approaches (to estimate values indirectly)
A non-marketed good or service may be related to a marketed good or service. By using information about this relationship and the price of the marketed product, the analyst may be able to infer the value of the non-marketed product. This broadly defined Related Goods Approach consists of three similar valuation tools: the Barter Exchange Approach, the Direct Substitute Approach, and the Indirect Substitute Approach.

1. Barter Exchange Approach (to estimate the barter value of wild mushrooms, for example)
There are many forest products that are not widely traded in formal markets, for example, wild fruits, nuts and vegetables, medicines and structural fibres. However, some of these forest products may be exchanged on a non-commercial basis through a process of barter. If the bartered good that is exchanged for the forest product is also sold in a commercial market, then it may be possible to derive the value of the non-marketed good using information on the relationship (that is, the units of exchange) between the two goods and the market value of the commercial good. Consider, for example, a situation in which leafy vegetables are harvested from the tropical forest and consumed locally but not sold in the local market. Given that leafy vegetables are non-marketed goods, it is not possible to value these goods directly using market prices. However, if a basket of leafy vegetables of known weight is routinely exchanged for six eggs through a process of barter and six eggs fetch USD 1 in the local market, then it can be inferred that the basket of leafy vegetables is worth USD 1; that is, the market price of the marketed good is used to estimate indirectly the value of the non-marketed good.

2. Direct Substitute Approach (to estimate the value of fuel wood, for example)
If forest goods used directly are non-marketed (for example, fuel wood), then the value of their use may be approximated by the market price of similar goods (for example, fuel wood purchased from other areas) or the value of the next best alternative/substitute good (for example, kerosene or charcoal). The extent to which the value of the marketed good reflects the value of the non-marketed good depends to a large extent on the degree of similarity or substitution between the two goods. That is, if the goods are perfect substitutes then their economic values should be very close. As the level of substitution decreases, so does the extent to which the value of a marketed good can be taken as an indication of the non-marketed forest good. Once again, market imperfections may distort the economic value of the good or service reflected in the market place.

3. Indirect Substitute Approach (to compare a non-marketed good/service with a close substitute)
The tools presented above are not always applicable in remote areas and rural settings in developing countries. An alternative but second-best approach to valuation is the Indirect Substitute Approach, which does not relate directly to Willingness-to-Pay. The Indirect Substitute Approach is similar to the Direct Substitute Approach but requires one additional step in the valuation procedure. This additional step consists essentially in combining the Production Function

Approach with the Direct Substitution Approach. That is, if a non-marketed forest good has a close substitute then it may be possible to derive the value of the non-marketed forest good from the value of the substitute good. However, if the value of the substitute good cannot be determined directly from the market then it may be possible to derive its value indirectly, by analysing the change in value of economic output caused by a change in the use of the substitute good as an input into production. However, the Indirect Substitute Approach is necessarily based on fairly stringent assumptions about the level of substitution between the two goods, the role of the substitute good as an input into economic output, and the value of the economic output.

Constructed Market Techniques (hypothetical "Willingness-to-Pay")
Constructed Market Techniques measure individuals' Willingness to Pay in order to continue receiving benefits, or their Willingness-to-Accept compensation in return for forgoing benefits. This is done by presenting people with a hypothetical or simulated market situation and either directly eliciting consumer preferences for the object of the valuation or obtaining preference orderings which can then be linked to a revealed preference. It is important to note that both evidence and theory indicate that, for a particular measurable change in the provision of a good, measures of Willingness-to-Accept and Willingness-to-Pay will not necessarily be identical. Willingness-to-Accept will exceed Willingness-to-Pay. The use of Willingness-to-Accept as a measure of economic welfare in examining unique environmental goods has been questioned since the difference between Willingness-to-Pay and Willingness-to-Accept is likely to be particularly large in such cases.

Within this context, some caution should be exercised in the use of Willingness-to-Pay and Willingness-to-Accept. First, an accurate initial identification of the object, or property right, that is being measured must be made. This should lead to a proper assessment of whether a measurement of Willingness-to-Pay or Willingness-to-Accept is called for. Second, as they do not measure the same property right, it is important to avoid taking Willingness-to-Accept as a measure of Willingness-to-Pay, and vice versa.

The simulated market technique could be applied, for example, to the valuation of tropical forests as a means to investigate option and existence values held by non-tropical populations. The usefulness of such an investigation to the tropical country that owns the resource is not clear. What is the purpose of a survey to determine Willingness-to-Pay and/or Willingness-to-Accept – for example to preserve the Amazonian rain forest – if the person does not even know where exactly the Amazon is located? On the other hand, the person can answer in terms of any value since he/she is not actually going to pay anything. However, would this value be the same if he/she had to actually pay? Beyond this one possibility, these techniques are as yet of limited usefulness in evaluating natural resource issues in developing countries where the actual task at hand is concerned.

   1. Contingent Valuation Method (the consumer's perceived value of a good/service)
Interest in the Contingent Valuation Method has increased over the last decade or so. Contingent Valuation techniques use one of two measures of consumer surplus: compensating variation or equivalent variation. Compensating variation is the amount of payment or change in income necessary to make an individual indifferent with respect to an initial situation and a new situation with different prices. Equivalent variation may be viewed as a change in income equal to a gain in welfare resulting from a change in price. This method is used to estimate the consumer's Willingness-to-Pay for a specified good or service or Willingness-to-Accept compensation for receiving an undesired good or service. In practice, it is usually derived from the responses of potential consumers to a hypothetical exchange situation. The method assumes that the consumer's expressed Willingness-to-Pay in a hypothetical situation is a measure of the value to the consumer in an actual situation. It is particularly difficult to apply meaningfully when the respondent is asked to express a value for many functions of the forest that have no established monetary market value, such as provision of cleaner water, which might become available in a hypothetical set of circumstances, such as through a reduction in upstream harvesting activities.

Applications of the Contingent Valuation Method to ecotourism in the market of developing countries illustrate the use of this technique. For example, a report on a survey of option and existence values conducted at Khao Yai Park in Thailand was based on this approach. In a Contingent Valuation Method study of the viewing value of elephants in the Kenyan national parks, Willingness-to-Pay for current levels of elephants in Kenyan parks was estimated. The value of ecotourism at a tropical rain forest site in Costa Rica was based on this approach. Another

example from Costa Rica was a study that used a "take-it-or-leave-it" personal interview survey to establish Willingness-to-Pay for the Monteverde Cloud Forest Preserve

2. Contingent Ranking Method (using relative rather than absolute values)

The Contingent Ranking Method differs from other methods in that it does not ask respondents to place a monetary value on the environmental amenity itself. Instead, a range of amenities are ranked and then scored relative to one other, with one of the amenities serving as an "anchor". The respondents' Willingness-to-Pay for the anchor is then elicited and used in inferring their Willingness-to-Pay for the other amenities. The valuation of multi-purpose tree resources in Zimbabwe involves an excellent example of this technique. Zimbabwean smallholder farmers were asked to rank and score 10 categories of commodities obtained from trees. These non-monetary preferences were calibrated by simultaneously asking respondents to score a hand-pump borehole and a well-known type of pit latrine. Respondents were then asked for their Willingness-to-Pay for the borehole and latrine in order to provide an "anchor" for use in inferring the value of the forest products and services.

Cost-based Valuation (what it would cost to provide the goods/service by other means)

A final set of valuation tools for non-marketed goods and services can be grouped together under the heading of "Cost-based Valuation". These tools assess the cost of various different measures that would ensure the maintenance of the benefits provided by the environmental good or service that is being valued. These cost estimates are then used as proxies for unknown environmental benefits.

1. Indirect Opportunity Cost (for example, labour cost of gathering fuel wood)

The Indirect Opportunity Cost method is used to calculate the value of non-market environmental goods when individual labour is involved in harvesting or collecting them. The basic assumption of this tool is that the decision to spend time on collecting or harvesting NTFPs, for example, is weighed against alternative productive uses of labour.

Such a tool assumes that the harvesting and collection of NTFPs generally require the expenditure of human effort with only minor investments in capital equipment. In many cases, however, it is almost impossible to assess how much labour is used in collecting NTFPs. For example, how often do farmers collect NTFPs on their way to their fields? These "user cost-based techniques" suffer from the same deficiency –what something is worth has no necessary relationship to the costs involved to produce it. The fact that it is hard to estimate the users' cost to produce in the context of joint products such as NTFPs in the informal sector makes this tool somewhat dubious.

2. Restoration Cost (what it would cost to recreate the original ecosystem)

The Restoration Cost Technique is based on the idea that given an alternative land-use option the non-marketed benefits provided by an intact ecosystem or the particular goods and services provided by such an ecosystem can be measured by estimating what it would cost to re-create the original ecosystem (or environmental good or service). The assumption is that restoring the original ecosystem will restore the original level of benefits. In the case of primary forests, this tool would involve costing the restoration of the original forest cover. Clearly, this is not something that –even with active intervention in silviculture and forest management– could be concluded quickly, if at all. Such considerations suggest that the technique is unlikely to prove useful.

3. Replacement Cost (what it would cost to replace the good/service)

A perhaps more realistic tool for re-creating non-marketed benefits consists of replacing specific natural ecosystem functions or assets with man-made production processes and capital instead of relying on the restoration of the original ecosystem or function in order to provide the original level of benefits. This tool generates a value for the benefits of an environmental good or service by estimating the cost of replacing the benefits with an alternative good or service. It relies on the availability of such an alternative for the original good or service. The alternative should produce, as nearly as possible, the same level of benefits supplied by the resource or environmental function being valued. This tool relies heavily on the assumption that replacing the original good or service is worthwhile and that the benefits generated by the investment in doing so outweigh the cost of replacement.

4. Relocation Cost (cost of moving people to where the original good/service still exists)

This tool involves estimating how much it would cost to relocate (and re-equip) communities in order that they may obtain a level of benefits in their new location similar to those derived at their

original site. Instead of investigating the cost of bringing substitute benefits to populations at existing sites, this tool examines the potential for moving people to alternative locations where such benefits exist. Application of the Relocation Cost Technique to forests is typically restricted to a different purpose, namely that of assessing the direct cost of establishing new protected areas that require the resettlement of forest-dwelling communities.

5. Preventive/defensive Expenditure (what it would cost to prevent degradation)
A cost-based approach to estimating environmental benefits by examining Preventive Expenditure involves obtaining a figure for what it would cost to maintain environmental benefits by investing in the prevention of their degradation. For example, in the case of a selective harvesting regime, the watershed protection benefits that would be lost by building logging roads for the extraction of logs from the forest could be valued by examining what it would cost to select less damaging extraction techniques such as non-mechanised extraction or even extraction by helicopter.

Valuation tools: advantages and limitations

The valuation tools that have been proposed have their advantages and their limitations. The following text is based on work by IIED (1994, in IPF 1996b).

The use of *market prices for valuation* has the advantage that price data are relatively easy to obtain and reflect a true Willingness-to-Pay for individuals. But this is only the case when market imperfections and/or policy failures do not distort market prices. If they do, the prices will fail to reflect the economic value of the goods or services to society as a whole. Seasonal variations and other effects on prices need to be considered when market prices are used in economic analyses

The advantages of the *Hedonic Pricing Method* are its potential for valuing certain tropical forest functions (e.g. micro-climate regulation, groundwater recharge) in terms of their impact on agricultural land values, assuming that the link between forest functions and agricultural productivity is widely known and fully reflected in agricultural land prices. Application of Hedonic Pricing to the environmental functions of tropical forests requires that these values are reflected in surrogate markets. The approach may be limited where markets are distorted, choices are constrained by income, information about environmental conditions is not widespread and data are scarce.

The *Travel Cost Method*, widely used to estimate the value of recreational sites such as public parks and wildlife reserves, is an effective means of estimating the willingness-to-pay for eco-tourism to tropical forest areas in some developing countries. However, the methodology is data intensive, makes restrictive assumptions about consumer behaviour (e.g. trip multi-functionality), and appears to be highly sensitive to the statistical methods used to specify the demand relationship.

The *Production Function Approach* estimates the value of a non-marketed or ecological function resource in terms of changes in economic activity. It is widely used to estimate the impact of deforestation, soil erosion, wetlands and reef destruction, air and water pollution etc. on productivity activities such as crop cultivation, fishing, hunting, etc. It requires explicit modelling of the "dose-response" relationship between the resource or function being valued and some economic output. Application of this approach is most straightforward in the case of single use systems; it becomes more complicated with multiple use systems. Problems may arise from mis-specification of the ecological-economic relationship or double counting.

Related Good Approaches can provide a rough indicator of economic value, subject to data constraints and the degree of similarity or substitution between related goods. The Barter Exchange Approach requires information on the "rate of exchange" between two goods. The Direct Substitute Approach requires information on the degree of substitution between them. The Indirect Substitute Approach requires information on the degree of substitution and on the contribution of the substitute good to economic output.

Constructed Market Techniques measure Willingness-to-Pay and Willingness-to-Accept by directly eliciting consumer preferences. These techniques directly estimate Hicksian welfare measure and provides the best theoretical measure of Willingness-to-Pay. The practical limitations of Constructed Market Techniques may detract from their theoretical advantages, leading to poor estimates of true Willingness-to-Pay. The Simulated Market technique constructs an experimental

market in which money actually changes hands. It is a controlled experimental setting that permits close study of factors determining preferences. The Simulation Market technique has a sophisticated design and implementation method, which may limit its application in developing countries.

The *Contingent Valuation Method* constructs a hypothetical market in order to elicit respondents' Willingness-to-Pay. This is the only method that can measure option and existence values and provide a true measure of total economic value. The Contingent Valuation Method appears to be sensitive to numerous sources of bias in survey design and implementation.

Cost-based Valuation is based on the assumption that the cost of maintaining an environmental benefit is a reasonable estimate of its value. However, it is generally easier to measure the costs involved in producing benefits than the benefits themselves when the costs comprise traded goods and services and the benefits are non-marketed. The data and resource requirements of cost-based approaches are therefore less intensive.

Appendix 9.: Including the non-monetary costs and benefits: Multi-Criteria Analysis

Non-monetary values and decision-making

Not all costs and benefits can be expressed in monetary terms, either directly or by means of valuation tools. There will always be values that cannot be expressed in money and thus cannot be compared directly with all the other costs and benefits. As already indicated, these are the values that are considered different to the economic values referred to by Ruijgrok (1999) as ecological values (ecocentric point of view) or psychological values (Ruijgrok, 1999). Some other values can also be assigned directly to this category, which deal with matters of life and death, religious matters and the like. This means that these aspects cannot be brought together under the same denominator, but that the different aspects can have their own justification and should be seen in relation to each other. In fact, one refers to different objectives and different criteria that should be weighed against each other.

"When projects or policies and their impacts are to be embedded in a system of broader (national) objectives, some of which cannot be easily quantified in monetary terms, multi-objective decision-making offers an alternative approach which may facilitate the optimal choice between investment options or policies available" (Munasinghe, 1992). "Several Multi-Criteria methods have been developed. Which practical method in particular is suitable to determine the 'best' alternative available, depends upon the nature of the decision situation. For instance, interactive involvement of the decision-maker has proven useful in the case of problems characterised by a large number of decision variables and complex causal interrelationships. Some objectives can be dealt with through direct optimisation, while others require the satisfaction of a certain standard (level of a pollutant in water). (Munasinghe, 1992).

Multi-Criteria Analysis has been developed "expressly for situations where decisions must be made, taking into consideration more than one objective which cannot be reduced to a single dimension. Its central focus is the quantification, display and resolution of trade-offs that must be made when objectives conflict. The overall methodology involves the following steps:
- the definitions of the options should be examined;
- the selection and definition of the attributes, selected to reflect the planning objectives;
- the explicit economic valuation of those impacts for which valuation tools can be applied with confidence. The resultant values are then added to the system costs to define the overall cost attribute;
- the quantification of those attributes for which explicit economic valuation is inappropriate, but for which suitable quantitative impact scales can be defined;
- the translation of attribute value levels into value functions ("scaling");
- the display of the trade-off space, to facilitate understanding of the trade-offs to be made in decision-making;
- the definition of a candidate list of options for further study. This also involves the important step of eliminating from further consideration options that are clearly inferior." (Munasinghe, 1993 in Hein & De Kruijf, 1997).

Dimensions of Multi-Criteria Analysis

A Multi-Criteria Analysis is usually clustered into three dimensions, the ecological, the economic and the social. Within these dimensions the criteria are set and the decision-maker can weigh the importance of one element in relation to the other elements. The most important accomplishment of Multi-Criteria methods is that it "[allows] for a more accurate representation of decision problems, in the sense that several objectives can be accounted for. However, the key question concerns whose preferences are to be considered. The method only aids a single decision-maker (or a homogeneous group). Various interested groups will often assign different priorities to the respective objectives, and normally it may not be possible to determine a 'single' best solution via the multi-objective models". (Munasinghe, 1992)

This means that decision-making now becomes arbitrary, depending on the decision-maker and his/her interpretations and criteria. Nevertheless, the main advantage in using these tools is the

transparency they create in decision-making and the possibilities they open up for communicating information on the nature of the problems concerned.

Monetary values determined and estimated by means of an (extended) Cost-Benefit Analysis can be incorporated within the Multi-Criteria Analysis as one of the attributes with their specific criteria to be weighed against all other attributes in decision-making.

Choices of Valuation and Decision Support Techniques

All the tools and methods presented in Appendix 7 and 8 have fairly wide applicability. They cannot be prescribed a priori since the choice is dependent on many factors. However, any of them, used appropriately, should produce results that can be employed in a decision-making context. As already stressed above, the main use for monetary measures of forest values is as information on which to base comparisons of proposed changes in forest management and use and ultimately decisions on them. "However, the application of economic valuation tools to the full range of forest benefits is an area that needs much more development. Certain recent studies illustrate the appropriate application of these tools, but much more empirical work is required. In short, the following stages should be considered when choosing the economic valuation tool/method to be used.

The first stage in the evaluation process consists in defining clearly the overall objective or problem at hand. The type of economic assessment approach chosen will directly depend on the problem confronting the analyst. It is important to understand the decision-making context before moving on to the attempt to measure or estimate economic values. The values needed and the best way to estimate them will vary with the decision-making context.

After the appropriate economic assessment approach is identified, the next stage consists in defining the analysis and information required to conduct the assessment. The first step is to identify the area under consideration (whether an existing forest or possibly an area to be reforested or forested) the time-scale of the analysis, and the geographical and analytical boundaries of the system. It is also important to identify the various interest groups involved or affected by a proposed change and then define their own value perspectives that need to be taken into account in the
decision-making process. These will obviously differ given the type of problem to be analysed. Once the analytical boundaries have been set, the economic values within these boundaries of relevance to the assessment need to be identified. It is therefore helpful to distinguish among different types of values: direct use, indirect use and non-use values. Identifying system and analytical boundaries, listing similar and conflicting values by interest groups and ranking them in terms of their importance to the assessment are all important steps in defining the information required for the analysis. As an example, consider the proposal to open a given forest area for logging. Some obvious interest groups would be the proposed loggers, the indigenous populations that live in the forest area, the county or province that owns the forest (and would thus gain revenue), various environmental groups, and the consumers of timber products, particularly if the increased logging resulted in lower prices for consumers.

The final stage involves carrying out the actual assessment itself. Priority should obviously be given to assessing those values that are more relevant to the decision-making requirements. Constraints on time, finances and skills will affect which goods and benefits can be valued and to what degree of accuracy. For example, a resource, function or characteristic may be given high importance initially, but other constraints may prevent its valuation." (IPF, 1996b).