The Valuation of Biological Diversity for National Biodiversity Action Plans and Strategies:

A Guide for Trainers

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Contents

1 Introduction

This document provides guidance to trainers on the content of workshops on the economic valuation of biodiversity for the National Biodiversity Strategy and Action Plan (NBSAP) process. The guide focuses on the key information required, and the appropriate methodologies which may be employed, to address the economic components of the NBSAP (and to complete the economic elements of Biodiversity Country Studies). It is assumed that this guidance will be used by trained economists in their design and development of workshops for audiences in both developing and transition economies.

This document therefore supplements several existing guidance documents that have emerged as the implementing agencies (UNEP, UNDP and the World Bank) have sought to structure the development of the NBSAP process. The most relevant of these are as follows:

- National Biodiversity Planning: Guidelines Based on Early Experiences Around the World, WRI/UNEP/IUCN (1995). This document provides a comprehensive framework for countries embarking on the NBSAP process. It makes comprehensive cross reference to the most salient terms of the Convention in Biological Diversity.

- Guidelines for Country Studies on Biological Diversity, UNEP (undated). This document gives guidance that is more substantial on step 2 of the NBSAP route map set out in WRI/UNEP/IUCN (1995).

- A Guide for Countries Preparing National Biodiversity Strategies and Action Plans, by Roy Hagan, prepared for UNDP. http://www.undp.org/bpsp/.

These documents provide guidance on how contracting parties to the Convention on Biological Diversity (CBD) might organise their stocktaking exercises and conservation strategies. The main element of the stocktaking process is a physical inventory of resources and diversity in country. While it is important to develop a record of national biodiversity, physical information in itself is typically insufficient to promote biodiversity onto the mainstream policy agenda. But the recognition that biodiversity and biological resources have **economic value** can be the basis of a compelling case for conservation activity. Economic value information can therefore be considered as an important addition to the stocktaking process. Such values can be more easily integrated with other development activities denominated in money terms. *In the most general terms, a valuation exercise is worth undertaking because both the process and resulting information facilitate the discussion of biodiversity in economic terms. This is important because economic measurement of the value of biodiversity is a step toward putting biodiversity on a level playing field with the forces that drive habitat and species loss.*

Valuation can also be important for

- establishing the basis of any benefit sharing discussion

- activating appropriate conservation incentive measures and instruments

- including the value of biological resources in adjusted national accounting systems

It is important to note that while the overall stocktaking or resource documentation process is clear, the specific use of economics is somewhat vague and awaits further guidance from the Conference of the Parties (COP) [1]. This is particularly true in the development of processes for benefit sharing and for processes integrating the sustainable use of biodiversity into relevant sector and cross-sector plans. Both these processes are greatly facilitated by information on the economic value of biodiversity.

While guidance on these issues is pending, the salient elements of any economic training should be designed with a suitable degree of flexibility and generality. Some elements of economic value are likely to be more important, while not all values indicated by the CBD can be assigned a monetary value. Other elements related to the issue of valuation include benefit sharing, and the design of instruments and mechanisms required for capturing local and global values. Suitable guidance must therefore go beyond benefit measurement and consider the instruments for benefit capture and the national and international conduits for benefit sharing.

WRI/UNEP/IUCN (1995) contains the most comprehensive summary of early NBSAP attempts and includes illustrative examples of what strategies look like. The need to undertake economic valuation is implicit in several sections although no definitive guidance on methodology is provided. Instead "basic step" or section 2 as detailed in the planning flow diagram (page 14), is a call for national country studies to be conducted.

In the UNEP 'Guidelines for Country Studies on Biological Diversity, specific sections of Technical Annex C address valuation and current expenditures and the requirement for countries to report on economic values using guideline tables. The Annex suggests that original work will generally ***not*** be feasible for the reporting process and that parties should rely on existing studies and borrowed information where these are available. Qualitative information may also be reported where appropriate. Overall the UNEP document highlights the role of biodiversity benefits on several occasions, recognising the intractability of functional benefits and the nature of opportunity costs in relation to conservation. The approach set out in this training guidance is directed towards addressing the reporting requirements laid out in the UNEP country study document. At the time of writing it is unclear to what extent the country study guidance document is to be used in conjunction with other guidance documents. The documents address different enabling activities although neither provides a comprehensive route map for conducting valuation. However, the approach outlined here covers the methodologies necessary to complete both the Country Study and NBSAP exercises. A number of countries have taken UNEP guidance in preparation of country studies. The authors have found it particularly useful to refer to the Namibian country study and that prepared by Papua New Guinea, as good regional examples.

The UNDP BSAP document is much less emphatic in its guidance on economic valuation. A number of strategic considerations are highlighted for the preparation of national stocktaking for the NBSAP. The issue of benefit sharing stands out, although the guide does not address the nature of benefits to be shared, nor how these benefits are measured or captured. This is partly due to the need to await further COP guidance. The UNDP guide also refers to the development of innovative measures that create economic incentives for biodiversity conservation and that compensate local communities that incur opportunity costs associated with its conservation. The document does not provide any practical guidance on these issues.

[1] To date the COP decision IV/10.1c encourages parties to "take into account economic, social, cultural and ethical valuation in the development of relevant incentive measures".

Accordingly, the current training guidance will attempt to address some of these needs for countries preparing the NBSAP.

The economics of biodiversity is still evolving and it is impossible to claim completeness for a review in this area. The current guidance is ***not*** an exhaustive review of the economics of biodiversity. What the Guide highlights are the most important factors to be considered when delivering a one-week (5 day) course to non specialist advisers and or economists with limited exposure to recent developments in environmental economics. Note that the contents will necessarily have to be tailored for specific audiences with more emphasis laid on basic economic theory being necessary for participants with little or no previous exposure to economics.

The objectives of the Guide are to familiarise trainers with the core concepts and methodologies that need to be presented to workshop participants. These include:

- the relevance of economics to biodiversity conservation;
- relevant environmental economic methods (advantages and limitations);
- data requirements for undertaking different valuation methods
- available sources of information on biodiversity valuation
- sources of information for the NBSAP process;
- what should and should not be attempted as part of the national stocktaking activities

To elaborate on the last point - early NBSAP initiatives indicate that the compilation of basic resource inventories is a labour intensive process. Many countries do not as yet have the expertise in country to undertake basic valuation research. Therefore, economic values such as they exist in market values, should be recorded and reported. Such information will contribute to guide priority setting. More sophisticated measurement of economic value beyond market values is possible but is unlikely to be a priority. Countries should therefore rely on existing data and await the evolution of both the CBD and economic methods before deciding on the most pragmatic route for economic data collection.

In sum this Guide provides methodological insights that are more forward looking than the immediate reporting requirements, as understood by the authors. Countries may wish to choose methods according to their immediate needs and their available resources. More sophisticated or data demanding techniques may be deferred for further research and future use. An understanding of this framework and process can be an important tool in any national conservation strategy.

The outline of this guidance is as follows. Section 2 provides a basic framework for the valuation of biodiversity. A topic outline for a 5 day workshop covering the basis issues in biodiversity valuation relevant to the country study and NBSAP exercise is presented in Section 3. The outline is flexible and several adaptations are suggested for different audiences. The recommended content of key sections of the program are addressed in more detail in Section 4. Key points and analytical requirements necessary to enhance the understanding of the role and relevance of the topic to the NBSAP exercise are outlined. Relevant practical exercises and readings are also suggested at the end of each section. Section 5 provides a selection of exercises on key valuation methodologies and assessment approaches. The final section includes a more extensive reading list and bibliography of relevant sources.

2 Framework for the Valuation of Biodiversity

This section introduces the economic value taxonomy relevant to biological resources, summarises the valuation techniques, and presents the cost-benefit framework for integrating them into the conservation decision. This is one framework for organisation economic information and a possible rationale for compiling economic information alongside and consistent with physical data on biological resources in any stocktaking exercise.

2.1 Valuing biodiversity

It is important to note that biodiversity valuation normally entails measuring the economic value of **'biological resources',** not the intrinsic value of biodiversity (Pearce and Moran, 1995).

While there is growing awareness of the value and importance of diversity *per se*, there is a lack of consensus on how diversity can be defined and measured. For example, species richness is frequently the only accessible indicator of species diversity, although it is well known that a head count of the number of apparently different species in an area may not be a good proxy for the genetic distance between them. Some index or set of indices of biodiversity change is fundamental to any economic valuation. Valuing biodiversity would further require some idea of people's preferences (willingness to pay) for 'intrinsic values' (values in themselves and, nominally, unrelated to human use). Intrinsic values *are* relevant to conservation decisions, but they generally cannot be measured (Pearce and Moran, 1995). As a result, biodiversity valuation focuses on **biological resources** such as forests, wetland and marine habitats (undisturbed or sustainably managed) which maintain current or potential human uses. Such a focus is more tractable. Biological resources are subject to human preferences which places them firmly within the purview of economic analysis.

2.2 Total Economic Value

The framework commonly used for valuing natural resources is known as the Total Economic Value (TEV). This comprises use values (direct, indirect and option value) and non-use values. An example for tropical forests is provided in Table 2.1.

Direct use values are values derived from direct use or interaction with environmental resources and services (e.g., timber, fuelwood, tourism are direct use values of a tropical forest). They involve both commercial, subsistence, leisure, or other activities associated with a resource. Subsistence activities are often crucially important to rural populations.

Indirect use value relates to the indirect support and protection provided to economic activity and property by the ecosystem's natural functions, or regulatory 'environmental' services. For example, the watershed protection function of a tropical forest may have indirect use value through controlling sedimentation and flood drainage that affect downstream agriculture, fishing, water supplies and other economic activities.

Option value is a type of use value in that it relates to future use of the environment. Option value arises because individuals may value the option to be able to use the environment some time in the future. For example, there mat be an additional 'premium' placed on preserving a forest system and its resources and functions for future use, particularly if one is uncertain about the future value but believe it may be high and if current exploitation or conversion may be irreversible.

Non-use values are derived neither from current direct or indirect use of the environment. For eample, there are individuals who do not use the tropical forest but nevertheless wish to see them preserved 'in their own right'. These 'intrinsic' values are often referred to as existence values.

Table 2.1. Total Economic Value of a Tropical Forest

Use Values			Non Use Values
(1) Direct Value	(2) Indirect Value	(3) Option Value	
Sustainable timber Non timber forest products Recreation and tourism Medicine Plant genetics Education Human habitat	Watershed protection Nutrient cycling Air pollution reduction Micro climatic functions Carbon store Biodiversity	Future use as per (1) and (2)	Existence value Cultural heritage Biodiversity

2.3 Valuation Methodologies

Economic valuation methodologies have reached a considerable degree of sophistication. The range of methodologies available is summarised in Table 2,2. Once the economic values under study have been categorised into direct, indirect, option and non-use values, the most appropriate valuation technique for each component of value needs to be identified based on available data and resources (time, money, technical expertise). Approaches using market prices offer the most pragmatic route to the monetisation of environmental use values. The NBSAP are most likely to employ these techniques in their assessment process. Direct use surveys may need to be undertaken to determine necessary price and quantity data, however such surveys are simpler and less costly to conduct that those required by the more sophisticated valuation approaches (e.g., travel cost, hedonic pricing, contingent valuation method).

Table 2.2. Categories of Valuation Techniques

PRICE BASED

Price based approaches use the market price of forest goods and services (corrected for market imperfections and policy failures that may distort prices).

RELATED GOODS APPROACH

The related goods approach uses information on the relationship between a marketed and non-marketed good or service in order to estimate the value of the non-marketed good (e.g., barter exchange approach, direct substitute approach, indirect substitute approach)

INDIRECT APPROACHES

Indirect approaches are those techniques which seek to elicit preferences from actual, observed market based information. These techniques are indirect because they do not rely on people's direct answers to questions about how much they would be WTP. The indirect group of techniques can be divided into two categories:

Conventional Markets Approach (Market Valuation of Physical Effects): use market prices to value environmental services in situations where environmental damage or improvement shows up in changes in the quantity or price of marketed inputs or outputs (e.g., the value of changes in productivity approach; the production function approach)

Surrogate Markets Approach (Revealed Preference Approach): use information about a marketed commodity to infer the value of a related, non-marketed commodity (e.g., travel cost method (TCM), hedonic pricing)

DIRECT APPROACHES

Constructed Market Approaches – such as contingent valuation method (CVM) – are used to elicit directly, through survey methods, consumer's willingness to pay for non-marketed environmental values

COST-BASED METHODS

Cost based methods use some estimate of the costs of providing or replacing a good or service as an approximate estimate of its benefit (e.g., opportunity cost, indirect opportunity cost, restoration cost, replacement cost, relocation cost, preventive expenditure).

Cost-based methods are second best techniques and must be used with caution

Source: Bann, 1998

2.4 A Framework for Assessing the Costs and Benefits of Land Conversion

Loss or alteration of habitat is the most common point of departure for analysing biodiversity loss (eg see Hannah *et al* 1995). The economics of land use change can be assessed from the point of view of the individual land user (financial analysis) and from the point of view of society (economic analysis). A decision whether to conserve or develop (convert) land can be rationally based on the net benefits (benefits minus costs) of competing options within a **cost benefit analysis framework (CBA).**

The Individual Land User

Consider a rational economic agent trying to decide whether to conserve or develop for agriculture an area of tropical forest he owns or rents. Economic rationality suggests that the decision will be determined by the relative profitability, or *rate of return*, of the two options. Within the conservation option we include *sustainable use* of the forest for say agro-forestry or for non-timber products such as medicinal plants and eco-tourism. On this analysis the relevant rates of return are those that accrue to the land owner or tenant, no account is taken of any returns to society.

In this simplified situation the decision to conserve the land will be the right one if:

Rate of Return from SUB > Rate of Return from 'Development'

where SUB is the 'sustainable use of biological diversity', i.e., the conservation option.

$$B(SUB) - C(SUB) > B(DEV) - C(DEV) \quad ...(1)$$

or

$$B(SUB) - C(SUB) - [B(DEV) - C(DEV)] > 0 \quad ...(2)$$

where

B(SUB)	=	the benefits of sustainable use of the forest;
B(DEV)s	=	the benefits of traditional development of the land for, say, agriculture or forestry or industry;
C(SUB)	=	the costs of the sustainable use option;
C(DEV)	=	the costs of the development option;

Rule (1) or (2) says that the net benefits from sustainable use of biodiversity should exceed the net benefits from development if conservation is to be the preferred option. The benefits and costs here are all *private costs and benefits*.

Typically, the landowner will prefer benefits now rather than later, and costs later rather than now. To allow for this we have to introduce *discounting* which permits us to compare gains and losses that occur over different time periods.

Allowing for time, rule (2) can be restated in terms of *present values*:

$$PV[B(SUB) - C(SUB)] - PV[B(DEV) - C(DEV)] > 0 \quad ...(3)$$

where $PV(B) = \Sigma B_t/(1+r)^t$, and similarly for costs (t = time; r = the rate of interest)

As many of the benefits of SUB are often not marketed (e,g, watershed protection functions of the forest, carbon storage functions, existence value) the individual landowner has no incentive to account of them. Conversely, the benefits from development are typically tangible and easily observed. When conservation values are not valued in monetary terms and thereby not reflected in the CBA framework, there is a bias in favour of development options. This can result in economically inefficient land use decision. The returns from clearance may simply be higher than the returns from conservation because the latter may consist of a range of unmeasured non-market benefits and/or benefits that accrue to people other than the landowner (external benefits).

Society's View and Global Values

From the standpoint of society we need to redefine the benefits and costs in equation (3) to account for the TEV of biodiversity conservation (the full range of use and non-use values). A second adjustment arises from the fact that both use and non-use values can reside in the host nation or globally (where globally means all nations other than the host nation).

$$TEV(SUB) = UV + NUV = DUV + IUV + OV + BV + XV \quad ...(4)$$

and

$$TEV(SUB) = UV_n + UV_g + OV_n + OV_g + BV_n + BV_g + XV_n + XV_g \quad ...(5)$$

Where:

UV	=	use value
NUV	=	non use value
DUV	=	direct use value
IUV	=	indirect use value
OV	=	option value
BV	=	bequest value
XV	=	existence value
n	=	national
g	=	global

The expression for the cost-benefit rule, then, is that sustainable use will be preferred if:

$$PV\,[TEV(SUB) - C(SUB)] - PV[B(DEV) - C(DEV)] > 0 \quad ...(6)$$

Equation (6) sets the requirements for the comparison of sustainable land use and its opportunity cost, namely the forgone development values. Equation (6) indicates what would be needed for sustainable use to be preferred over traditional development land use if a national host country standpoint is taken, and if that country seeks to secure the biggest gains in national efficiency. It tells us that conservation is preferred if the *national* gains are greater than the costs, and that those national gains will be larger still if the country can 'capture' some of the global use and non-use values. If the individual land user does not get part of the national gains from conservation, or part of the global gains, then he has no incentive to act in accordance with equation (6). He will simply operate according to his own private gains and losses. This divergence between global, social and private returns does much to explain continuing biodiversity loss.

3 Workshop Structure and Program

The workshop structure is designed for a period of 5 days and may be delivered to both technical and non-specialist audiences. The economic content means that trained economists have a considerable head-start, and with such an audience it is likely to be possible to cover basic economic concepts relatively quickly and consequently allocate more time to the methodologies of benefit estimation. **We recommend that trainers know the capabilities and educational background of their audience in advance of workshop preparation.** This will guide the emphasis on background readings, workshop delivery and case study materials used to aid comprehension. The structure of presentations is optional and additional topics are indicated where appropriate.

RECOMMENDED PROGRAM

METHODOLOGIES FOR THE VALUATION OF BIODIVERSITY
UNITED NATIONS ENVIRONMENT PROGRAMME
Location/Date

Workshop sponsors and facilitators:

DAY 1

9.00-9.30 Introduction

9.30-10.45 Introduction to the workshop

- Workshop objectives
- Current issues in biodiversity valuation
- Biodiversity and economic development
- Why value biodiversity?
- Can we measure biodiversity?
- Distinguishing between the value of biological resources and biodiversity.

Break

11.00-1.00 Introduction to country case studies

- Country case studies
  - What have we learnt?
  - What were the main findings?
  - What were the main problems/issues?

Lunch

2.00-3.30 Measuring the benefits: developing a framework

- Overview of UNEP guidelines for country studies / UNDP guidelines for NBSAP on biological diversity.
- Developing a taxonomy of benefits (based on Tables 8.1-8.4 Technical Annex C of the UNEP country study document)
- Ecological and economic values (structural components and ecological functions)
- Different types of value relating to biodiversity (direct, indirect, consumptive, non-consumptive, option, existence values)
- Applications to ecosystems (eg. Forests; wetlands; rangelands; marine ecosystems)

Break

3.45-5.00 The economic value of biodiversity: key economic concepts

- Economic concepts underlying environmental valuation
- Market and policy failures
- Overview of valuation techniques

DAY 2

9.00- 10.00 Questions and recap

Recap (different types of value; economic concepts; taxonomy of biodiversity benefits; developing a methodological tool-kit)

10.00-11.00 Introduction to group proje cts

- Participants work together in teams on aspects of biodiversity valuation
- Presentation of main findings on the final day
- Distribution of CVM survey

11.00-11.15 Break

VALUING BENEFITS: METHODS AND PRACTICAL APPLICATIONS

Key concepts; methodological steps; data requirements; limitations; exercises

11.15-1.00 Valuing benefits: Market prices and productivity method

Lunch

2.00-3.00 Valuing benefits: Preventative Expenditures and Replacement Costs

Break

3.15-3.45 Summary and Questions

3.45-5.00 Group Exercises

DAY 3

9.00-9.30	**Questions and recap**
9.30-11.15	**Valuing benefits: Travel Cost Method**
	Break
11.30-1.00	**Value benefits: Hedonic Pricing**
	Lunch
2.00-3.30	**Valuing benefits: Contingent Valuation**
	Break
3.45-4.30	**Contingent Valuation Exercise**
4.30-5.00	**Group Work**

DAY 4

9.00-9.30 Question and recap

9.30-11.00 Value benefits: Transferred Values

- Opportunities and caveats
- Useful case studies

11.00-11.15 Break

11.15-11.45 Option values and pharmaceutical prospecting

11.45-1.00 Comparing costs and benefits

- Financial and economic prices
- Discounting
- Net present value
- Sustainability constraints

Lunch

2.00-3.00 Issues in valuation and CBA

- Distributional issues
- Discounting and future generations
- Utility and preferences
- Irreversibility, uncertainty and risk

3.00-3.15 Break

3.15-4.00 Capturing Biodiversity Values

- Institutional capture – local, national and global issues

4.00-4.30 Measuring Expenditures and Costs (DM)

- UNEP guidelines: current expenditure costs of biodiversity conservation

4.30-5.00 Group work

- Applying the concepts, tools and methods to hypothetical case studies

DAY 5

9.00-1.00 Participant presentation of group projects

4 Outline of Key Sections of Program

4.1 The Economic Value of Biodiversity: Key Economic Concepts

A. Overview: This section is important as it introduces the theoretical underpinning of economic valuation of the environment crucial for a full appreciation of sections to follow on the individual valuation techniques. This section may be difficult for people without an economics background, and trainers should be aware of the make-up of the audience and pitch technical content of this section accordingly. Visual aids (diagrams) should be used to explain basic demand and supply curves and consumer / producer surplus.

B. Key Sections and points to be covered

1 The rationale for economic valuation of the environment

- Why economic valuation is important for sustainable development.
- Differences between traditional Cost Benefit Analysis (CBA) and a social and environmental CBA. Traditional CBA fails to capture non-marketed environmental benefits. This means that project selection is often biased against the environment whose values are under recorded
- Uses of economic valuation of the environment (Social CBA, Green National Accounts, guidance on the size of financial devices necessary to correct market and policy failures)

2. Basic principles that determine economic value

- Neo-classical welfare economics as the foundation of economic value
- Well-being or utility of individuals as a measure of economic activity
- People's preferences as the bases of value
- Money, markets and demand and supply curves
- Preferences and willingness to pay (WTP)
- Market prices and consumer / producer surplus. Economic values comprise both the price paid in markets and the consumer surplus that users obtain. Consumer surplus indicates the excess of what the consumer would have been willing to pay over what he or she actually had to pay. This concept is particularly important when estimating the benefits of environmental goods and services which have a low, or no market price. In such cases, the entire area under the demand curve represents the benefit of the good.
- The two concepts of consumer surplus: Equivalent variation and compensating variation
- WTP and WTA (willingness to accept)
- The concept of opportunity cost. Opportunity costs is the forgone benefit (opportunity lost) from undertaking a particular project.

3. Market and policy failures

- Market failures. Where markets fail, market prices will be distorted. There are many types of market failures such as: externalities, unpriced assets, transactions costs, property rights, incomplete information. Explanations and examples should be provided for each of these (see, for example, Box 4.1).
- Policy failure.

4. An Overview of Monetary Assessment Techniques

Brief introduction of the range of valuation techniques available and how these techniques are typically categorised (as in Table 2.2)

Box 4.1: Types of Market Failure

Externalities are the effects of an action on other parties which are not taken into account by the perpetrator. For example, a private industry releasing effluent into a river used for bathing and drinking is causing externalities by reducing the welfare or increasing the costs for others, since these repercussions do not enter into the **private** calculations of the firm. The task of policy makers is to **internalise** externalities by imposing on offenders themselves the **full costs** of their actions on others.

Many environmental assets valued by society, such as clean air, attractive landscapes and biological diversity, are not bought and sold in markets. As a result **many environmental assets are unpriced** Unless restrained by other measures, individuals have no incentive to reduce their use of these assets, still less to invest in their preservation and growth.

A public good is one that is available to everyone and which cannot be denied to anyone - they are therefore **open access resources**. Under such circumstances it is unprofitable for a private party to invest in the protection or enhancement of the resource - because of the impossibility of recovering costs from other users (free riders). There is also no incentive for a user to abstain from consumption - since someone else would step in instead. This quality of public goods is sometimes called *non-exclusivity*.

Markets to perform well, need to be supported by institutions and, specifically, a system of **property rights**. An obvious case is the farmer. A farmer who owns his/her land, or has secure and long term tenure, has an obvious incentive to look after it and reinvest in it, especially if it is also possible to sell it and realise those investments. Tenant farmers, squatters, and those enjoying only the right to use land (*usufruct*) have much less incentive to mange their land or invest in it, and indeed have every reason to squeeze as much as possible from the soil while they still occupy it.

Incomplete information (ignorance and uncertainty) also hinder the functioning of markets. In such cases markets are imperfect. The function of markets is to signal emerging scarcities, such as environmental resources. Because environmental processes are badly understood, changes (and their implications) may not be perceived in time for prices to operate.

Markets fail when environmental processes are irreversible. Where the future is uncertain, there is value in keeping future development options open. Where an attractive valley is flooded to create a hydro-electric scheme society losses the option of preserving that landscape for future generations. Generating the same power from a thermal power station would retain that option, yet the market would point to the hydro project if it were cheaper. In other words the market would ignore the option values which are destroyed by building the dam.

Source: adapted from OECD, 1995.

C. Exercises

(i) Exercises may be devised to test understanding of market prices, demand and supply curves and the concept of consumer surplus.

(ii) Participants may be asked to categorise a list of values into direct use, indirect use, option value and non-use value and suggest types of valuation approaches that might be used to value them.

(iii) Participants can be asked to identify examples of market and policy failures in their own countries

D. References

Pearce and Moran, 1994. 'The Economic Value of Biodiversity'. In Association with the Biodiversity Programme of IUCN. Earthscan Publications Ltd, London.

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H. Varian. 'Intermediate Microeconomics – A Modern Approach' Fourth edition. W.W. Norton & Company, Inc.

4.2 Market Prices and Productivity Method

A. Overview: This is the first session to talk about valuation methodologies. Simpler techniques are presented first, starting with market prices. When available, market prices should serve as the bases of the NBSAP assessment studies. It should be noted, however, that theoretical robust estimates using market prices may require a number of adjustments. Market prices maybe distorted due to market and policy failures and cost information needs to be deducted to derive gross values. Even then, market prices will exclude the consumer surplus element and thus underestimate value. Issues of sustainability and seasonaility should also be highlighted when market prices are used to value products. Efficiency and shadow pricing should be discussed here.

Related goods approach such as the barter exchange approach, and the direct substitute approach offer practical approaches for evaluating non-marketed goods which are 'related' to a marketed good. For example non-marketed fuelwood collected from the forest could be valued based on its closest substitute, for example, gas.

The production function approaches observes physical changes in environmental quality and estimates what differences these changes will make to the value of goods and services that are marketed (e.g., agricultural and forest products, and fish). The production function approach has widespread application and is commonly used.

All the above techniques are considered to have considerable application in NBSAP analysis. That is, they are typically less data intensive and time consuming than other methods and may be used to value direct use values (market price, related goods approaches), and indirect use values (the production function approach).

B. Key Points to be Covered

1. An overview of valuation techniques
- Recap of valuation techniques

2. Choosing between techniques
- Guidance on how to select techniques. This will be based on what types of values are most prominent, what information is feasible to collect and what resources are available to the analyst.

3. Market Prices
- Net value versus gross value
- Efficiency / Shadow pricing
- Market prices and consumer surplus
- Quantity measures and maximum sustainable yields
- Seasonal effects

4. Related Goods Approach
- Barter Exchange approach
- Direct Substitute Approach
- Indirect Substitute Approach

5. The Productivity Method

- Intuitive explanation
- Possible applications. This technique has many applications such as measuring the costs of soil erosion based on crop loses, or water pollution based on fish stock damage.
- When appropriate. The technique is most appropriate when: the environmental change directly causes an increase or decrease in the output of a good (or service) which is marketed; the effect is clear and can be observed or tested empirically; and market function well.
- Main steps. Three main steps can be defined: (i) identifying the physical effect of the change in environmental quality on the economic activity concerned; (ii) estimating what difference this physical effect will have in terms of output or costs; and, (iii) estimating the market value of this change in output.
- Problems and limitations. Problems with this approach may include: specifying the physical effect; distorted and missing markets; situations where the environmental change has a sizeable impact on market making a more complex view of market structure necessary. This valuation approach does not capture consumer surplus and can't be used to measure non-use values.
- Policy relevance

C. Exercises: Simple exercises can be devised using market prices to value environmental assets (price multiplied by quantity), but which require a number of adjustments (for example, deduction of government subsidies, accounting for the fact that the product is only harvested for 3 months a year etc.,)

Participants can be asked think of applications of the related goods approach and the productivity approach in their own countries and to detail data requirements and steps that they would take to carry out valuation exercises.

Exercises 3, Section 5 incorporates the productivity approach.

D. References / Case Studies

Bann, C. 1998. 'The Economic Valuation of Tropical Forest Land Use Options: A Manual for Researchers'. The Economy and Environment Program for South East Asia. [can be downloaded from EEPSEA web-site – http://www.idrc.org.sg/eepsea.]

Bishop, J., and Allen J. 1989. 'The On-site Costs of Soil Erosion in Malawi'. Environment Department Working Paper No21. The World Bank. Washington DC.

Cruz W., et al. 1988. 'The On-Site and Downstream Costs of Soil Erosion in the Magat and Pantabangan Watersheds', Discussion paper 88-04, College of Economics and Management, University of the Philippines Los Banos.

Dixon, J, et al. 1992. 'Nepal Hill Forest Development Project'. in 'Economic Analysis of the Environmental Impacts of Development Projects' Earthscan, London.

Ruitenbeck. H. J. 1992. 'Mangrove Management: An Economic Analysis of Management Options with a Focus on Bintuni Bay, Irian Jaya'. EMDI, Jakarta

Granstaff S., and Balagot, B., 1986. 'Togonan Geothermal Power Plant in Leyte, Philippines' in Dixon J., and Sherman, P. (eds). 'Economic Valuation Techniques for the Environment: a Case Study Workbook' John Hopkins University Press, Baltimore, Maryland

4.3. Preventative Expenditures and Replacement Costs

A. Overview: This session introduces two new valuation approaches – the preventative expenditure and replacement cost methods. Both these methods use market prices to estimate value, and herefore do not account for consumer surplus. They are likely to have high application to NBSAP analysis as they are less data intensive and time consuming than the more sophisticated approaches such as the Travel Cost Method and Contingent Valuation.

The preventative expenditure method is based on actual expenditures incurred to prevent, eradicate or reduce adverse environmental effects. The replacement cost approach estimates replacement costs once environmental damage has taken place. Other cost based approaches include relocation costs and restoration cost. The analyst should be aware that while cost based approaches can represent a practical means of providing estimates of environmental values, they are considered to be second best valuation techniques. This is because they are inherently measuring values or benefits, by looking at costs. Further, because they do not actually measure the demand or WTP for environmental goods and services, cost estimates fail to reflect consumer surplus (and may also underestimate producer surplus) thus tending to underestimate environmental values.

B. Key Points to be Covered

1. **Preventative Expenditure Approach**

- Theory
- Possible areas of application
- When appropriate
- Methodology
- Methods for obtaining information
- Limitations

2. Cost Based Approaches

- Replacement Cost
- Relocation Cost
- Restoration Costs
- Theoretical issues concerning cost based approaches
- Applications and examples

C. Exercises

See Exercise 3, Section 5.

D. References

Kim, S. H. and Dixon J.A. 1986. 'Economic Valuation of Environmental Quality Aspects of Upland Agricultural Projects in Korea'. In Dixon J., and Sherman P.B., 'Economic valuation techniques for ten Environment: a Case Study Workbook'. John Hopkins University Press, Baltimore, Maryland.

OECD, 1995. 'The Economic Appraisal of Environmental Projects and Policies: A Practical Guide'.

4.4 The Travel Costs Method (TCM)

A. Overview: The TCM is the first 'valuation' methodology to be discussed. TCM along with Hedonic pricing are examples of revealed preferences methods, which seek to determine preferences for the environment from actual, observed market based information. It is based on the assumption that that people's preferences for the environment can be 'revealed' indirectly by examining their behaviour in markets that are linked to the environment. With the TCM it is assumed that travel costs to a site can be regarded as a proxy for the value of the non-market asset. The TCM is commonly applied to recreational areas and national parks. It may be applicable to NBSAP evaluations where suitable sites, time, money and expertise are available to carry out the work (i.e., trained interviewers to carry out survey work, statisticians and econometricians to carry out analysis).

Two perspectives are possible. Simple travel cost models (the focus here) attempt to estimate the number of trips visited to a site or sites over some period of time, perhaps a season. Random utility models consider the specific decision of whether to visit a recreational site, and if so, which one (see Freeman, 1994).

B. Main Points to be Covered

- Intuitive introduction to TCM
- Potential situations or sectors where TCM might be applied
- When TCM is most appropriate. TCM is applicable when: the study site is accessible for at least part of the time; there is no direct charge or entry fee for the good or service in question, or where such charges are very low; and, where people spend a significant time, or incur other costs, to travel to the site.
- Methodology (study site selection; divide area around site into zones; sample visitors to the site; obtain visitation rates for each zone; estimate travel costs; derive a statistical regression; construct a demand curve; estimate consumer surplus; estimate benefits of environmental improvement at the site).
- Discussion of costs to be included. Costs should include: direct expenses incurred by visitor getting to and from the site; the opportunity cost of time spent travelling and at the site; and any entry fees and other incidental expenses.
- Presentation of a basic travel cost model. For example:
  Vi = a + bTCi + c INCi + dEDi....fSTC.
  where: Vi = the number of visits to the site; TC = total travel cost; INC = individuals income; ED = respondents educational level; STC = the travel cost to substitute sites; i = the respondent; a, b, c, d and f are the coefficients to be estimated
- Discussion on deriving demand curve (with graphical representation). A demand curve is derived relating travel costs (price) to the number of visitors (quantity).
- Practical and Technical Issues. This technique is survey based and has large data requirements. Theoretical issues include: how to value time; how to account for substitute sites; dealing with multi-purpose visits; treatment of utility or dis-utility from travelling; sampling biases; the fact that the method does not account for non-users and off-site benefits, and non use values.
- Policy relevance. This method can be used to provide information on: the setting of appropriate entrance fees to national parks and reserve areas; the allocation of national recreation and conservation budgets between different sites; and land use decisions – for example whethere it is worth preserving a site in recreational use rather than aa rival land use.
- Case study example

C. Exercises

Exercises could be designed using hypothetical data to illustrate how data would be analysed, demand curves derived, and value of the site estimated.

D. References

Tobias and Mendelsohn, 1991. 'Valuing Ecotourism in Tropical Forest Reserve' Ambio

Grandstaff, S., and Dixon, J. 1986. 'Evaluation of Lumpinee Park in Bangkok, Thailand', in Dixon, J. and Sherman, P.B. (eds). 'Economic Valuation Techniques for the Environment: A Case Study Workbook'. Johns Hopkins University Press, Baltimore, Maryland.

Freeman, A.M. III, 1994. ' The Measurement of Environmental and Resource Values: Theory and Methods'. Resources for the Future.

4.5 The Hedonic Price Method

The Hedonic Price (HP) technique is another revealed value technique that relies on market prices (typically property prices or wages) to embody the value of the environmental attribute (or job risk) of interest. With sufficient data on property values, it is in theory possible to tease out the value of the environmental feature holding other things constant. In other words, the value is revealed from within the value of the property. The method is data demanding and there are few applications available in the published literature. It is only included here for completeness. It is fair to say that the common property value variant on the method has never been used for valuation of biodiversity. Few biodiversity related attributes are likely to show up systematically in market prices and data is rarely available to undertake robust analysis. It is extremely unlikely therefore, that NBSAP teams will wish to undertake original research using the theoretically correct version methodology. However, there is some value in giving participants an intuitive feel for the method using simplified version.

B. Main Points to be covered

- Some market prices for property can reflect environmental values (e.g. neighbourhoods with clean water, good air quality, good environmental amenities, access to food and fuelwood). But there has to be a well-functioning market in the first place. HP technique aims to compare market values for identical properties (in terms of rooms, size etc) and see whether the presence or absence of the favourable environmental attribute is reflected in any price difference.
- Much data is required; observations on many properties with and without the identified attribute to be valued. Need to have detailed descriptions of properties in order to rule out the effect of structural differences as opposed to the environmental attribute sought.
- Need to establish a statistical relationship - define the hedonic price function to show how price changes with the environmental attribute holding other things constant;
  P = P (S, N, E); where
  P = property price, S = Structural characteristic of housing, N = neighbourhood characteristics (e.g. safety, transport, employment), E= environmental factor
- From information on the price function calculate the marginal WTP for the environmental factor or slope of the WTP curve that gives us the additional marginal WTP for an increase or decrease in environmental attribute E.
- If data is unavailable it may be possible to use more anecdotal or quick and dirty sources of information such as asking people how much they would pay for a house nearer an environmental source (e.g., a location where they can harvest naturally occurring products). Most countries have sources of information on property values but rarely as detailed by the full HP methodology.

Finally it is also worth mentioning that the method has some interface with the valuation of plant genetic resources for agriculture. The steps for conducting this research are similar to the property example although the data requirements are just as onerous.

The following description summarises the only available research in this area as described by Evenson and Gollin (1998). The steps allow the direct estimation of the contribution of germplasm of original landraces to rice productivity

- For a crop – e.g., rice, divide gains in output into gains from yield and gains from increased area under cultivation

- Disaggregate rice yield gains into gains attributable to varietal improvement, other technological advances and other sources of change
- Assume varietal improvement is dependent on stocks of advanced crossing material from different sources and other research resources
- The stocks of advanced material depends on the existence of traditional landraces and wild species.
- Link productivity to original germplasm, its origins and ownership
- Note finally that the data requirements are onerous. In short detailed information is required on the productivity of all factor inputs in all the above stages

Clearly this methodology has important implications for the issues of benefit sharing and intellectual property rights. In theory, the methodology offers the potential for the identification of key germplasm contributions to crop development by countries and communities within countries. In practice, data sources will prevent identification of inputs for many crops.

C. Exercises

No simple exercise can be devised for this methodology

D. References

References on the methodology of Hedonic Pricing tend to be mathematically and statistically complex and are only likely to be of interest and use for specialised groups.

Freeman, A.M. III, 1994. ' The Measurement of Environmental and Resource Values: Theory and Methods'. Resources for the Future.

D. Gollin and R. Evenson, (1998) An application of Hedonic Pricing Methods to Value Rice Genetic resources in India, chap 9 in: R. Evenson, D. Gollin and V. Santaniello, Agricultural Values of Plant Genetic Resources, published by CABI.

4.6 The Contingent Valuation Method (CVM)

A. Overview: CVM is a hypothetical valuation technique and is one variant on a family of techniques that are generally known as stated preference methods. Related methods include contingent ranking methods, choice models and conjoint analysis. Participants should be made aware of this family of methods although no further detail is necessary at this point. It is important to stress that stated preference techniques can be nested within an even wider family of participatory approaches for eliciting information about household natural resource use and valuation. Participatory appraisal methods can accommodate hypothetical resource use statements, but are more commonly used for a stocktaking exercise of what direct and indirect uses are made by households. Participatory methods are often far more detailed and in many ways less extractive than CVM surveys and there is much to be gained from integrating the methods.

Hypothetical methods are placed last in terms of the hierarchy of approaches to valuation. While they are powerful in terms of the issues that can be addressed in hypothetical market, participants should be made aware of the need to consider all other methods that provide market prices before resorting to hypothetical methods. It is generally the case the market prices (i.e. what people actually pay) carry far more weight in terms of convincing policy than hypothetical statements of WTP.

The advantage of hypothetical techniques (of which the most common is CVM) is that they are survey based and can be designed to consider a range of different environmental changes including species and habitat loss. The individual undertaking a contingent valuation problem can define the problem or environmental good within the confines of a survey, then present the survey to a sample population to discover each respondents' WTP to have or prevent the change under consideration. A particular advantage of CVM over other valuation techniques is that the method can be designed specifically to identify non use values. CVM responses of users of a resource (e.g., park visitors who are currently in a park) are statements of their total economic value. When CVM is conducted among populations who are or who never have been users, then their responses can be interpreted as non use value statements.

CVM has been applied to consider a range of environmental changes relevant to biodiversity conservation. However, the process requires considerable expertise to carry out the work (i.e., trained interviewers to carry out survey work, statisticians and econometricians to carry out analysis). The requirements to undertake an accurate CV study are a significant disadvantage of the method. It is unlikely that countries will wish to carry out CVM exercises as a priority for their NBSAP's.

B. Main Points to be covered

- Intuitive introduction to CVM and stated preferences in general
- Linking different survey techniques – e.g. CVM with PRA
- Potential situations or sectors where CVM might be applied
- When CVM is most appropriate
- Methodology:

  Revision of the WTP/WTA concepts and link to robust economic theory of demand. Note that WTP need not be in monetary terms. Other units of value can be used to benchmark WTP – e.g. bags of rice, fuelwood or time equivalents.

  Issue identification and survey design, size of sample and logistics

Question formats: open versus closed ended formats
Collection of attitudinal and socioeconomic data of respondents
Selecting population samples for administering questionnaires
Data collection and codification

- Presentation of data
  Tabulation of attitudinal responses as bar chart
  Calculation of mean WTP - arithmetic mean or expected value mean (using closed ended question formats)
- Tests of validity – e.g., regressions of WTP on explanatory variables such as income level, age, gender etc., to check signs are consistent with expectations. These tests require access to a statistical package such as SPSS that allows regression analysis (multivariate OLS and discrete choice modelling)
- Practical issues
- Policy relevance
- Case study example

C. Exercises

An effective case study example would involve participants completing a simple contingent valuation survey. Annex () provides such an example followed by further details on how the results should be analysed and presented to be effect.

D. References

Mitchell, R., and R.T. Carson. (1989), *Using Surveys to Value Public Goods: The Contingent Valuation Method*, Washington DC, Resources for the Future

Freeman, A.M. III, 1994. ' The Measurement of Environmental and Resource Values: Theory and Methods'. Resources for the Future.

Shyamsundar, P and R. Kramer (1997) Biodiversity Conservation – At What Cost? A Study of Households in the Vicinity of Madagascar's Mantadia National Park, in: *Ambio*, Vol. 26, 3 pp180-184

On participatory appraisal and economic valuation

Emerton, L. (1996) Participatory Environmental Valuation: Subsistence Forest Use Around the Aberdares, Kenya, African Wildlife Foundation, discussion paper, ACE-DP 1

4.7 Transferring Benefits Theory and Practice

A. Overview: There is a deficiency of case studies on the valuation of biodiversity. This is hardly surprising since environmental valuation methodology is still developing and most of the existing studies concentrate on keystone biological resources. It is nearly always the case that these early studies have been limited in terms of the number of dimensions valued as part of the study. Moreover, new studies are costly and time consuming to conduct and it certainly would not be advisable for all NBSAP exercises to undertake extensive valuation programmes that would most likely end up duplicating existing information from other countries. One short cut to overcome this information gap is to borrow and transfer benefit estimates from existing studies to the new or subject study site, an approach known as benefits transfer. This approach is essentially the second best option when data is unavailable. Most of the NBSAP economic valuation process is likely to take some form of benefits transfer and different degrees of rigour can be applied to the transfer process.

Concerns over the legitimacy of transfer are essentially divided between: a) the reliability of the original estimate. This may be an estimate of WTP per household per year for say, conservation of a species, which is borrowed; and b) the similarity of the environmental characteristics of the target site to which the value is applied. That is, is the value going to be used for the same species in the target site?

In essence it is difficult to separate the reliability of the resulting numbers from the underlying or original studies from which they are drawn. Much of the existing literature on the subject deals with the direction of any resulting bias in benefit estimates which are a product of bias in the original studies and those arising from the transfer process itself. To understand this process it is necessary to have a rudimentary understanding of methods that give rise to original estimates. This section provides a summary of key element to the benefits transfer approaches that are proposed in the fast developing literature on this subject.

B Key Issues to be Covered

- Reasons why benefits transfer is necessary (cost and time constraints)
- Differing levels of sophistication in transfer: unit/average WTP transfer or transfer of benefit function (i.e. the statistical function that explains WTP)

- Transferring unit/average WTP from a single study to another site which has no study

The basic idea is to 'borrow' an estimate of WTP in context i and apply it to context j, but make adjustments for the different features of the two contexts. But means transfer (with modification) has been practised elsewhere in the literature. For example, if incomes vary we might have

$$WTPj = WTPi\ (Yj/Yi)^{e}$$

where Y is income per capita, WTP is willingness to pay, and `e' is the income elasticity of demand. i is usually called the *study* site and j is the *target* or *policy* site.

This is probably the commonest approach taken to transfer. There is a considerable body of studies on biodiversity that can serve as the basis for limited forms of transfer of this type. NBSAP teams should identify other countries where valuation studies of interest have been undertaken.

- Transferring benefit functions

A more sophisticated approach is to transfer the *benefit function* from i and apply it to j. Thus if we know that WTPi = F(A,B,C,Y)where Y is income and A,B,C are factors affecting WTP at site i, then we can predict WTPj using the coefficients from this equation but using the values of A,B,C, Y at site j. A more sophisticated approach will take random draws from the confidence intervals associated with the coefficients. The important step to note here is that comparison of the socioeconomic charateristics of the two valuing populations must be similar.

- Comparing like with like

Remember that transferring benefit values between different countries often requires a currency conversion and - if the valuation data is from previous years – some allowance for inflation. It is important to accommodate for inflation over time and maintain the real value of willingness to pay in purchasing parity terms. Thus if our original study to protect forest x is £20 in 1980 prices (as measured by the Retail Price Index, RPI 1980), the a transfer to forest y in 1998 might be achieved by deriving a factor z which is simply:

RPI (1998)/ RPI(1980) * WTP £(1980)

Since the RPI will typically show positive rates of inflation, we might expect the WTP for 1996 to be some multiple of the 1980 value. Most countries will have reliable inflation information

- Validity testing in benefits transfer

Testing the validity of benefits transfer presents further difficulties. With both the mean and functional transfer, the absence of a mean or function actually generated at the target means there is no direct test that the result is `correct'. Errors can be minimised by taking care to ensure that the two subjects of valuation and the valuing populatio ns are suitably simialr.

- Basic benefits transfer guidelines – a summary

The following list of measures is only offered as a summary of an emerging consensus in the benefits transfer literature:

adequate data from those studies included in the analysis
sound economic and statistical techniques in both original study and transfer
studies with regressions of WTP on determining variables
similar population in the compared sites
similarity of the environmental good to be valued
similar sites
similar distributions of property rights

C References

Brouwer, R. 2000. 'Environmental Value Transfer: State of the Art and Future Prospects'. *Ecological Economics* Vol.32, No.1, pp.137-152

4.8. Option Values and Pharmaceutical Prospecting

A Overview: Option value relates to the welfare benefits of conserving natural assets including biodiversity for the value of being able to use them in the future irrespective of their current value. Forest resources for example, may not pay for themselves using current valuation calculations, but the possibility that a multiplicity of cures may reside in naturally occurring plant and animal materials is sufficient motivation for most people to have a preference for, (or be WTP something) to insure, that possible future use.

Option value is one of the most compelling reasons advanced for biodiversity conservation worldwide. The argument for keeping options open is often couched in terms of the precautionary principle. This is an emotive argument that can seem rather hollow in developing countries with high opportunity costs of conservation. It is therefore important to attempt to substantiate the magnitude of some of the estimates advanced for option value. While difficult and imprecise, some attempt has been made to develop frameworks for evaluating likely magnitude. As part of the workshop it is useful; to draw on the arguments advanced in a limited literature on the subject. Participants may also wish to share information on prospecting arrangements, deals and laws in their own countries. Note that this subject can often be discussed in terms that highlight the cultural and traditional uses of biodiversity as opposed to strict monetary values.

B: Key issues to be covered

- Definition of option value
- Importance of plant and animal genetic material for drug and agricultural development
- An understanding of the pharmaceutical prospecting process
- An understanding of the uncertainties related to key model parameters that constitute the prospecting process e.g. the probability of discovering a useful compound, research and development costs, market sales (use references cited below)
- Case study material
- Contractual arrangements for benefit sharing

C: References

Pearce, D.W and Puroshothaman, S. 1995 'The Economic Value of Plant-based Pharmaceuticals'. In: Swanson, T. (ed.) *Intellectual Property Rights and Biodiversity Conservation: an Interdisciplinary Analysis of the Values of Medicinal Plants*. Cambridge University Press, Cambridge, pp. 127-138

Simpson, D., Sedjo, R. and Reid, J. 1996. 'Valuing Biodiversity for use in Pharmaceutical Research'. *Journal of Political Economy* 104 (1), pp. 163-185

Simpson, D. and Craft, A. 1996. 'The Social Value of Biodiversity in New Pharmaceutical Product Research', Resources for the Future, Discussion Paper 96-33, Washington DC

4.9 Comparing Costs and Benefits

A. Overview: Once all the costs and benefits of a particular policy or project have been identified and estimated, they can be added and compared within a CBA framework. A key consideration within this procedure is time. Since costs and benefits occur, and vary, at different points in time throughout the project period, it is necessary to discount future streams of costs and benefits back to the present in order to determine the net present value of alternative proposals. This section should give an overview of CBA, clarify the differences between an economic and financial analysis, explain discounting and how social and private discount rates can be determined, and explain the main decision rules.

B. Main Points to be Covered

1. Cost benefit analysis
- Definition
- Pareto criterion and Hicks-Kaldor compensation principal
- Underlying value judgements of CBA

2. Financial and economic analysis
- Differences between economic and financial analysis
- Identifying economic benefits and costs

3. **Discounting**
- Intuitive discussion of discounting
- The rationale for discounting (time preference, the opportunity costs of capital)
- The mechanics of discounting including the use of discounting tables and present value factors
- Definitions of terminology (present value, discounting, the discount rate, the social discount rate
- Choice of the discount rate – what is the correct rate to use? How do you determine a social discount rate?
- The power of discounting. How does discounting affect costs and benefits occurring in the future

4. Decision Rules
- Net present Value
- Internal rate of return
- Benefit/cost ratio

C. Exercises
See Exercises 1 and 2 in Section 5 for CBA examples. All exercises deal with discounting.

D. References
Pearce, D.W. 1983. 'Cost Benefit Analysis'. Macmillian, Basingstoke.

Hanley N, Spash, C. 1993. 'Cost Benefit Analysis and the Environment'. Edward Elgar, Aldershot.

4.10 Issues in Valuation and Costs Benefit Analysis

A. Overview: There are a number of issues associated with CBA and valuation of the environment, some of which are ethical in dimension. This section should address some the common criticisms levelled against CBA and detail ways in which these concerns might be dealt with. Key issues to be considered are: distributional equity, discounting and future generations, utility and preferences, irreversibility, uncertainty and risk.

B. Key Points to be Covered

1. Distributional Issues

- Discussion of issues – valuation based on wtp is constrained by ability to pay. CBA based on principle that some people will gain/lose
- Explain possible adjustments – distributional weights, compensation, sustainability constraints
- Social impact assessment as a means of providing additional information along side CBA

2. Discounting and Future Generation

- Effects of discounting on future generations and on biodiversity
- Arguments for and against lowering discount rates to protect the environment and future generations

3. Utility and Preferences

- Using human preferences as the basis of environmental resource allocations is the subject of moral debate
- Human needs versus human preferences
- Private versus community preferences

4. Irreversibility

- Development decisions are often associated with irreversible change to the natural environment e.g., species extinction
- Precautions to deal with projects with potentially irreversible effects: safe minimum standards and cost effective analysis; Krutilla Fisher adjustments

5. Risk and Uncertainty

- Defining risk and uncertainty
- Ways to deal with uncertainty: investing in information; risk assessment; risk assessment and subjective preferences; risk management
- Investing in information: Environmental impact assessment (EIA); pilot schemes; quasi option value; delays to project; precautionary principle; safe minimum standards; sensitivity analysis; switching analysis

C. Exercises:

Hypothetical exercises may be designed to illustrate how the findings of a CBA or CV study could be weighted to account for distributional concerns.

Participants may be asked to think of examples in their own country where the compensation principle might be applied to biodiversity conservation.

D. References

Myers, N. 1993. 'Biodiversity and the Precautionary Principle'. Ambio, Vol 22. No 2-3, May 1993

J. O'Neil. 'Ecology, Policy and Politics'. Routledge, London 1993.

Diamond, P.A., and J.A. Hausman. 1994. 'Is Some Number Better than No Number?' Journal of Economic Perspective, vol.8, no 4. Fall 1994.

4.11 Optional Workshop Sections

NBSAP guidance emphasises the need to look for avenues to mainstream biodiversity values. National Accounts and sector-based economic instruments and incentives (e.g. in agriculture, forestry and water), offer the potential for integrating biodiversity values in economic planning at macro and micro levels and for capturing biodiversity values. An understanding of national income accounting for the environment and environmental economic instruments are optional elements to be included in a valuation workshop.

4.11.1 National Income Accounting

Though not a valuation technique**,** Systems of National Accounts offer a policy-relevant vehicle for reflecting the value of biological resources in mainstream economic performance. Environmental values can be integrated into the main accounting process, or alternatively, physical information (e.g. stocks of water and timber) can be compiled in satellite accounts that can be monitored through time.

A Key Issues to be Covered

- Composition of SNA elements, consumption, Investment, Government expenditure, Imports and Exports
- Aggregate SNA measures GNP, GDP, NDP and NNP.
- Definition of depreciation on man made capital
- Methods for valuing depreciation on renewable and non renewable environmental assets
- User cost and net price approaches
- Presentation of an example of adjusted national accounts showing difference between conventional and green GDP
- Presentation of non-monetary physical accounts
- Alternative representations of SNA information such as Genuine Savings
- Policy relevance of SNA methods

B References

Atkinson G. et al (1997) Measuring Sustainable Development: Macroeconomics and the Environment, Edward Elgar

4.11.2 Economic Incentive Methods and Instruments

Economic incentive measures and instruments aim to reflect the economic values of biodiversity in sectoral activities that have the greatest impacts on biodiversity. Instruments are varied and it is difficult to generalise about applicability within and between countries. Some modification may be necessary for specific instruments to be suitable in some countries. Note that the issue of value capture can be addressed in this section.

A Key issues to be covered

Table (4.1) summarises the available instruments and incentive measures used around the world. Information contained in the table may be suitable for participant discussion on the applicability and experience with instruments and incentives.

Table (4.1) for the Classification of Incentive Measures

Positive Incentives	Disincentives	Indirect Incentives	Removal of Perverse Incentives
• agricultural land set-aside schemes • public or grant-aided land purchase • wetland reserves • covenants/conserva-tion easements • cost-sharing/manage-ment agreements • species enhancement schemes • customary cultivation of biodiversity • international biodiversity transfers • incentive payments for organic farming • taxation and fiscal measures	• user fees • non-compliance fees • fines for damages • environmental liability • performance bonds • habitat mitigation schemes • marine pollution liability	• individual transfer-able fishing quotas • tradeable develop-ment rights • property-right mechanisms • species com-mercialisation • biodiversity prospecting deals • forestry offsets • air emission trading • effluent discharge trading • tradeable water entitlements • wetlands mitigation banking • joint implementation • debt-for-nature swaps • international franchise agreements • eco-labelling	• reduction and restructuring of agricultural support harmful to biodiversity • introduction of agricultural conservation compliance measures • reform of public forestry concession pricing, licence fees, reforestation fees, and royalties • full appraisal of forest benefits • discontinuation of below-cost timber sales • reform of tax structures • full cost pricing for water services • appraisal of biodiversity impacts in the transport sector • road pricing • costing of biodiversity loss in energy investment appraisal

from ***Saving Biological Diversity: Economic Incentives OECD (1996)***

5 EXERCISES

This section contains a selection of group exercises related to the material covered during the workshop. The first is an example of how to compare the costs and benefits of different land uses for a wetland area. The second is another land use study exercise and looks at how to estimate the opportunity cost of conserving land for conservation. The third exercise looks at the preventative expenditure and replacement cost approach. Finally a CV exercise is provided which can be used to illustrate the CV concept and simple analytical procedures.

We recommend distributing these early on in the program. The studies can be tailored to the particular region or country where the workshop is taking place and perhaps even be related to current issues.

1. Estimating the Costs and Benefits of the Conservation of a Tropical Wetland

An economic analysis of wetland values requires identifying the relevant wetland functions and resources and assessing their importance in terms of their impact on or relevance to economic activities and the value of the non-marketed functions.

Key steps:

- Define the wetland area and specify the system boundary
- Identify the use and non-use of the wetland
- Identify the information required to assess each value
- Use this information to quantify economic values, where possible
- Correct for price distortions and discount the values over time to calculate the net present value of the conservation option
- Review development plans and development options for the area and estimate the opportunity costs of preservation. Calculate the NPV of the development option
- Compare the NPV of the conservation and development options

NOTE: In many cases it will not be possible to attach monetary estimates to all the use and non-use values. However, by calculating the net returns to the development option it gives an idea of what the net conservation benefits would have to be to make conservation a viable option.

The following use and non-use values have been estimated.

(a) What do you think would have been the best valuation method(s) to use and what might be possible data sources.

Use Value	Valuation Method	Possible Data Source	Estimated Value ($'000) per annum
Eco-tourism			350
Building materials			10
Fuelwood			20
Peat			2
Medicinal herbs			15
Meat/skins			30
Wild foods			100
Fish			150
Fodder			5
Water for domestic use			15
Water transport			3
Groundwater recharge			20
Flood and flow control			25
Shoreline stabilisation & erosion control			15
Sediment retention			12
Water quality maintenance			15
Research licence medicinal value of wild plants			20
			807

(b) Using the UNEP Guidelines (Technical Annex C) you have estimated the following annual expenditures have been incurred in conserving the wetland as a protected area:

	Protected Areas	Fisheries
Government		
Site Management	150	200
Data Management		50
Multilateral & Bilateral		
Species management	75	
Institutional capacity Building	25	
Local NGO's		
Education	25	
	275	250

Now calculate the net present value (NPV) of conservation over a 20 year period taking into account the following additional information:

- Tourist operators incur private expenses of $150,000 per annum to run the wildlife viewing and fishing operations (transport; labour; administration; camping, etc)

- Assume a discount rate of 10% per annum

- Government levies a 10% subsidy on medicinal herbs

(c) Estimating Opportunity Costs

- What alternative land uses could the wetland ecosystem be put to?

Suppose the next best use was conversion of the wetland for intensive agricultural use. The net benefits of complete wetland conversion to intensive agriculture can be measured by:

- Net private returns from annual agricultural yields (estimated at $300,000 pa)
- Deduct the direct costs incurred in the development such as the costs of drainage, dredging and filling (estimated at $200,000 in the start up year of the project)
- Deduct any additional environmental costs that arise due to the conversion (e.g. increased flooding downstream due to wetland conversion). Estimated at $15,000 pa

(d) Comparing NPV of conservation and development options

Estimate the present value of the private and social returns from the sustainable use and development options using the following additional information:

- Private discount rates are 10% per annum
- Social discount rates are 5% per annum
- Assume that the private returns of the sustainable use project relate only to the development of eco-tourism. The other benefits of the sustainable use project accrue to nearby communities.
- Assume a lifespan of 20 years
- For the private developer which is the best land use option?

  For society overall, which is the best land use option?

(e) Discuss the policy implications for government.

2 The Opportunity Costs of Biodiversity Conservation

Biodiversity conservation is a matter of development, and the essential characteristic of state lands set aside in parks, reserves, and forests for biodiversity (PRF land) conservation is that the land remains undeveloped. This carries an opportunity cost, in that the value of other economic activities are forgone. In (Kenya), land in the parks and reserves is used mainly for wildlife-based tourism and forest land is used mainly for forestry and for gathering non-timber forest products. In contrast, land not set aside for parks, reserves and forests (non PRF land) is used for settlement, agriculture and livestock.

The net returns for agricultural and livestock production on non-PRF land can be used to estimate the opportunity costs of leaving the parks, reserves and forests of (Kenya) undeveloped.

Given the following information calculate the net benefits of conservation. You can assume that the release of PRF land for agricultural/ livestock development will not drive down the price of these commodities or affect land prices.

- Net returns to wildlife tourism: $27.2 million
- Net returns to the forestry sector: $14.8 million

Table 1: Areas (km^2) of land potential zones in parks reserves and gazetted forests.

Zone	Park/Reserves	Gazetted Forests
Zone 1: Per Humid	**350**	**1210**
Zone 2: Humid	**1030**	**2050**
Zone 3: Sub-Humid	**1980**	**6170**
Zone 4: Transitional	**9500**	**1630**
Zone 5: Semi-Arid	**23590**	**6520**
Zone 6: Arid	**4970**	**1620**

Table 2: Gross Revenues and Net Returns from Agricultural and Livestock Production within land potential zones ($/km^2/year)

Zone	Gross Revenue	Net Revenue
1	**11840**	**3830**
2	**41140**	**15070**
3	**23200**	**9070**
4	**14940**	**5420**
5	**2120**	**530**
6	**160**	**60**

(a) By how much must net revenues from tourism improve to match the opportunity cost of land set aside in Parks and reserves. How could this be done?

(b) By how much must net revenues from forestry improve to match the opportunity cost of land set aside in protected forests. How could this be done?

(c) Suppose that the private net revenues from agricultural and livestock production included a price subsidy of 20%. Would this change the outcome significantly? How

might long term erosion from intensive agriculture and livestock overstocking affect the outcome in the long term?

(d) What values are missing from the estimate of the net benefits of conservation?

3. Preventive Expenditure/Replacement Cost Exercise

Soil erosion in an upland agricultural area in (Fiji) is leading to declining agricultural productivity. Table 1 below shows the trend in maize yields over a 15 year period.

Table 1: Trend in Maize Yields

Year	Maize Yield (kg/hectare)
0	2350
1	2243
2	2134
3	2026
4	1918
5	1810
6	1629
7	1448
8	1267
9	1086
10	905
11-15	905 (Per year)

Given that the real price of maize remains relatively constant over this period at R250 per kg

(i) calculate the annual and cumulative value of lost production over the period

(ii) using a 10% discount rate, what is the present value of lost production

A new management regime involves replacing lost nutrients by using chemical and organic fertilisers and investments in land terracing. Annual replacement costs required to maintain fertility are estimated at R268,000.

(iii) Calculate the present value of replacement costs over a 15 year period using a 10% discount rate.

(iv) From an economic and environmental perspective compare the new management method with the 'no management alternative'.

(v) If the management technique incurs greatest costs in the first few years of introduction and the discount rate of 5%, how might this affect your answer to (iv)?

(vi) Suggest reasons to explain the fact that many farmers have not adopted the new soil management method.

N.B. Participants need to be supplied with discounting tables including present value factors to complete this exercise. Such tables can be found as annexes in most project/investment appraisal texts. Alternatively if P.C. access can be arranged, this exercise can be conducted using the present value functions found in spreadsheets such as Excel (See section 4.9).

4. The Peril at Your Door: A Contingent Valuation Exercise

Malaria continues to be a global killer. In 1990 the WHO estimated global Malaria incidence at about 120 million clinical cases annually. In 1994 they estimated 300-500 million cases annually. For countries where the disease is prevalent the economic burden of the disease in terms of loss of life or treatment is phenomenal. At the individual level, each case is a tragedy that might be preventable were better pest management available.

Malaria is not evenly distributed across the globe, being largely confined to tropical regions. Some countries have opted for better strategies for dealing with the disease. Only 9% of Malaysia's population (of approximately 21 million people) now live with an appreciable risk of exposure to Malaria carrying mosquitoes. In contrast, the whole of Tanzania's population of 29 million remains at risk of infection. About 40% of the world's population remain at risk, of whom 19% live in Africa. In addition about 90% of clinical malaria cases occur in sub-Saharan Africa.

Consider that Malaria is preventable using both individual caution and collective action. The latter include proper vector management methods and the correct regulation of anti-malarial drugs.

The attached map gives further information on the prevalence of Malaria. Identify your country and the likely risk you face. Then consider the following information.

Suppose I offered you the following deal …

Assume that I own five of the "Mosquito Hawk" devices described in the attached advertisement:

America's Most Innovative Products
Stop swatting, stop itching …
with the powerful Mosquito Hawk

Electronic Repellent stops mosquitoes in their tracks!

If these pesky mosquitoes go after you with a vengeance despite the stinky insect repellents, you need a Mosquito Hawk. The Mosquito Hawk is named after the mosquito's most dreaded enemy: the dragonfly. A mosquito who even hears a dragonfly forgets about biting, and turns its tail in the opposite direction.

The Mosquito Hawk, a solid state electronic dragonfly, works by imitating the sound of a dragonfly's wings, something between a barely audible click and a hum. It's just loud enough that the mosquitoes can hear it from 50 ft, yet it won't affect people or pets.

Just pop a 9v battery in the back (not incl.) and it's ready to protect you anywhere you go: on the sundeck or patio, camping or fishing, on a picnic or hike. Compact size 2½" x 1½" x 1¾". Use the Mosquito Hawk at night for a peaceful, restful sleep! Once you try the Mosquito Hawk, you'll order one for all your friends and relatives. It's good! One year warranty. Made in the USA

I have used one of these Mosquito Hawks throughout my travels in Africa, and I assure you that it works: mosquitoes absolutely stay away from me when I carry it. If I put it in my hotel room at night, I'm never bitten by mosquitoes and do not need to sleep under a mosquito net or put on insect repellent. I can hardly even hear the noise it makes. The faint noise does not bother me at all. The "Mosquito Hawk" requires a small, normal-size battery that is cheap and easy to find. The device draws very little current, and the battery does not need to be replaced often, even if you use it on a regular basis.

Unfortunately, the manufacturer has stopped making these "mosquito hawks", and they are no longer available in the market. You cannot now buy one from any store or catalogue. Frankly, I don't know why the manufacturer stopped making such a great product. I spoke with the salesman at the only catalogue store that I know that sold the "mosquito hawk", and he told me that he didn't know either why they were no longer available, but that they had been very popular. Perhaps the manufacturer went bankrupt for other reasons, or it was a family business and the owner died.

Let's suppose that I have one of these "mosquito hawks" in my pockets right now. It is almost brand new. Assume that I've only used it once, and I know that it works as well as my first one. It should last for many years. Suppose I am willing to sell it this morning. If I offered this "mosquito hawk" to you today for $30, would you buy it? (Circle your answer)

Yes – I would pay $30 for the mosquito hawk in your pocket

No – I would not pay $30 for the mosquito hawk

Not sure / Don't know

Please answer the following additional questions:

In 1998, about how many days did you spend in countries where malaria is endemic?
No. of days _____

2. Have you personally had malaria during the last five years? Yes / No

3. How effective do you think the "mosquito hawk" would actually be in repelling mosquitoes? (i.e. how well do you think it would work?). Please circle the number than best reflects your judgement.

-2	-1	0	+1	+2
Definitely will not work as promised	Probably will not work	Not sure / don't know / might work	Probably will work	Definitely will work as promised

In what field is your primary disciplinary training?
Economics _____
Engineering _____
Sociology _____
Anthropology _____
Other (specify) _____

5. What is your age? No. of years _____

Which of the following income categories best describes your household income?
Annual
<$10,000 _____
$10,000 - $19,999 _____
$20,000 - $29,999 _____
$30,000 - $39,999 _____
$40,000 - $49,999 _____
$50,000 and above _____

For several decades researchers have been working to develop a vaccine against malaria, but to date they have not been successful. No malaria vaccine now exists, nor do most researchers expect an effective vaccine to be developed in the near future.

However, imagine that a Swiss pharmaceutical company did develop an effective malaria vaccine. Suppose that this malaria vaccine lasted for an individual's entire lifetime, just like the small pox vaccine, and that it was 100% effective. Imagine that it could be take at any physician's office or clinic, either by injection or orally.

However, suppose that this new malaria vaccine required a very expensive ingredient that was not in short supply, and that only a very limited quantity of the vaccine could be made available for the foreseeable future. Suppose that the Swiss pharmaceutical firm controlled he world's supply of this ingredient and could set the price of its new malaria vaccine without fear of competition.

> Suppose that the Swiss manufacturer set the price of the malaria vaccine at £100 per person. Suppose that you were offered an opportunity to purchase it, but that you had to decide today whether you wanted it or not. Assume that you had to pay this price

yourself, and that you would not be reimbursed by your employer, your insurer, or any government agency. Also, assume that this is a one-time offer and that you would not have another opportunity to purchase the vaccine.

There are not right or wrong answers. We really want to know your opinion. Some people say that they would not purchase the new malaria vaccine because they never plan to travel to tropical regions where malaria is prevalent, and they do not think malaria will every again become a problem in Europe or the United States. Other people agree to purchase the vaccine because they expect to be travelling to tropical areas, and feel this is a reasonable price to pay to insure against the possibility of contracting malaria.

Would you agree to pay £100 today for the malaria vaccine? (circle or check you answer)

Yes – would pay _____

No – would not pay _____

6 Readings

Several web sites offer extensive lists of published sources on biodiversity valuation and environmental economics in general. Workshop organisers should familiarize themselves with these sites and indicate these sources for follow up material.

1/ King, D. and M. Mazzotta (2000) Ecosystem Valuation http://www.ecosystemvaluation.org/

This website provides a simple guide to the techniques used by economists for ecosystem valuation. It is designed for non-economists

2/ Polasky, S. *et al* (1999) Bibliography on the Conservation of Biological Diversity: Biological/Ecological, Economic, and Policy Issues, http://www.orst.edu/Dept/ag_resrc_econ/biodiv/biblio.html

An extensive list of biodiversity papers listed under separate topics (e.g., valuation, priority setting, protected areas). The papers are both published and unpublished monographs.

3/ Stavins, R., and A., Pfaff (1999) Readings in the Field of Environmental and Resource Economics, at: http://www.aere.org/links/readings.pdf

An extensive library of studies covering general themes in environmental economics including "green issues" and environmental valuation. More advanced participants may wish to access more theoretical papers in the field.

At least two web-based valuation libraries are currently available for conducting benefits transfer. Both are valuation databases that attempt to extract vital information from exiting studies that can be used to give guidance on how the values can be used as "off the shelf" transfer values. Both sources should be of interest to NBSAP organisers. At the time of writing one site has free access . Note however that the vast proportion of studies included in the databases are from developed countries.

4/ Envalue is produced by the New South Wales Environmental Protection Agency at http://www.aere.org/. This resource has free access.

The alternative database EVRI is produced by Environment Canada and US EPA. Access is chargeable and access arrangements are as yet unclear.

5/ A recent review of biodiversity valuation studies by Cartier and Ruitenbeck can be found at: http://www.island.net/~hjr/

Suggested Texts:

Pearce and Moran, 1994. 'The Economic Value of Biodiversity'. In Association with the Biodiversity Programme of IUCN. Earthscan Publications Ltd, London.

Pearce, D.W. 1983. 'Cost Benefit Analysis'. Macmillian, Basingstoke.

Hanley N, Spash, C. 1993. 'Cost Benefit Analysis and the Environment'. Edward Elgar, Aldershot.

J.A. Dixon and M.M. Hufschmidt. 1986. 'Economic Valuation Techniques for the Environment: A Case Study Workbook'. Baltimore: John Hopkins University Press.

More Advanced:

Freeman, M.A. 1994. 'The Measurement of Environmental and Resource Values: Theory and Methods.' Resources for the Future.

Johansson, P. 1994. 'The Economic Theory and Measurement of Environmental Benefits'. Cambridge University Press.

A good intermediate microeconomics text book is:

H. Varian. 'Intermediate Microeconomics – A Modern Approach' Fourth edition. W.W. Norton & Company, Inc.

Further Reading

Bann, C. 1998. 'The Economic Valuation of Tropical Forest Land Use Options: A Manual for Researchers'. The Economy and Environment Program for South East Asia. [can be downloaded from EEPSEA web-site – http://www.idrc.org.sg/eepsea.]

Bann, C. 1998 'The Economic Valuation of Mangroves: A Manual for Researchers'. The Economy and Environment Program for South East Asia. [Can be downloaded from EEPSEA web-site – http://www.idrc.org.sg/eepsea]

Dixon, J.A. and Sherman, P.B. 1990. 'Economics or Protected Areas: A New Look at Benefits and Costs'. Earthscan Publications: London.

Hannah, L., Loshe, D., Hutchinson, C., Carr, J., and Landerani, A. 1994. 'A Preliminary Inventory of Human Disturbances of World Ecosystems'. Ambio, Vol. 23, No. 4-5 July 1994, pp. 246-250

Markandya, A. and Richardson, J. 1993. 'The Earthscan Reader in Environmental Economics'. Earthscan Publications, London.

OECD, 1995. 'The Economic Appraisal of Environmental Projects and Policies: A Practical Guide'.

Pearce D, Markandya A., Barbier. E. 1989. 'Blueprint for A Green Economy'. Earthscan Publications Ltd, London.

Pearce, D. 1991. 'Blueprint 2: Greening the World Economy'. Earthscan Publications Ltd, London.

Pearce, D. 1993. 'Blueprint 3: Measuring Sustainable Development'. Earthscan Publications Ltd, London.

Swanson, T. and Barbier, E. 1992. 'Economics for the Wilds: Wildlife, Wildlands, Diversity and Development', Earthscan, London.