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Valuing the Environment in Small Islands

An Environmental Economics Toolkit

JOINT NATURE CONSERVATION COMMITTEE

OTEP

Sampling methods are frequently used by government statistical departments and as such this department should be contacted for further information. If this is not an option many resources on sampling are available on the internet, an excellent resource is the UK Government National Audit Office 2000 publication “A practical guide to sampling”.

information

Sampling
To ensure that you identify the correct sample from whom to collect data specific methods should be used. There are nine main methods which produce different levels of accuracy (Cluster sampling; Convenience sampling; Judgement sampling; Multi-stage sampling; Probability proportional to size; Quota sampling; Simple random sampling; Stratified sampling; and Systematic sampling). These are all described in detail in the UK Government National Audit Office 2000 publication “A practical guide to sampling”. See: **http://www.nao.org.uk/publications/Samplingguide.pdf**

6.6 Data limitations

Data are not always available to the quality and standard that is desirable. Three main issues affect the quality of data:

Data availability: Data may not be available over a long period of time, simply because no one has collected data over time. This might mean that there are no baseline data against which change can be compared. In other cases a variety of different groups may have been collecting data using different methods. This could mean that the data are not comparable and should not be pooled. Finally, for various reasons there can be gaps in the data. This may be due to hazards affecting data collection, inadequate resources being made available for data collection or simply data collection not being prioritised.

Data accessibility: Even when data are available, they may not be available for the analysis. In many cases the private sector collect data, for example large multinational corporations often undertake environmental audits – which assess their impacts on the environment around them. To do this they collect baseline data. However, these reports are internal to the company and the data are often not shared. Even within governments there may be a lack of willingness to share data sets across government departments.

Data quality: Where the data do exist and are available, they may not always be of the highest quality, again, perhaps because of a lack of resources invested in their uptake, or because of a lack of prioritisation of careful data collection.

There are several types of problems that may occur in data quality, which call for solutions. First, where resources are available but limited, options would include: reducing the size of the sample engaged, and extrapolate future impacts from existing data. Second, where there is very poor data and no resources available to undertake an impact assessment or to collect economic values, then the best option would be to identify an academic partner who may be able to identify a student to collect this data as part of a masters dissertation or as part of a PhD thesis. Third, other options in this case would be to contact NGOs or external funders who may be able to release funds to collect the data needed.

7

Decision support tools

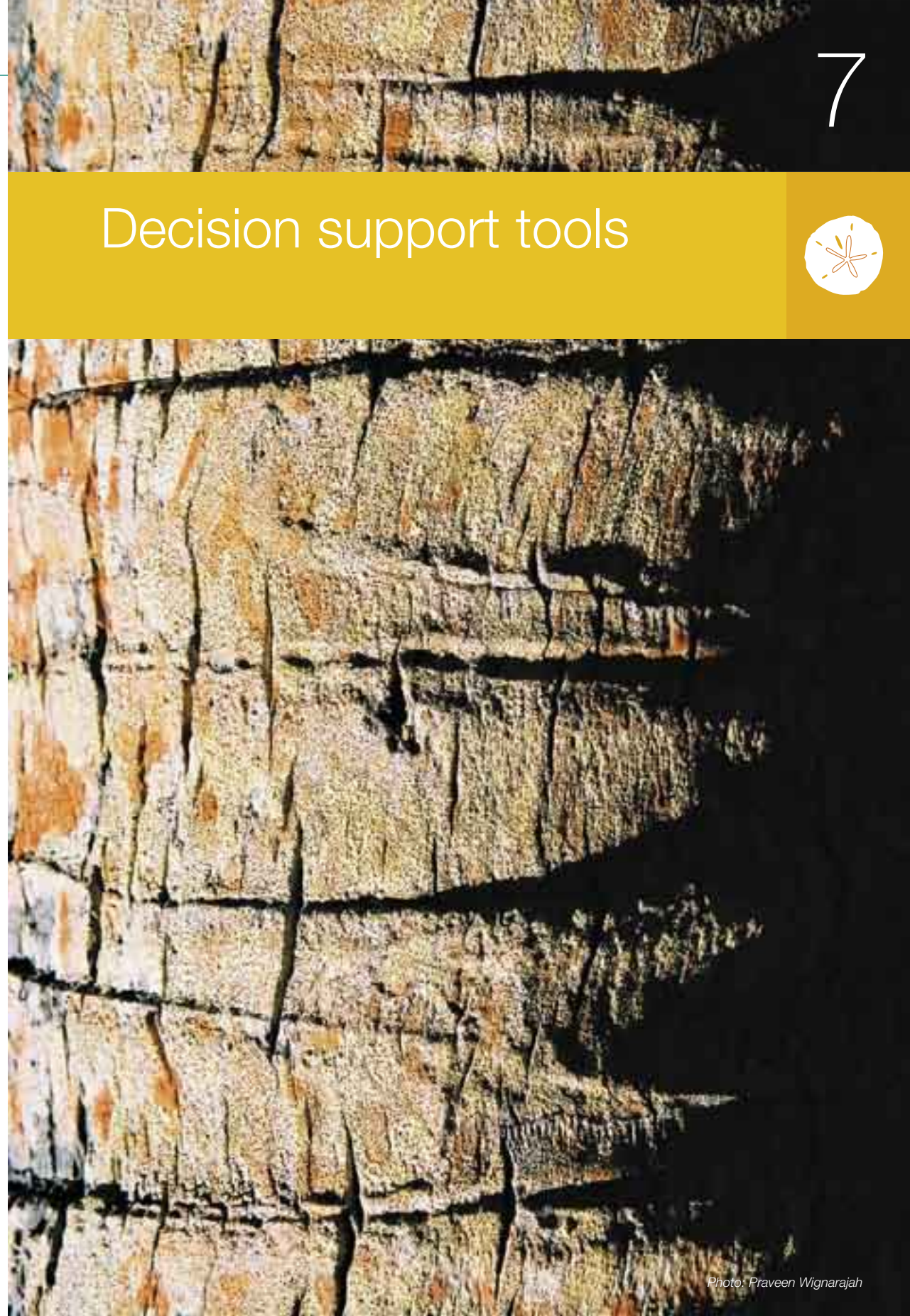
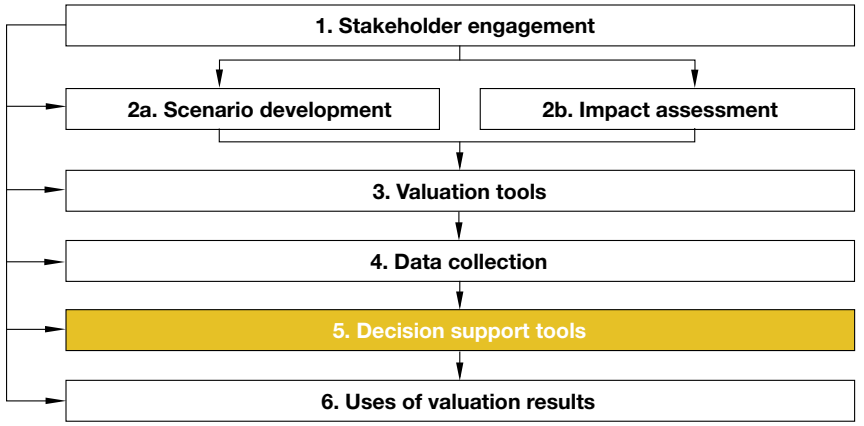


Photo: Praveen Wignarajah

7 Decision support tools

What you will learn in this section:

- The main economic decision support tools that are available for evaluating projects
- The basic steps in applying each decision support tool
- The strengths and weakness of each decision support tool, and when they are likely to be most appropriate
- How to deal with risk, uncertainty, and distributional and spatial issues



7.1 Introduction

There are a number of decision support tools available to help decision makers to structure the valuation information, in order to weigh-up the alternative scenarios, and select between alternative investments, projects, or policies. The choice of which decision support tool to use will largely be determined by the type of decision problem and the availability and nature of information related to each potential option.

When all the impacts of alternative options can be quantified in monetary terms, the most common tool for appraisal is *cost-benefit analysis (CBA).* This decision support tool involves summing up the value of the costs and benefits of each option and comparing options in terms of their net benefits (i.e. the extent to which benefits exceed costs).

For decisions that involve selecting between options to achieve a single specific goal (e.g. meeting air pollution standards, or supplying a specified quantity of clean water) and where all costs can be expressed in monetary terms, the *cost-effectiveness analysis (CEA)* decision support tool should be used.

In the situation that not all relevant criteria (costs and benefits) to the decision can be expressed in monetary values, but can only be expressed in other units or in qualitative

terms (i.e. impacts can be ranked in order of importance), *multi-criteria analysis (MCA)* is a useful decision tool.

7.2 Cost-Benefit Analysis

Cost-benefit analysis (CBA) is the most commonly used decision support tool for assessing and comparing economic and financial trade-offs. It is the standard tool for appraising and evaluating investments, projects and policies within many government departments and donor organizations. CBA is a decision support method in which the costs and benefits of alternative options are expressed and compared in monetary terms and it provides a framework into which monetised environmental values can easily be integrated. CBA provides an indication of how much a prospective project or investment contributes to social welfare by calculating the extent to which the benefits of the project exceed the costs – essentially society's "profit" from a project. It is important to recognise the difference between a CBA that is carried out from the perspective of society as a whole (societal or economic analysis or extended CBA) and CBA that is from the perspective of an individual, group, or firm (financial analysis).

The main steps in performing a CBA are presented in Figure 7.1, showing how these steps fit with the overall framework of analysis advocated in this toolkit. These steps are described in detail below:

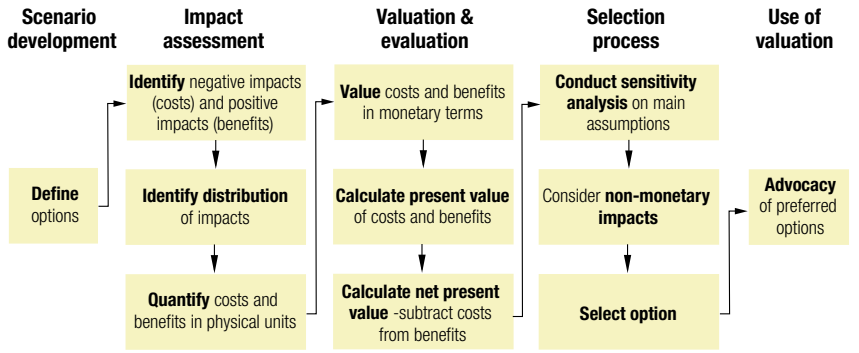


Figure 7.1 Methodological steps in cost-benefit analysis

1. **Define options**. The first step in a CBA (and in any evaluation framework) is to identify the alternative options to be considered. The options under consideration will generally be specific to the particular problem and context, but may include investments, projects, policies, development plans etc. It is important to have a clear and detailed description of what each option is.

See Scenario development and impact assessment sections in Chapter 4.

2. **Identify costs and benefits**. Identify all negative impacts (costs) and positive impacts (benefits) related to each option under consideration. This includes costs and benefits accruing to all affected groups and individuals (not just those involved in the project development) and costs and benefits that are incurred in the future. It is useful to describe the geographical and temporal boundaries of the analysis, i.e. the area and number of years over which costs and benefits occur.

3. **Identify the distribution of impacts**. Costs and benefits of alternative options will

not be distributed evenly over the various individuals and groups that are impacted by a project – see Section 7.5 for more detail on distributional issues. Although the overall impact of a project may be positive, some groups may lose out while others gain. The distribution of costs and benefits (and the potential need for compensation) therefore becomes an important determinant of whether a project is acceptable and desirable. The gainers and losers from each option should be identified using categories that are relevant to the context in question. Relevant groups might be defined by income class, ethnic group, profession, location etc.

4. **Quantify costs and benefits in physical units**. Each cost and benefit should be quantified in relevant physical units for each year in which it occurs. It is useful to use spreadsheet software such as Excel to create a table with each cost and benefit item represented by a column and each year included as a row.
5. **Value costs and benefits in monetary units**. Quantify each cost and benefit in monetary units for each year in which it occurs. In cases where costs and benefits are not directly observable in monetary terms in well-functioning markets (as is the case for many environmental impacts), estimates should be made using non-market valuation methods or value transfer.

See Chapter 5 for methods to estimate non market values.

6. **Calculate present values**. Calculating present value (PV) involves discounting values that occur in future years (see temporal distribution of impacts in Section 7.5). Present value costs and benefits should then be summed across years to obtain the total present value costs and benefits.
7. **Calculate the net present value (NPV)**. The net present value (NPV) of each option is calculated by simply subtracting the present value costs from present value benefits. A positive NPV indicates that implementing a project will improve social welfare. The NPVs of alternative investments should be compared in order to identify the most beneficial project.
8. **Calculate the benefit cost ratio (BCR) and internal rate of return (IRR).** The results of a CBA can also be represented by two other indicators of a project's worth (in addition to NPV). These are the benefit cost ratio (BCR) and the internal rate of return (IRR). BCR is the ratio between discounted total benefits and costs, and shows the extent to which project benefits exceed costs. A BCR greater than 1 indicates that the benefits of a project exceed the costs. The IRR is the discount rate at which a project's NPV becomes zero. If the IRR exceeds the discount rate, the project generates returns in excess of other investments in the economy, and can be considered worthwhile.
9. **Conduct sensitivity analysis**. Information on the monetary values of costs and benefits of alternative options will often not be known with absolute certainty. Uncertainty over the values or assumptions included in the analysis leads to the results also being uncertain. Different values may have resulted in a different ordering of options in terms of NPV. It is therefore necessary to recognise areas of uncertainty and test how sensitive the results are to changes in values or assumptions (see Section 7.5 below).
10. **Select option**. Based on the information generated on the NPV of each option, the sensitivity of the results, the distribution of impacts, and additional non-monetary information, a decision maker can select the most preferred option.
11. **Use the results.** The results of the CBA can be used in various ways to influence a decision over a policy or project. See Chapter 8 for more details on how to use the findings of valuation studies that are fed into CBAs.

Strengths and weaknesses

The steps in a CBA, as set out above, are largely computational and should be completed by an analyst. As such, the results of a CBA of alternative options can be computed reasonably quickly. The process of conducting an MCA, on the other hand, requires input from relevant stakeholders in setting weights. The MCA process is therefore slower and more labour intensive.

An important drawback of CBA is the requirement that all costs and benefits need to be expressed in monetary terms. Although economic valuation methods have been developed to estimate values for a wide range of non-market environmental goods and services, there are still considerable limitations to the accuracy and reliability of results in some areas. Furthermore, the application of non-market valuation techniques can be expensive and time consuming. For these reasons it may not be possible to estimate monetary values for some costs and benefits and so they cannot be entered into a CBA. Whether or not the omission of certain costs and benefits that cannot be monetised affects the decision result is case specific. In some cases the omitted impacts can be significant.

example

Example Box 7.1: Kihei's algae, Hawaii

Algae blooms have been a recurring problem on reef flats off the southern and western coasts of Maui for many years. This has caused significant, but localized, disturbance to the beach front, both in terms of its unattractive appearance and unpleasant odour. Potential contributing factors include wastewater discharge, leaching of injection wells, storm water and agricultural runoff, and golf course runoff. This leads to nutrient enrichment of the shallow reef area, which can cause phytoplankton blooms, affecting coral health. The major algal blooms occur in the North Kihei area, which has an algae cover of over 50 percent. The North Kihei algae problem is both a costly nuisance and a direct biological threat to local coral resources.

This case study estimated the net-benefits of solving the algal bloom problem in Kihei. Annual benefits were estimated for two scenarios: one with and one without nutrient reduction. Not surprisingly, the annual benefits further decline from US$25 million to US$9 million if the coral reef gradually disappears and algae blooms continue to occur. However, in a situation where nutrients are successfully reduced, the annual benefits will eventually increase by almost US$30 million. The majority of this increase can be attributed to the growth in property values. In addition, recreational values, in terms of snorkeling and diving, increase over time by about $2 million.

Upgrading the sewerage plant is estimated to cost US$13 million in capital investments and US$0.5 million per year in operating costs. The net present value of reducing nutrients by up-grading the sewerage plant is calculated to be $170 million using a discount rate of 5% over a time-period of 50 years. Note that several important additional benefits, such as reductions in health risks and water savings, have been excluded from the study. Therefore, even larger expenditures on sewerage and run-off reductions would certainly be a worthwhile investment; they would benefit both the economy and the marine environment.

Source: Van Beukering and Cesar. (2004)

7.3 Multi-Criteria Analysis

Multi-criteria analysis (MCA) has become a well-established tool for decision making that involves conflicting or multiple objectives. MCA can be used to establish preferences between alternative options by reference to a set of measurable criteria that the decision making body has defined. Unlike in a CBA, criteria do not need to be quantified in a common metric (i.e. money). Instead MCA provides a number of alternative ways of aggregating the data on individual criteria to provide indicators of the overall performance of options. This allows the inclusion in the analysis of effects that cannot be expressed in monetary terms. The basic idea behind MCA is to define a framework that allows the integration of different objectives (or criteria) without assigning monetary values to all of them. In short, MCA provides systematic methods for comparing these criteria, some of which may be expressed in money terms and some of which are expressed in other units. The main steps in performing a MCA are presented in Figure 7.2.

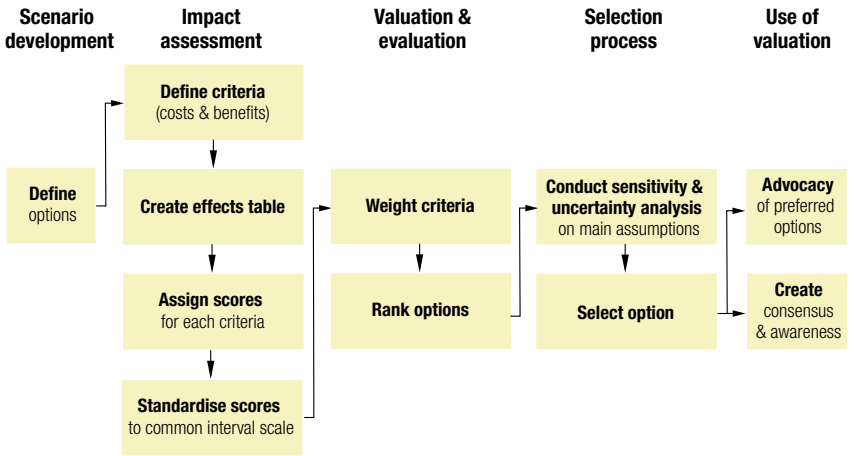


Figure 7.2 Methodological steps in multi-criteria analysis

These steps are described in detail below:

1. **Define options**. Same as Step 1 for CBA.
2. **Define criteria**. Identify and define all criteria that are relevant to the decision problem. These will include all important categories of costs and benefits resulting from the options under consideration. It is often useful to group criteria into economic, social, and environmental categories. In an MCA it is possible to include criteria that are difficult to quantify and can perhaps only be assessed in qualitative terms such as political sensitivity, equity, and irreversibility.
3. **Create effects table**. An effects table is a matrix with the alternative options listed in the columns and the criteria listed in the rows (see Example Box 7.2 for an example in Tobago).
4. **Assign scores to each criterion for each option**. Information on the magnitude of each impact (criteria) can be expressed in monetary units, physical units, or simply on a qualitative scale. Data on impacts can be collected from surveys, existing data, experts, or stakeholders.
5. **Standardisation of scores** for each criterion to a common interval scale (usually to values between 0-100 or 0-1). There are several software packages available that can be used to help with the computations in MCA.
6. **Weighting of criteria** to quantify the relative importance of each criterion in the decision process. Weights should be derived from existing information or from stakeholders by asking them to state their preferences for the various criteria. Again, MCA software can be used to help in this process.
7. **Ranking of options**. The alternative options should be ranked usually through a weighted summation of criteria scores for each alternative.
8. **Sensitivity and uncertainty analysis**. Assess the robustness of the ranking result to changes in weights and scores.
9. **Select option.** Based on the ranking of options and the sensitivity of the results, a decision maker can select the most preferred option.

A number of software packages are available to structure and process information in an MCA, including: DEFINITE, HIVIEW, MACBETH, and VISA.

Strengths and weaknesses

A key strength of MCA is that it is not necessary to quantify all impacts in monetary terms. This means that complex and expensive valuation studies of all environmental impacts can be avoided, and that qualitative criteria such as political sensitivity can be included in the decision framework. MCA can therefore provide a degree of structure, analysis, and openness to decision problems that lie beyond the practical reach of CBA.

MCA is, however, reliant on the judgement of the decision making team, in defining alternatives and criteria, estimating the relative importance of criteria and, to some extent, in calculating and inputting data into the effects table. The subjectivity that pervades these processes can be a matter of concern. Another important limitation of MCA is that the results do not necessarily show whether alternative options produce welfare gains or losses. Unlike CBA, there is no rule that benefits should exceed costs. Thus in MCA, as is also the case with cost effectiveness analysis, the analysis can only produce a ranking of alternative options and does not indicate whether the options result in a welfare improvement. It is, however, often possible to include a business-as-usual alternative in the set of options, and this should be used as a reference point to indicate whether the other options are better or worse than undertaking no action.

example

Example Box 7.2: Buccoo Reef marine park, Tobago

The Buccoo Reef is one of the most visited recreational sites in Tobago. Tourism has become an important contributor to local incomes yet it degrades the natural resource base on which many islanders directly depend for their livelihoods. The challenge is therefore to find ways of managing the Buccoo Reef that are acceptable to stakeholders while maintaining environmental quality. An MCA was conducted in 1999 to identify the best management option for the Buccoo Reef.

Four future scenarios for south-west Tobago were considered, each describing different levels of tourism development and environmental management. Tourism growth could continue along its current development path or it could be influenced by Government policy and promoted more actively. The environment could be managed as at present, or the Government could engage in more active environmental management. The scenarios were:

A: Limited tourism development without enhanced environmental management
B: Limited tourism development with enhanced environmental management
C: Expansive tourism development without enhanced environmental management
D: Expansive tourism development with enhanced environmental management

example

The criteria used to assess these options included economic, ecological, and social indicators, as shown in the effects table below. Note the different units in which the criteria are measured. A variety of sources were used to provide information on these criteria for each management option, including Government statistics, expert judgement, a business survey, and a contingent valuation survey. The CV survey asked visitors to and residents of south-west Tobago about their willingness to pay to prevent further damage to Buccoo Reef Marine Park and their willingness to pay under changes in environmental quality. From this an estimate of average willingness to pay was calculated under different environmental conditions. A mean estimate was then multiplied by the possible number of visitors and projected under the different scenarios of more or less tourists.

Scores for each criterion were scaled to values between 0 and 100 using standard MCA techniques. Weights for the criteria were set in a stakeholder meeting. The Buccoo reef tour operators were asked to prioritise the main management issues for Buccoo Reef Marine Park. Each stakeholder was given a voting form and was asked to rank the three main issues (economic, social and ecological) in order of importance. Using these stakeholder-defined management priorities (which showed a high priority for improved management of social issues and ecological interests, but less priority for economic issues) a weighted ranking of the scenarios identified Option A as the most preferred management scenario.

Table 7.1 MCA Effects Table for Buccoo Reef Marine Park

Criteria	Option A	Option B	Option C	Option D
Economic				
1. Economic revenues to Tobago (US$)	9	11	17	19
2. Visitor enjoyment of BRMP (US$)	1.2	2.5	0.9	1.7
Social				
3. Local employment (no. jobs)	2,500	2,600	6,400	6,500
4. Informal sector benefits (score)	5	4	3	2
5. Local access (score)	6	5	6	7
Ecological				
6. Water quality (g N/l)	1.5	1.4	2.2	1.9
7. Sea grass health (g dry weight/m2)	18	19	12	15
8. Coral reef viability (% live stony coral)	19	20	17	18
9. Mangrove health (ha)	65	73	41	65

Source: Brown et al (2001)

Snorkeling at Buccoo Reef, Tobago. Photo: Colin Campbell

7.4 Risk and uncertainty

Decision making in the presence of risk

Most decision making contexts involve some degree of uncertainty about the possible range of outcomes for a given option. This is often the case with the economic valuation of changes in complex environmental systems for which the outcomes cannot be known with certainty. If the decision-maker has good knowledge of the probability of occurrence of each outcome, the decision making context is one of 'risk'. The main approach to dealing with risk in a decision framework is to consider the expected value of alternative options. Given information on the probability of a range of possible scenarios occurring, the expected value of each option should be calculated.

Decision making in the presence of uncertainty

Various decision-support techniques have been developed which do not require knowledge of the probabilities of occurrence. These so-called 'non-probabilistic' criteria simply involve the application of predefined rules to the outcome possibilities. These criteria include the precautionary principle, maximin, minimax, maximax and Hurwicz -criterion.

Assessing the effect of uncertainty on project evaluation

Information on the physical magnitude and monetary value of costs and benefits of alternative options will often not be known with absolute certainty. Uncertainty over the impacts included in the analysis leads to uncertainty in identifying the best option. It is therefore necessary to recognise areas of uncertainty and test how sensitive the evaluation results are to changes in the values included in the analysis. Several techniques exist for testing the key factors which underpin the estimated outcomes in a decision problem, including: sensitivity analysis, Monte Carlo simulation, and interval analysis.

Sensitivity Analysis focuses on assumptions that have a significant effect on the evaluation results. It should be applied whenever anticipated costs and benefits are quantified. It involves recalculating the present value cost and benefits for different values of major variables, one at a time. It involves selecting variables to which estimated costs and benefits may be sensitive, determining the extent to which they may vary, calculating the effect of different values on net present value (NPV), and interpreting the results, in particular regarding whether or not certain combinations of variables may result in NPV switching from positive to negative or vice versa.

7.5 Distributional, spatial, and temporal issues

Distribution of impacts across individuals and groups

The distribution of costs and benefits across different groups in society is usually an important criterion in public decision making and needs to be assessed as part of the evaluation process. The allocation of the benefits and costs among different groups within society may well determine the political acceptability of alternative options.

The uneven distribution of costs and benefits has both practical and ethical consequences. In practical terms, it is important to assess the burden of costs and benefits received by local residents, as they often have a strong influence on how successful project implementation will be. If local residents stand to lose out from a particular project they are unlikely to support it. It is often the case with ecosystem conservation in small islands that

simply attempting to exclude local people from accessing an environmental resource will not be successful without sharing the benefits of conservation with them. Understanding who gains and – in particular – who loses from each policy option can provide important insights into the incentives that different groups have to support or oppose each project. This approach can thus provide useful information in the design of appropriate responses.

In terms of ethical considerations, the analysis of the distribution of costs and benefits is important to ensure that conservation interventions do not harm vulnerable groups within society. Recent studies show that the poor are often very dependent on natural resources for their livelihoods, and may therefore be heavily affected (positively or negatively) by changes in resource management.

Identifying and estimating the distribution of costs and benefits across different groups is the first step in designing measures to avoid disproportionate or undesirable allocation of impacts, compensation mechanisms, or payment schemes between gainers and losers.

A general approach to identifying which groups will be affected by alternative options is through stakeholder analysis. One way of displaying the distributional effects of alternative options is to construct a distributional matrix, which displays the costs and benefits of a policy option, and shows how they are distributed among different socio-economic groups.

See Chapter 3 for more information on stakeholder analysis and engagement

Girls playing in Solomon Islands. Photo: Pieter van Beukering

example

Example Box 7.3: Distribution of net benefit to stakeholders in Leuser park

The Leuser Ecosystem in Northern Sumatra is officially protected by its status as an Indonesian national park. Nevertheless, it remains under severe threat of deforestation. Rainforest destruction has already caused a decline in ecological functions and services. This is affecting numerous economic activities in and around the Leuser National Park. The objectives of this study were twofold: firstly, to determine the total economic value (TEV) of the Leuser Ecosystem and secondly, to evaluate the economic consequences of deforestation versus conservation, disaggregating the economic value for the main stakeholders and regions involved. Three scenarios were considered: 'conservation', 'deforestation' and, 'selective use'.

- The economic *benefits* considered include: water supply, fisheries, flood and drought prevention, agriculture and plantations, hydro-electricity, tourism, biodiversity, carbon sequestration, fire prevention, non-timber forest products, and timber.
- The *stakeholders* include: local community members, the local government, the logging and plantation industry, the national government, and the international community.
- The *regions* considered cover the 11 districts involved in the management of the Leuser Ecosystem.

With a 4% discount rate, the accumulated TEV for the ecosystem over the 30-year period is: US $7.0 billion under the 'deforestation scenario', US $9.5 billion under the 'conservation scenario' and US $9.1 billion under the 'selective utilisation scenario'. The main contributing benefits in the conservation and selective use scenarios are water supply, flood prevention, tourism and agriculture. Timber revenues play an important role in the deforestation scenario. Compared to deforestation, conservation of the Leuser Ecosystem benefits all categories of stakeholders, except for the elite logging and plantation industry.

Table 7.1 shows the distribution of the NPV among the stakeholders for the different scenarios. Several typical features can be observed. The local communities are by far the main beneficiaries of the Leuser Ecosystem. As such, their share will grow in the conservation scenario. As expected, deforestation benefits mainly the logging industry in the short run. A striking element is that the elite (logging) industry collects a much larger share of the total value in the deforestation scenario (23%). If the Leuser Ecosystem were strictly conserved, their share would only be 11%. This reduction in value for the elite industry in the conservation scenario contrasts with benefits for the local and international community. The power structure of the elite (logging and plantation) industry and the socio-spatial distribution of the local and the international community, however, prevents the conservation scenario from being realised.

Scenario	Local community	Local government	Elite industry	National government	International community
Deforestation	45	11	23	7	13
Conservation	56	9	11	5	19
Selective use	53	10	14	5	18

Source: van Beukering et al. (2003)

Table 7.2 Distribution of NPV among stakeholders (in %)

Spatially distributed impacts

The spatial distribution of impacts from alternative policy options may also be of interest to decision makers, particularly where different user groups are located in different areas. The analysis of the spatial distribution of impacts may be seen as an extension of the distributional analysis described in the previous section and may be a useful approach to identifying different societal groups that are impacted by a project. For example, projects that address water management at a river basin level are likely to affect upstream and downstream stakeholders differently – and this should be identified through spatial analysis. Alternative policy options will generally result, not only in different aggregate costs and benefits, but also in the spatial distribution of impacts. If these differences in spatial distribution are considered of importance, the decision problem of selecting between alternative mitigation options has a spatial element. A useful means of conducting spatial analysis of impacts and of representing spatial distributions of costs and benefits is through the use of Geographical Information Systems (GIS).

Fishing. Photo: Praveen Wignarajah

example

Example Box 7.4: Which reefs in Saipan are the most valuable?

Not all of Saipan's coral reefs are worth the same amount of money. With a limited amount of money to spend on protection, Saipan needs to know which reefs are the most important. One way to work out which reefs are most valuable is to use GIS. These maps show us the location of the most valuable reefs as well as those reefs that are in most danger from pollution and muddy run-off.

If you look at the first map (Figure 7.3) you will see the most valuable reefs are the green ones. These are mostly small reefs located within 200-metres of the most popular diving and snorkelling spots (e.g. Managua Island, Bird Island). These reefs are worth nearly US $13 million per square kilometre!

The reefs that are in most danger from pollution and muddy run-off are indicted in different colours on the second map (Figure 7.4). They are located just outside Garapan. The main source of pollution is nutrient-rich runoff from the Tapochau watershed that used to drain into Garapan wetlands. These wetlands filtered and cleaned the water but they were filled in as Garapan grew over the years. Now stormwater carries nutrient-rich water directly to the reef.

If you look carefully, you may notice that the most valuable reefs are the same as those in most danger from pollution! This means that these are the areas that CNMI should spend money on first, in order to manage and protect reef values.

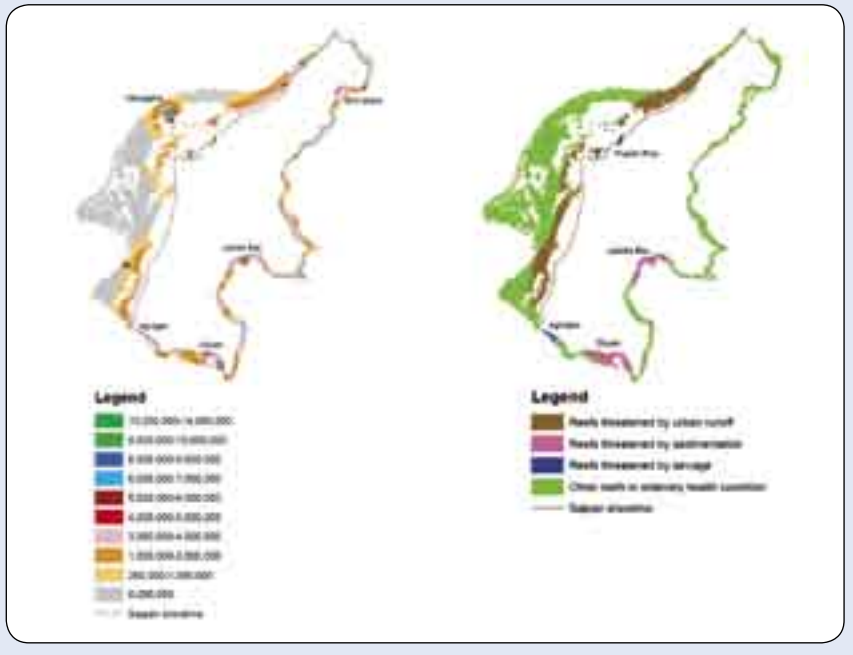


Figure 7.3 Total Economic Value

Figure 7.4 Threats to Saipan's reefs

Source: Van Beukering et al. (2006)

Using valuation to influence decisions

Temporally distributed impacts

Most policy options will result in impacts not only in the current year but also over a number of years into the future. Both the costs and benefits of a project will therefore have a temporal distribution. It is often the case that projects involve initial investment costs and that a stream of benefits is received over several years in the future. It is important to account for this distribution of costs and benefits over time because people tend to value a benefit or cost in the future less than a benefit or cost now. The practice of accounting for this time preference is called discounting and involves putting a higher weight on current values.

There are two explanations for this higher weighting of current values. The first is that people are impatient and simply prefer to have things now rather than wait to have them in the future. The second reason is that, since capital is productive, a pound's worth of resources now will generate more than a pound's worth of goods and services in the future. Therefore, an entrepreneur is willing-to-pay more than one pound in the future to acquire one pound's worth of these resources now. In most cases, the discount rate is therefore based on the opportunity cost of capital – the prevailing rate of return on investments elsewhere in the economy, i.e. the interest rate.

The UK Treasury guidelines recommend a discount rate of 6% for public sector projects while for most environmental and social impact studies 3.5% is recommended.

Information

For more information on appropriate discount rates, see
The Green Book: Appraisal and evaluation in central government (2003) By HM Treasury. **http://www.hm-treasury.gov.uk/media/05553/Green_Book_03.pdf.**

In Pacific Island Countries, discount rates used to conduct non-market valuations during 2003-2006 varied between 3 and 12% (Paula Holland, SOPAC, personal communication).

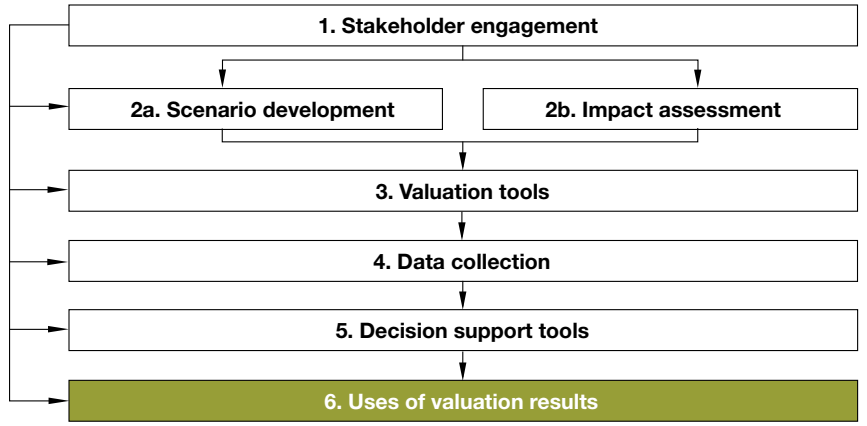
There is evidence to suggest that people discount the future differently for different goods. If people have lower rates of time preference for environmental goods than for money, a lower discount rate than the interest rate should be used. It is also possible that rates of time preference diminish over time, i.e. that the discount rate declines for impacts in the far future. The choice of discount rate can have a huge impact on the findings of an evaluation or valuation study, and should therefore be varied in a sensitivity analysis to check how it influences the results.

Photo: Nature Picture Library

8 Using valuation to influence decisions

What you will learn in this section:

- How economic valuation should be used to influence decisions
- How economic valuation should be used to extract finances for environmental management



8.1 Introduction

By and large, the main reason to generate environmental economic indicators (including environmental values) is to influence policy decisions about the economy, society or the environment. Chapter 1 pointed out several reasons why one might conduct an economic valuation. In this Chapter, the ways in which economic valuation can be used to influence policy are discussed, we focus on four of the most common justifications for economic valuation: (1) for *advocacy;* (2) to influence *decision making and policies*; (3) to calculate *damages* for compensation; and (4) to identify *extractable revenues* for environmental management.

The WWF has produced a book "The Green Buck" which describes in detail how to use economic valuation of environment resources for policy making. Details on this and other resources can be found in section 9.4

To obtain the greatest policy use from an economic valuation, four steps need to be taken:

1. Identify and engage the *target audience* at the outset of the evaluation

For more information on targeting the right audience, see Chapter 3 Stakeholder Engagement.

2. Provide the audience with *economic values* that are relevant for them (e.g. in one case Total Economic Value in another Cost-benefit ratio);
3. Provide *additional information* to economic values (such as employment, income distribution or revenue retention);
4. Develop a *communication strategy* to deliver the information.

In the next Sections and in Table 8.1 these four steps are described in more detail for the four most common uses of valuation results (namely: advocacy; decision making; damage assessment and revenue extraction).

Table 8.1 Specification of uses of the results of economic valuation

Use	*Step 1:* **Identify target audience**	*Step 2:* **Determine valuation output**	*Step 3:* **Select other indicators**	*Step 4* **Design communication tool**
Advocacy purposes	General public, parliament, non-governmental organisations	Total Economic Value	Employment, distribution of benefits	Public education and outreach, flyer for visitors
Decision making	Specific ministries, investment banks, private firms	Cost Benefit Ratio, Net Present Value	Risks involved, earning-back period, winners & losers	Policy brief
Damage assessment	Specific ministries, the Court and law enforcers	Restoration and Compensation costs	Payment scheme, re-investment scheme, biodiversity loss	Legal opinion
Extract revenues	Ministry of Finance, dive and tourism industry	WTP for conservation	Impact on tourism, level of earmarking, transaction costs	Report on design of user fee schemes

8.2 Advocacy purposes

Economic valuation is often used to advocate the economic importance of the environment, with the ultimate purpose of encouraging sustainable development. For example, by demonstrating that the economic values of a threatened ecosystem have previously been underestimated, it can be argued that the ecosystem should receive more attention in public policy. Thus economic valuation can provide powerful new arguments that support increased protection of the environment.

Typical key messages

Advocacy is one of the most important motives for organisations to apply economic valuation. Within the context of advocacy, economic valuation can convey different key-messages to their audiences:

1. *Quantifying the value of the ecosystem puts it on the planning agenda:* Decisions are often made on the basis of economic analysis. By quantifying the economic value of ecosystem goods and services, these components can be included in the decision process. This information can be used to justify investment in ecosystem management.
2. *Economic values of ecosystem services can reduce costs and protect profits:* It is expensive to transform polluted water into potable water. If groundwater becomes polluted due to the degradation of surrounding ecosystems, water company costs are likely to rise and these costs are likely to be passed on to the household consumer. Protecting the environment that affects groundwater can alleviate this problem.
3. *Under-investing in ecosystems results in increased costs to households:* Inadequate protection of fertile land, forests or fisheries can result in their overuse, exploitation and degradation. For those households that rely on these resources this can mean that foodstuffs need to be purchased, which may be unaffordable. These households may then be forced to turn to the government for assistance.
4. *Ecosystems matter for people's health:* Healthy mangroves and sea grass beds filter some pollutants that run-off from the land. Without this, coastal waters would contain higher levels of pollutants, which can create stomach upsets, eye infections and other illnesses. Illness is never pleasant for the individual, but there are also costs to the national economy if people are unable to work.
5. *If key stakeholders are involved, they are more likely to support a decision:* If decisions are being taken about an ecosystem, it is important to find out the main interests and concerns of the primary stakeholders, who use or benefit from the ecosystem. If the interests and concerns of these people are represented, it is likely that they will be more receptive to the study and its outcomes. Professional communicators should be used to design and implement a communications strategy to reach this group.

Typical audience

Valuation studies can be more effective if targeted at a specific decision or process. A study should not take place in isolation from the *policy context* and the people who will ultimately be involved in making the decision.

For more information on stakeholders see Chapter 3 on stakeholder engagement, and Chapter 4 on scenario development

Table 8.2 shows the different audiences that may be relevant in the context of advocacy, their interest in the resource, and the role of economic valuation in addressing this specific audience.

Table 8.2 Audiences and their interests in the context of advocacy

Audience	Interest in the resource	Use of the valuation study
Local residents / primary stakeholders	• Extractive use • Recreational use • Harvesting • Aesthetic use • Derived economic benefits (e.g. dive industry from mangrove and sea grasses)	• Increase knowledge about the range of ecosystem goods and services provided by the resource • Inform about the range of uses • Detail the direct and indirect costs associated with ecosystem degradation • Detail potential economic benefits from ecosystem health and sustainable use
Politicians and national policy makers / secondary stakeholders	• Possibly none • Possible lack of awareness of uses and services provided and associated economic benefits	• Increase awareness of the economic uses of the ecosystem • Describe economic benefits/costs locally and nationally from ecosystem health or failure • Describe economic benefits nationally from ecosystem health or degradation
International and local NGOs / external stakeholders	• Conservation • Exploitation • Development	• Provides all parties with same data on which to come to a consensus about the resource. • Explicit valuation

Valuation data and additional indicators

Depending on the standards desired by policy makers, the *extent and depth* of valuation studies varies. Sometimes it may be sufficient to estimate only the most important economic values of a threatened ecosystem, rather than trying to cover all ecosystem services.

Valuation exercises for advocacy purposes can also range enormously in scale. The largest environmental subject ever addressed through economic valuation was the estimation of the current economic value of 17 ecosystem services for 16 biomes. For the entire biosphere, the value is estimated to be in the range of US$16-54 trillion per year, with an average of US$33 trillion per year (Constanza et al., (1997). Although the usefulness and validity of such an exercise has been questioned, the study has certainly generated tremendous publicity and opened the eyes of many policy makers concerning the economic importance of nature. However, conducting economic valuation studies at a more local scale is generally more meaningful for influencing policy and decision making.

In the local context, the overall goal of the valuation study must be kept firmly in mind.

For more information on scenario development see Chapter 4

General estimates of the total value of the nearly extinct Mediterranean Monk Seal may be academically interesting but have little impact on decision making. Similarly, comprehensive valuation studies of all the services provided by an ecosystem are often time-intensive and costly, while vague or faulty studies can serve to destroy the confidence of the decision makers. For this reason, the economic values that are critical to the goals of the valuation study should be carefully thought through at the beginning of the study. Once estimated, these values must be presented in a clear and appropriate context. For example in Samoa

an economic valuation of the country's biodiversity highlighted the reliance of the national economy on tourism, fisheries and agriculture, each of which relied on the ecosystem health.

For economic valuation studies to be strong advocacy tools and influence policies, it may be necessary to include *alternative indicators,* thus going beyond conventional indicators such as income. Employment and poverty are often primary concerns of policy makers and the general public, and should therefore accompany the monetary value estimates. Other powerful indicators, for example, include the number of people depending on the resource.

Communication tool

Basic advocacy tools should be used in conjunction with the analysis. The *quality of communications* can be as important as the quality of the analysis, and this should be planned from the outset. Communication can be as simple and as cheap or as expensive and comprehensive as resources allow. Whatever funds available, there are several central elements that have to be considered when communicating information as an advocate:

- What is your message?
- Who is your message for?
- What does your audience think now?
- What would you like them to think?
- How can you get your message across?

People don't always react to information in the way you might expect. Therefore if you are new to communications – it is important to refer to guidelines on best practice.

Information

The UK Government Department for Environment, Food and Rural Affairs (DEFRA) has produced an excellent 12 page guidance note "Your guide to communicating climate change" on how to communicate climate change (see section 9.4).

8.3 Decision making

The role of government is to allocate scarce resources to achieve economic, environmental and social goals. These are often full employment, an equitable distribution of national resources, rising standards of living, a balanced budget and an equal balance of exports and imports. Decision makers constantly operate under short time frames, their windows of opportunity are limited by the election cycle and they often have to take decisions without full information. Economic valuation studies are critical to assist decision makers make fair and transparent decisions.

Typical key messages

Typical key messages that economic valuation can provide to decision makers include:

1. *Ecosystem values reveal economic costs and benefits that should be included in decision-making:* Valuation results can be used to highlight important environmental impacts that should be considered when making decisions. Environmental costs are often ignored because they are difficult to quantify and compare with other economic costs. Estimating monetary values for lost ecosystem values raises their profile in decision making.
2. *Including ecosystem values in economic analysis improves decision-making:* If the economic values of ecosystem goods and services are not explicitly included in the decision making process then decisions could be taken that will not generate the optimal level of benefits for the society. Comparisons can be made in terms of economic welfare between decisions that incorporate ecosystem values and those that do not in order to show that including values improves decision-making.
3. *The distribution of ecosystem values is useful for decision making:* The distribution of values across different groups in society is often important information for decision-making. Policy makers are sensitive to who gains and who loses from a policy, and quantifying this in monetary terms is useful.

Typical audience

Decision makers can be effectively targeted by recognising the different interests that they may have. For example, the Minister of Finance's primary concern is to avoid budget deficits. Therefore, by demonstrating the revenue raising potential of environmental services, you are more likely to get the Minister's support than when you stress required expenditures for the environment. The Minister of Environment is likely to be triggered by a different message, which highlights the importance of the islands' ecosystems in terms of supporting sustainable development. Table 8.3 shows different decision making audiences and their specific interest in the resource and economic valuation.

Table 8.3 Audiences and their interests in the context of decision making

Audience	Interest in the resource	Use of the valuation study
Politicians and national policy makers	• Role of the ecosystem in providing economic benefits • Interconnectedness of the ecosystem with others that provide valuable economic services	• Provides comparable data for decisions to be made • Provides the total economic costs from exploitation or development of ecosystems
Government	• Sustainability of the ecosystem and associated ecosystems for supporting long term economic and social development • Possible revenue generating opportunities from use of the ecosystem	• Enable civil servants to explain more clearly the functions and benefits of ecosystems to political leaders • Enable civil servants to explain more clearly the functions and benefits of ecosystems to other government departments

Valuation data and additional indicators

Cost benefit analysis is a common decision support tool for decision makers. Decision makers are increasingly expected to justify the *costs* of their policies by demonstrating the *benefits* of these measures. The direct financial costs of policies in terms of government expenditures are often known, and therefore economic valuation can play an important role by estimating the indirect costs and benefits of these interventions.

Economic valuation for decision making is especially useful if the costs and benefits of alternative measures with the same outcome are presented as comparison. For example, where an infrastructure development project is being criticised, ideally an alternative should be suggested that would achieve the same aims but with greater environmental benefits.

Typical alternative indicators that complement economic values can be anything that is high on the political agenda of the policy makers. This usually includes employment, education, national security, import dependency especially in the case of energy, technological development, and poverty reduction.

Communication tool

The importance of being able to compare projects in dollar terms makes decision making easier and more transparent. It provides decision makers with an objective framework on which to base their decisions and allows them to allocate resources in a transparent manner.

If the economic values have been carefully estimated then the process of comparing various development scenarios should be significantly easier if decision makers have all the information about the impacts of their choices at their fingertips.

The more powerful a decision maker or politician, the less time is available to expose the results of your economic valuation study. Ministers rarely read a full report. Therefore, it is of crucial importance to present the results of the study in the form of a policy brief or a five-minute presentation, which presents the most important findings in a compact and accessible manner.

8.4 Damage assessment

It is becoming increasingly common for economic valuation to be used as a means of assessing the compensation that is required after an environmental catastrophe has occurred or damages have been inflicted on an ecosystem. Damage assessment has been used in many cases to assess the compensation owed after oil spills by large ships and after accidents by mining companies that lead to tailings dam leakages or other toxic waste spills.

Typical key messages

Typical key messages that economic valuation can provide to decision makers include:

1. *Economic valuation allows more accurate estimation of damages from environmental disasters:* Economic valuation tools allow more accurate estimates of the damages that might have been created. Without the use of such tools the true economic, social and environmental impact may not be known.
2. *Economic valuation could bring consensus about compensation among conflicting partners:* Where there is debate among those involved in an environmental dispute, economic valuation tools can be used to resolve legal differences. Such was the case after the Exxon Valdez oil spill in Prince William Sound in 1989. Economists hired to estimate the damage costs reported a lower bound willingness to pay (to prevent another oil spill similar to the Valdez) of $2.8 billion, the mean estimate was $7.2 billion. In 1993, to address the issue the US Government's National Oceanic and Atmospheric Administration (NOAA) set up a 'Blue Ribbon Panel' to answer the question 'Is Contingent Valuation (CV) a valid method for determining the lost economic value from natural resource damages?' The panel members concluded that the CV method can produce reliable estimates of damages associated with lost value if the research is undertaken to a high standard. The CV method has since been used in courts of law to estimate damages.

Typical audience

Economic valuation can be used effectively to serve different audiences. As shown in Table 8.4, victims of environmental damage may require economic valuation to determine lost benefits from direct and indirect ecosystem services. Such victims can be private persons as well as government officials that represent the general public. Because cases of damage compensation are increasingly brought to court, lawyers also have become an important audience for studies that value damages.

Audience	Interest in the resource	Use of the valuation study
Victims of the environmental damage	• Lost benefits from direct and indirect ecosystem services	• Provides data as a basis for claim for compensation
Lawyers representing defendant	• Fair estimation of compensation	• To provide a fair estimate of compensation

Table 8.4 Audiences and their interests in the context of damage assessment

Valuation data and alternative indicators

For natural resource damage assessment, the economic valuation of environmental goods and services is a first step to determine losses. Damage claims basically have two main components:

1. The cost of *restoring* the damaged resource to its original state; and,
2. The *compensation* of interim losses from the time of damage until full recovery.

Figure 8.1 shows both the restoration costs as well as the interim costs (referred to as unavoidable natural resource losses). In the absence of intervention, natural recovery could take place in this hypothetical case but complete recovery would take much longer. The additional foregone natural resource benefits in this case are referred to as the 'avoidable natural resource losses'. Unless the restoration costs are exorbitant, damage claims based on the sum of restoration costs and compensation of interim losses are both economically justified and fair.

The interim losses need to be assessed on a case-by-case basis and depend on the extent of damage incurred by the goods and services that the ecosystem provides at that specific location. It will in any case be lower than the Total Economic Value of the area affected. Restoration costs also vary considerably. Cases on coral reef damage in Florida show that these can range from $550 to over $10,000 per square metre.

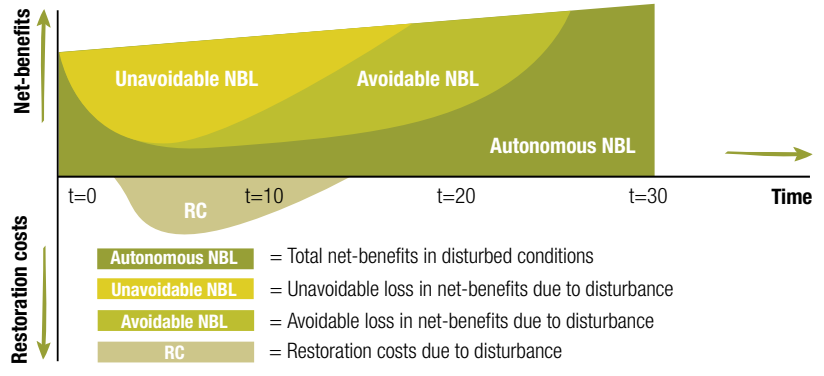


Figure 8.1 Illustration of damage assessment

Both the unavoidable and avoidable natural resource losses are difficult to assess. This is true both for the ecological and the economic assessment. In the case of coral reef damage, for instance, there can be major uncertainties with respect to possible ecological phase shifts with enormous implications for property values of adjacent coastal areas. In this case, even rather high restoration costs seem economically justified.

Communication tool

The legitimacy of the economic valuation method for use in these circumstances is critical to communicate. The NOAA Blue Ribbon Panel, and more recent guidance should be used in developing the tools, and the quality of the research should be communicated.

It is important to focus on the benefits that the compensation will bring, i.e. if the compensation will be used to replant mangroves, clear up an oil slick, clean a polluted river, the economic, social and environmental benefits should be highlighted, i.e. the jobs created and the economic benefits as well as the restoration of the environment.

8.5 Extracting financial revenues

Valuation of ecosystem goods and services can be used to set taxes or charges for the use of those goods and services. Setting taxes or charges has a double role in terms of environmental management. They help to control the extent to which environmental resources are exploited (i.e. the more a resource costs the less it is used) and simultaneously generate revenue that can be used to pay for management, protection and restoration of the ecosystem. Valuation results can be used to set taxes or charges at the most desirable level.

Typical key messages

Typical key messages that economic valuation can provide in the context of financial instruments include:

1. *Setting a tax on environmentally harmful activities will help restrict the activity:* Many activities may harm the environment. For example, driving a car causes air pollution, noise, and congestion. By estimating the value of environmental impacts it is possible to set taxes on the activities that cause harm in order to discourage them (e.g. tax on petrol). It is not necessarily the case that harmful activities need to be stopped completely, but setting taxes equal to the value of damage will restrict the activity to a socially optimal level.
2. *Economic valuation can set the price for use of a resource:* For ecosystem goods and services that are not traded, such as the recreational opportunities provided by a coral reef, it can be difficult to identify a price for their use. Economic valuation can be used to find a price that is optimal financially and environmentally. Revenues from user fees can be used to protect and restore the ecosystem being used and also for compensating people who lose out from conservation. The collection of user fees provides an incentive for people living within or near an ecosystem to help conserve it.

Typical audience

The audience for economic valuation in the context of financial instruments is diverse (see Table 8.5). On the one hand, beneficiaries of the ecosystem consisting of tourists and local users generally have an interest in protecting the environment and therefore may be willing to contribute to its conservation. On the other hand, managers and government officials may want to explore the optimal level of charging or taxation to generate funds for environmental management. Similarly, the tourist industry may be apprehensive about increasing the costs for visitors further because it can impact their business. At the same time, it is also in the interest of the tourist industry to maintain a healthy ecosystem, since it is an important element of the packages they sell.

Table 8.5 Audiences and their interests in the context of financial instruments

Audience	Interest in the resource	Use of the valuation study
Local residents and users / Tax payers	• Lost benefits or expected gains from direct and indirect use of ecosystem services	• To bring these stakeholders on board to support a user/extraction charge • To show that a fair process was involved in generating the charge
Government / Park managers / tourist industry	• Long term sustainability of the resources • Opportunity to extract economic revenues • Marketability of the ecosystem	• An indicator to show how the government is managing its resources (for internal monitoring and external review) • To set the appropriate charge for use of the resource • To demonstrate impact of charge on visitor numbers

Valuation data and alternative indicators

The valuation data required for setting a tax on an environmentally harmful activity is the value of damage per unit of activity. For example in the case of driving a car, the value of air pollution per mile driven can be calculated. This can then be converted into a tax per litre of petrol. In this way the price of the harmful activity reflects the full social cost of the activity.

The valuation data required for setting charges or user fees for beneficiaries of an ecosystem service is the value of their benefit from using the resource. For example, the willingness to pay of recreational divers to visit a coral reef might be used to set the level of a user fee. If a fee is set too high, it will completely stop divers visiting the reef. If it is set too low, it will not generate much revenue and will have no impact on the number of visitors. It is therefore useful to know what beneficiaries are willing to pay.

In addition to collecting local information on willingness to pay for environmental services, data on comparable user fees in other parts of the world is useful information in setting fees, particularly for foreign tourists.

Additional considerations in designing and setting tax and user fee schemes include: (1) The impact of reforming economic instruments varies widely between countries because of the different levels of legal enforcement of the collection of taxes and charges; (2) Taxation and charging is a highly disputed area of public policy because it creates winners and losers among individuals and businesses. The analysis of economic instruments should therefore pay a great deal of attention to the issue of the distribution of costs and benefits across different sections of society; (3) It is important to assess how people will adjust their behaviour and use of a resource under different levels of tax or charge, i.e. how sensitive people are to price changes; (4) The institutions involved in collecting, managing, and spending revenues are important in determining the acceptability of the tax or charge. It is important to gain public acceptance and support for environmental charges.

Communication tool

Proposing a new environmental tax or charge or reforming an existing one involves communicating with the relevant tax levying authority. This may be the central or local government finance department in the case of a tax or the park management authority in the case of a user fee. In both cases, a clear report of valuation results and details of the proposed tax or charge will be needed. Details should include the level of the charge, the estimated total revenue collected, the method and cost of collection, the institution responsible, the charge payers, the use of revenues, and the recipients of revenues.

Introducing a new tax or charge also involves communicating the motivation and benefits of the scheme to the people who pay in order to gain public support and acceptability. This can be done through an information campaign involving public meetings, flyers, and newspaper advertisements.

example

Example Box 8.1: Bonaire Marine Park – self-financed through user fees

Bonaire is a small island (288 km^2) situated in the Southern Caribbean. It is surrounded by fringing reefs that are easily accessible and have provided the island with a valuable resource for the tourism industry. The accessibility of the reefs also makes them vulnerable, being so close to shore, the reefs are affected by runoff from land, poor wastewater disposal, and seepage from septic tanks and overflow systems. The Bonaire Marine Park (BMP) covers the marine environment from the high water mark down to 60 metres and includes all 2700 hectares of coral reefs, mangroves and seagrass beds. It is a multiple use park with fishing and diving restricted to certain zones. It was established in 1979 with initial start-up funding for 4 years, which enabled a mooring system to be installed. The park functioned until funds ran out and, although supported by dive operators, it became little more than a 'paper park'.

BMP was revitalized in 1991 under the condition that the park had to be self-financing within a new 3-year term of funding. Self-financing was achieved by the end of 1992 when a $10 diver fee was introduced. The park has almost managed to eliminate destructive practices such as anchoring, spear fishing and coral collecting. The income generated from the $10 diver fees (through the sale of the diver badges) covers the salaries and operational costs of the park. For specific projects, the Park has to look to grant funding agencies for support. Income from divers has gradually increased as the number of divers has been increasing. The $10 fee remained in place until fairly recently, when it was raised to $25. Earlier valuation studies in 1991 showed that the fee could be increased, and that tourists would still be willing to pay.

Source: Dixon et al. (1993).

Practical information

Photo: Praveen Wignarajah

9 Practical information

What you will learn in this section:

- How to implement a valuation study in practice
- When and how to hire consultants to help you with your valuation study
- The role of communication in enhancing the impact of your study
- Where to go for more information on valuation and the case studies used in this toolkit
- What the impenetrable economics jargon all means!

9.1 Introduction

As explained in Chapter 5, when planning a valuation study, it is necessary to balance the benefits of using the best scientific and analytic techniques with the financial, data, time and skills limitations to be faced. To support readers with limited resources and experience in valuation to undertake a robust and appropriate study in a small island context, this section provides practical advice on conducting a valuation study. This includes advice on how to write a "terms of reference", when to employ a consultant and how to find one, what deliverables are required, and an indication of how long valuation studies take and how much they cost. This section also includes references to other guidelines and case studies for those who want to learn more about valuation.

9.2 How to implement a study

When to use external support and how to find good consultants

The limited human resources in many small island governments means that even when the skills exist in-house to undertake an economic valuation, the personnel may not be available. Before looking outside of government, a search should be made within the government to ascertain whether the skills (and time availability) exist in another department. If, having investigated these possibilities, there is no internal resource available, then consultants can fruitfully fill this personnel-gap.

When describing the work requirements to a consultant the following need to be clearly communicated:

- The purpose of the assignment.
- The project management arrangements, including management of deliverables and expectations.
- The means by which skills/expertise will be transferred to in-house staff (if appropriate).
- The proposed division of work between the external consultant and any in-house staff assisting them.
- How the consultant's performance will be reviewed.
- How the results of the consultancy will be implemented and monitored.
- To whom the results will be communicated.

In-house (environmental) economists can be used to draft the terms of reference for external consultants, and to apply quality control in monitoring their work.

Once the decision has been made to hire external consultants, finding the appropriate assistance can sometimes prove a challenge. Good places to start can include university economics faculties, special research institutes, international environment or development NGOs, or private consultancy organizations.

information

Possible sources of environmental economists for consultancy
There are a number of networks of environmental economists that can be tapped for finding good consultants:
• EEPSEA: Economy and Environment Program for Southeast Asia **http://www.idrc.ca/en/ev-7199-201-1-DO_TOPIC.html**
• SANDEE: The South Asian Network for Development and Environmental Economics **http://www.sandeeonline.org/**
• LACEEP: The Latin American and Caribbean Environmental Economics Program. **http://www.laceep.org/**
• PREM: The Poverty Reduction and Environmental Management (PREM) programme. PREM is active in Asia and Africa. **http://www.prem-online.org/**
• UKNEE, the UK Network of Environmental Economists. **http://www.eftec.co.uk/**
• IUCN/WWF Biodiversity Economics Site: A directory of environmental experts can be found at **www.biodiversityeconomics.org.**

What deliverables are required?

The required deliverables from an economic valuation study will depend on the research question at hand and the intended application of the results. Consideration of these deliverables should be carefully considered when designing a communications strategy early on in the planning stages of the valuation study.

*For information on **how to incorporate stakeholder preferences into an economic valuation**, go to Chapter 3*
*For information on **how to develop a communications strategy**, see later in this section*

Potential deliverables include:

- *Report of research results*. It is generally useful to have a detailed report of the valuation research including descriptions of the methodological approach, data collection, analysis, results, and policy conclusions. The report should include a short, descriptive and accessible executive summary as well as detailed technical information to allow the results to be scrutinised.
- *Database of valuation results*. This is very important for small islands so that collected information does not get lost but is archived for possible future repeated studies.
- *Policy briefs* provide a condensed, easy to understand summary of key results and policy recommendations arising from the valuation study. This is useful for dissemination of results and reaching a wider audience.

Policy brief for Turks and Caicos Islands online
For a good example of a colourful and easy to read policy brief on "Economic Valuation of Environmental Resource Services in the Turks and Caicos Islands", see **http://www.environment.tc/information/reading/consultancy_rep/naturalresources&economy.htm**

- *Other products* such as powerpoint presentations with detailed notes on the study and the results; written press releases for the media; sample interview responses for media coverage; video footage of study area and stakeholders perspectives on the study; stakeholder workshops (see Chapter 3 on stakeholder engagement).

How to write terms of reference?

A "Terms of Reference" (TOR) is a document that describes the purpose and structure of a project, with clearly defined roles and responsibilities for core project staff. A TOR is usually written during the initiation phase of a project and defines the:

- Vision, objectives, scope and deliverables (i.e. what has to be achieved);
- Stakeholders, roles and responsibilities (i.e. who will take part in it);
- Resources, financial and quality plans (i.e. how it will be achieved); and,
- Work breakdown structure and schedule (i.e. when it will be achieved).

The Terms of Reference sets out a roadmap for the project. It gives the project team a clear path for the progression of the project, by stating what needs to be achieved, by whom, how and when. The project team must then create a suite of deliverables, which conform to the requirements, scope, and constraints set out in this document. When external consultants are employed to work on a project, the TOR describes the work they are expected to do and the outputs they should deliver. It is therefore very important to write a clear and detailed TOR for a valuation study in order for all participants to know who is responsible for what and when they should deliver their work. An example of a typical TOR for a consultant who will conduct the economic analysis for a hypothetical valuation study is provided below.

Template: Terms of Reference for an economist
1. Description of the background to the study
2. Description of the purpose of the study
3. Description of the steering group and main role and responsibilities
4. Tasks and Responsibilities of the consultants
   - Organise, support and supervise the collection by a survey team of economic data related to the use and non-use values of ecosystem goods and services at the study site
   - Analyse the survey data to determine the economic value of ecosystem goods and services from the study site (giving the results as US$ per hectare per year).
   - Compare the results of the value of ecosystem goods and services under a conservation scenario with that under a scenario in which half of the current ecosystem is lost
5. Qualifications required of consultants
6. Deliverables and time frame for completion
7. Support provided in-house
8. Budget available for the study

How much time does a study take?

To provide a sense of how long studies can take (from the shortest to the longest) some of the times taken to complete a variety of studies and the resources used to complete them are shown below, see Table 9.1.

	Case study 1	Case study 2
Type of valuation exercise	WTP for conservation among 600 visitors	TEV for coral reefs of island
Location of valuation exercise	Seychelles	Saipan
Type of activities	Survey at the airport	Surveys, country statistics
No. of people involved	One economist, four interviewers, one data-enterer	Two economists, two social scientists, four interviewers, GIS expert
Total human resources used	80 mandays	200 mandays
Total cost(US$)	Total $21,000 [a]	Total $80,000 [b]
Time taken(Days)	3 months	16 months

Table 9.1 Examples of case studies conducted for the Seychelles and Saipan

[a] Questionnaire $2,500, Interviewers $6,000, Data-entry& cleaning $500, Analysis $4,000, Report writing $3,000, Travel costs $5,000.
[b] Questionnaires $4,000, Interviewers $12,500, Data-entry& cleaning $1,500, GIS analysis $10,000, Data purchase $2,000, Analysis $15,000, Report writing $15,000, Travel costs $15,000, Policy brief $5,000.

It is often very useful to specify the timing of each step in an economic valuation study in order to have a clear plan of how components of the study fit together, when deliverables will be provided, and as a means of assessing progress. A common and useful means of setting out a time plan for a valuation study is to use a 'Gantt diagram', which represents each step in the study implementation and the time at which it takes place. A simple example Gantt diagram is shown in Table 9.2.

	Months						
Activity	1	2	3	4	5	6	7
Identify key ecosystem services	X						
Design valuation study(ies)		X					
Implement valuation study(ies)			X	X			
Analyse results and formulate recommendations					X		
Write up final report						X	
Dissemination of results and recommendations							X

Table 9.2 Gantt diagram for time planning of a relatively small valuation study

Resources required for an economic valuation study

The answer to the question 'how much does an economic valuation cost?' unfortunately has the same answer as the question 'how long is a piece of string?' All studies are constrained by the resources available; this is the same in every country and in every context. The valuation exercise can always be shaped to meet the resource availability.

Economic valuation studies can be expensive. Large sample surveys in particular are labour intensive and therefore costly. One possibility to reduce the costs of implementing a questionnaire is to train and use students as interviewers. This can also be an educational

experience for the students if they are included in the survey design and analysis processes.

In the case that resources are limited, it can often be helpful to adopt an iterative approach to investigating ecosystem values. An initial scoping study should seek to provide a brief overview of the ecosystem functions and values that are important, thereby paving the way for more in-depth research into key impacts.

How to communicate the results to stakeholders

What researchers or consultants often forget is that communications can be as important as the content and quality of the analysis. Therefore it is important to plan communication from the beginning of the project, especially if the main motivation of the study is advocacy. Because a lot has already been said in this toolkit about communication, we will only reiterate the main steps that should be part of a communication plan.

Step 1: Formulate the *main message* that you convey: Keep it simple and do not try to be too comprehensive or all encompassing. It is better to get across one message that sticks than five messages that slip from peoples minds as soon as they leave the room;

Step 2: Identify your *audience* and determine how they currently think about the issue. The stakeholder engagement phase of the study is an excellent opportunity to do this (see Chapter 3);

Step 3: Decide on a *strategy* to get your message across to your audience. Decide in advance which will be the main economic values or indicators to be communicated (e.g. cost benefit ratio, total economic value) and which additional information will be used (e.g. employment, income distribution). See Chapter 8.

Step 4: Select *tools* to communicate your message to your audience. The "deliverables" section of this chapter (Section 9.2) already mentioned policy briefs and presentations as effective communication tools. Other tools are radio interviews, a webpage on the internet, or even the production of a short movie about the subject matter. Through these latter tools, a much wider audience can be reached than with any report or publication.

Information

Short documentaries on the economic importance of nature
For a good example of an affordable and easy way of communicating the results of research in the field of environmental economics by means of policy briefs and documentaries, see **http://www.prem-online.org/** and go to ***Vietnam***

9.3 Specialised guidelines, manuals and references used

Many different case studies and guidelines have been used in this toolkit to reflect the variety of ecosystem services that are provided and valued on small islands. The studies used, references cited and additional sources are listed below.

Biodiversity conservation

- Economics and the Conservation of Global Biological Diversity (1993). By Brown, K., Pearce, D., Perrings, C., and T. Swanson, Global Environment Facility; United Nations Development Programme; United Nations Environment Programme; World Bank. Not available online.
- Making economics work for biodiversity conservation. (2005). By Biological Diversity Advisory Committee, Department of the Environment and Heritage. Land & Water Australia. **http://www.environment.gov.au/biodiversity/publications/economic-valuation/pubs/conservation.pdf**
- Economic Values of Protected Areas: Guidelines for Protected Area Managers. No. 2. Task Force on Economic Benefits of Protected Areas for the World Commission on Protected Areas (WCPA) (1998). By IUCN in collaboration with the Economics Service Unit of IUCN, 1998, xii + 52pp. **http://www.iucn.org/dbtw-wpd/edocs/PAG-002.pdf**
- Handbook of Biodiversity Valuation: A Guide for Policy Makers. (2002) By Pearce, D.W., Moran, D., Biller, D., Organisation for Economic Co-operation and Development (OECD), Working Group on Economic Aspects of Biodiversity. p.156. Case studies can be downloaded from: **http://www.oecd.org/document/11/0,2340,en_2649_34285_34312139_1_1_1_1,00.html**
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Coastal zone

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- Trade-off Analysis for Participatory Coastal Zone Decision-Making. (2001) By Brown, K., Tompkins, E. L. and Adger, W. N. Norwich, U.K., Overseas Development Group. Publications Office, ODG, UEA, Norwich, NR4 7JT, UK
- Economic Valuation of Natural Resources: A Guidebook for Coastal Resources Policymakers. (1995) By Lipton, Douglas W., Katherine Wellman, Isobel C. Sheifer, and Rodney F. Weiher, NOAA Coastal Ocean Program Decision Analysis Series No. 5. Silver Spring. **http://www.mdsg.umd.edu/Extension/valuation/handint.htm**
- Economic Valuation of Coral Reefs and Adjacent Habitats in American Samoa: Final Report (2004) By Jacobs, US Department of Commerce. **http://doc.asg.as/crag/ASCoralValuation04.pdf http://doc.asg.as/crag/ASCoralValuation04_Appendix.pdf**
- Economic Valuation of the Terrestrial and Marine Resources of Samoa (2001) By Mohd-Shahwahid H.O. A, report to the Division of Environment and Conservation, Department of Lands, Survey and Environment, Government of Samoa. **http://www.wwf.org.uk/filelibrary/pdf/econ_samoa.pdf**
- Assessment of Economic Benefits and Costs of Marine Managed Areas in Hawaii, (2004) By Cesar, H., van Beukering, P. and Friedlander, A. Hawaii Coral Reef Initiative Research Program, NOAA. **http://marineeconomics.noaa.gov/Reefs/execsumm.pdf**

Fisheries

- Measuring the Benefits of Domestic Tuna Processing (2006) By Campbell, H. Paper presented to the Tuna Management Workshop for the Pacific Islands, September 25-26, 2006, Australian National University. **http://peb.anu.edu.au/pdf/PEB21-3campbell.pdf**

Mineral extraction

- Kiribati Technical Summary. Report of Economic Analysis of Aggregate Mining on Tarawa (2007). By Greer, R. EU EDF 8 – SOPAC Project Report 71b, Fiji. **http://www.sopac.org/data/virlib/ER/ER0071b.pdf**
- Economic Assessment of the True Costs of Aggregate Mining in Majuro Atoll Republic of the Marshall Islands (2006) By McKenzie, E, Woodruff, A. and McClennen, C., SOPAC Technical Report 383. **http://www.sopac.org/data/virlib/TR/TR0383.pdf**

Tropical forests

- The Economic Valuation of Tropical Forest Land Use Options: A Manual for Researchers (2002) By Bann, Camille, EEPSEA. **http://www.idrc.ca/uploads/user-S/10916232241spcbann1.pdf**
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Wetlands

- Economic Valuation of Wetlands, a guide for policy makers and planners (1997) By Barbier, E.B., M. Acreman, D. Knowler. Ramsar Convention Bureau, Gland, Switzerland. **http://www.ramsar.org/lib/lib_valuation_e.pdf**
- The Socio-economics of Wetlands (2002) By Stuip, Baker and Oosterberg. Wetland International, RIZA, RAMSAR. **http://www.wetlands.org/getfilefromdb.aspx?ID=e86956a6-4ab7-496e-91ba-374a1f027e69**
- An Economic Valuation of Watershed Pollution in Rarotonga, the Cook Islands (2005) By Hajkowicz, S. and Okotai, P. International Waters Project of the Cook Islands, SPREP. **http://www.sprep.org/att/publication/000517_IWP_PTR18.pdf**
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Waste management

- Economics of Liquid Waste Management in Funafuti, Tuvalu (2006) By Lal, P. Saloa, K. and Uili, F. Pacific Islands Forum Secretariat, SPREP and IWP-Tuvalu. **http://www.sprep.org/att/publication/000522_IWP_PTR36.pdf**
- Economic Costs of Waste in Tonga (2005) By Lal, P. and Takau, L. Pacific Islands Forum Secretariat, SPREP and IWP-Tonga. **http://www.sprep.org/solid_waste/documents/Economic%20costs%20of%20waste%20-%20Tonga.pdf**

Water supply

- Value: counting ecosystems as an economic part of water infrastructure (2004) By Emerton, L., E. Bos. Gland, Switzerland and Cambridge, UK, IUCN. **http://www.iucn.org/themes/wani/pub/VALUE.pdf**
- Economic valuation of water resources in agriculture, From the sectoral to a functional perspective of natural resource management (2004) By Turner, K., S. Georgiou, R. Clark, R. Brouwer. FAO, Rome. **http://www.fao.org/docrep/007/y5582e/y5582e00.htm**
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9.4 Web links and further reading

Communications information

- Your guide to communicating climate change (2006) DEFRA, UK Government http://www.climatechallenge.gov.uk/multimedia/communicating_climate_change.pdf
- The Green Buck. Using economic tools to deliver conservation goals: a WWF field guide (2005) Tom Le Quesne and Richard McNally. WWF-UK. **http://www.wwf.org.uk/filelibrary/pdf/thegreenbuck.pdf**

Data sources and natural resource monitoring

- *Global Development Research Center Tools for Environmental Management:* **http://www.gdrc.org/uem/e-mgmt/cover.html**
- *International Association of Impact Assessment*: **www.iaia.org**
- *The Conservation Finance Alliance*: **www.conservationfinance.org**
- *The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States.* **http://ccma.nos.noaa.gov/ecosystems/coralreef/coral_report_2005/**
- *Tropical Rain Forest Information Center (TRFIC):* **http://www.trfic.msu.edu/**
- *WWF and IUCN:* **www.biodiversityeconomics.org**. Within this site see the Biodiversity Economics Basics **http://www.biodiversityeconomics.org/library/basics/index.html**
- *WWF-US Center for Conservation Finance*: **www.worldwildlife.org/conservationfinance**

Environmental financing

- From good-will to payments for environmental services: A survey of financing alternatives for sustainable natural resource management in developing countries, ed. Pablo Gutman, Danida and WWF, August 2003. **http://assets.panda.org/downloads/fin_alt.pdf**
- Making markets work for forest communities, Sara Scherr, Andy White and David Kaimowitz, Forest Trends, 2002. **http://www.earthscape.org/p1/ES16909/markets_work.pdf**

Environmental taxation

- A review of OECD country experience and prospects for economies in transition, A. Markandya and Z. Lehoczai, REC, 2000. **http://www.rec.org/REC/Publications/PaperSeries/Paper1/cover.html**
- Selling Forest Environmental Services: Market-based Mechanisms for Conservation and Development, ed. Stefano Pagiola, Earthscan Publications, 2002. Not available online.

Impact assessment

- *Guidelines on biodiversity-inclusive Environmental Impact Assessment (EIA):* **http://www.biodiv.org/doc/reviews/impact/EIA-guidelines.pdf**
- *Guidelines for environmental impact assessment (EIA) in the Arctic*: This guide provides very clear and straightforward guidance on how to do an impact assessment: **http://www.nepa.gov/nepa/eiaguide.pdf**

Small island impacts

- *Global Conference On The Sustainable Development Of Small Island Developing States*: Report of the Global Conference On The Sustainable Development Of Small Island Developing States, Bridgetown, Barbados, 25 April-6 May 1994: **http://www.un.org/documents/ga/conf167/aconf167-9.htm**
- *Small island developing states network (SIDSnet):* SIDSnet is the global network for small island developing States service provided by the UN Department of Economic and Social Affairs. **http://www.sidsnet.org/**

Stakeholder analysis

- How to do stakeholder analysis – a guidance note. Overseas Development Administration, UK. **http://www.euforic.org/gb/stake1.htm**

Valuation in practice

- How much is an ecosystem worth? Assessing the economic value of conservation, Stefano Pagiola, Konrad von Ritter and Joshua Bishop, The International Bank for Reconstruction and Development/The World Bank, October 2004. **http://biodiversityeconomics.org/document.rm?id=710**

10

Glossary of terms

Photo: Praveen Wignarajah

Bayesian approach: An approach to value transfer that provides a systematic way of incorporating study case information with policy case information.

Benefit Cost Ratio (BCR): A measure of project desirability or profitability: the ratio between the discounted total benefits and costs of a project.

Benefits transfer: The practice of estimating economic values for ecosystem services by transferring value information from existing studies for one location (the study site) to another (the policy site. This is also called 'value transfer'.

Bio-economic model: A model of ecological and socio-economic reality that allows us to express the consequences of different management regimes on ecosystem values.

Choice experiment valuation methods: A stated preference technique for valuing ecosystems or environmental resources that presents a series of alternative resource or ecosystem use options, each of which is defined by various attributes including price, and uses the choices of respondents as an indication of the value of ecosystem attributes.

Choice Modelling valuation method: A stated preference valuation method in which values are inferred from the hypothetical choices or tradeoffs that people make between different combinations of attributes of a good. Data for choice modelling valuation is obtained through surveys of individuals.

Consumer Surplus: The difference between what consumers are willing to pay for a good and its price.

Consumptive use: The consumption of a good or service so that less remains for others to use.

Contingent Valuation methods (CVM): A stated preference valuation technique that elicits expressions of value from respondents for specified increases or decreases in the quantity or quality of an environmental good or service, under the hypothetical situation that it would be available for purchase or sale.

Cost-Benefit Analysis (CBA): A decision tool which judges the desirability of projects by comparing their costs and benefits.

Cost-effectiveness analysis (CEA): A decision tool that judges the desirability of a project according to the cost of attaining a particular objective.

Damage assessment: The determination of the extent of economic and environmental damage caused by natural hazards or human activities.

Damage cost avoided valuation method: A cost based valuation technique that estimates the value of ecosystem goods and services by calculating the damage that is avoided to infrastructure, productivity, or populations by the presence of ecosystem services.

Decision support tools: Methods to combine the valued impacts of a project or decision into a single measure in order to assist the decision making process.

Dependent variable: In a statistical equation, dependent variables (e.g. age, gender, income) explain some of the causes of change in an independent variable (e.g. choice of holiday).

Design bias is bias that results from the way in which information is provided in a contingent valuation survey. For example, a survey may provide inadequate information about the hypothetical scenario, or respondents can be misled by its description.

Direct use value: The value of environmental and natural resources that are used directly as raw materials and physical products for production, consumption and sale.

Disaster: A hazard event that has a profound impact on local people or places either in terms of loss of life or injuries, property damages, or environmental impact.

Discount rate: The interest rate used to determine the present value of a future stream of costs and benefits. The formula for discounting or calculating present value is: present value = future value/$(1+r)^n$, where r is the discount rate and n is the number of years in the future in which the cost or benefit occurs.

Discounting: The process of calculating the present value of a future stream of benefits or costs, using a discount rate.

Double counting: An error which occurs when costs or benefits are counted twice.

Economic CBA: Examines the effects of projects, investments, and policies on costs and benefits to society as a whole.

Ecosystem services: Ecosystem services describe the benefits that ecosystems provide to people.

Ecosystem: An ecosystem is a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.

Environmental Economics: Environmental economics is a subfield of economics concerned with the relationship between the economy and the environment. It studies the allocation and management of scarce natural and environmental resources in an optimal manner, accounting for externalities.

Exclusive Economic Zones: A maritime area over which a state has special rights to the exploration and use of marine resources, usually extending approximately 200 nautical miles from the coast.

Existence values: The value of environmental or natural resources, regardless of their current or future use possibilities.

Expected value: The average amount one "expects" when the outcome of an event is uncertain. In probability theory the expected value of a random variable is the sum of the probability of each possible outcome multiplied by the value of each outcome.

Externality: Occurs when a decision causes costs or benefits to individuals or groups other than the person making the decision. For example, a firm that is polluting surface water in the course of its production, may lead to nuisance or harm to others, thereby causing a negative externality. A positive example of an externality is a beekeeper, keeping bees for their honey, enhancing pollination of surrounding crops by the bees.

Extractive use: Use of a good or service that leaves less for others to use. Non-consumptive or non-extractive uses utilise the services of an ecosystem without extracting any elements from the same ecosystem.

Financial CBA: Examines the effects of projects, investments, and policies on the costs and benefits accruing to a particular individual or group, valued in financial prices.

Hazard: A threat to people and the environment. Environmental events become hazards once they threaten to affect society and/or the environment adversely

Hedonic Pricing valuation methods: A valuation technique that values ecosystem goods and services by relating their presence or quality to other prices, for instance housing property or wages.

Hurwicz a-criterion: The Hurwicz criterion for decision making under uncertainty attempts to find a compromise between the extremes posed by optimist (maximax) and pessimist (maximin) criteria. The Hurwicz criterion takes the weighted average of the minimum and maximum outcomes of each alternative option using weights that reflect the decision maker's optimism regarding the outcome of events, and suggests that the alternative with the highest weighted average should be selected.

Impact assessment: A process that identifies, predicts and assesses the consequences of a project or policy.

Indirect use value: The value of environmental services which maintain and protect natural and human systems.

Instrument bias arises in a contingent valuation survey when respondents react strongly against the proposed payment methods. Respondents may for instance resent new taxes or increased bills.

Internal Rate of Return (IRR): A measure of project desirability or profitability: the discount rate at which a project's Net Present Value becomes zero.

Interval analysis: Is a means of dealing with unknown parameter values by specifying the upper and lower bounds within which a parameter value can fall. It is similar to real number analysis except that the unknowns are defined by ranges.

Marginal Cost: The change in cost associated with producing one additional unit of a good or service.

Marginal Value: The change in value resulting from one more unit of a good or service produced or consumed.

Market Price valuation method: A valuation technique that uses the market price (how much it costs to buy, or what it is worth to sell) of environmental goods and services.

Maximax Criterion: The Maximax criterion for decision making under uncertainty selects the alternative that maximizes the maximum outcome.

Meta-analysis approach: An approach to value transfer that is generally seen as the most rigourous method. Meta-analysis is a statistical method of combining a number of valuation estimates that allows the analyst to systematically explore variation in existing value estimates across studies. Key variables from the policy case are inserted into the resulting value function.

Minimax Criteron: The Minimax criterion for decision making under uncertainty selects the alternative that minimises the maximum possible loss. Alternatively, it can be thought of as maximizing the minimum gain (maximin).

Monte Carlo simulation: A simulation method that randomly generates values for uncertain variables over and over to simulate different outcomes.

Multi-criteria analysis: A decision tool that integrates and weights different types of monetary and non-monetary information, based on ecological, social and economic criteria.

Net factor income valuation method: Estimates the value of an ecosystem input in the production of a marketed good as the total surplus between revenues and the cost of other inputs in production.

Net Present Value (NPV): A measure of project desirability or profitability: the sum of discounted net benefits and costs of a project.

Non-use value: An economic value attached to an environmental or natural resource that is not based on the tangible human use of the resource. Non-use values may include existence values, bequest values, altruistic values, and option values. Non-use value is sometimes called a passive use value.

Opportunity Cost: The value to the economy of a good, service or resource in its next best alternative use.

Option values: The premium placed on maintaining environmental or natural resources for future possible uses, over and above the direct or indirect value of these uses.

Pilot Analysis of Global Ecosystems (PAGE): The Pilot Analysis of Global Ecosystems (PAGE) takes stock of the earth's ecosystems, describing their extent, their condition, and their capacity to provide goods and services that people use. Add weblink.

Point estimate approach: An approach to value transfer that involves taking the mean value (or range of values) from the study case and applying it directly to the policy case. As it is rare that a policy case and study case will be identical, this approach is not generally recommended.

Precautionary principle: Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

Production function valuation method: Estimates the value of a non-marketed ecosystem product or service by assessing its contribution as an input into the production process of a commercially marketed good

Property rights: A property right describes the ownership of a resource, which can be: public, private, shared or open. A property right entitles the owner to: use the good; earn income from the good; or transfer the good to others. These rights can be held by a single person or collective.

Public Good: A good whose benefits can be provided to all people at no more cost than that required to provide it for one person. The benefits of a public good are indivisible, and people cannot be excluded from enjoying them.

Purchasing power parity (PPP): A purchasing power parity exchange rate equalizes the purchasing power of different currencies in their home countries for a given basket of goods. The PPP is often used to compare the standards of living of two or more countries.

Rapid research approach: A process of learning about local conditions where outsiders use a range of methods, tools and techniques to gain information from rural people quickly and cheaply.

Regression analysis: A statistical method to explain the relationship of a dependent variable to specified independent variables or predictors. In hedonic pricing, the house price is the dependent variable, while the quality of the house and the neighbourhood are typical independent variables. The mathematical model of the relationship is the regression equation.

Replacement Cost valuation method: A valuation technique that assesses ecosystem values by determining the cost of man-made products, infrastructure or technologies that could replace ecosystem goods and services.

Resilient: A system is resilient if it is able to buffer disturbance and maintain system functioning

Ridge to reef: 'Ridge to reef' is a management practice that requires upstream impacts to be taken into account when estimating impacts on the downstream environment.

Scenario: Scenarios describe alternative futures.

Sensitivity analysis: The study of how the variation in the output of a model (numerical or otherwise) can be apportioned, qualitatively or quantitatively, to different sources of variation

Shadow Prices: Prices used in economic analysis when market price is a poor estimate of "real" economic value. This may be due to market distortions such as subsidies.

Stakeholder analysis: The process of identifying, categorising and engaging stakeholders.

Stakeholder engagement: Methods used to bring stakeholders into a deliberative or consultative process

Stakeholder: A person or group with an interest in a project or a decision.

Starting point bias occurs when the starting point of the bid amount in a contingent valuation survey influences answers that respondents provide and therefore does not represent their true WTP/WTA.

Stated Preference methods: A group of valuation techniques that involve asking individuals to state their value or preference for specific ecosystem goods and services directly.

Total Economic Value (TEV): The sum of all marketed and non-marketed benefits associated with an ecosystem or environmental resource, including direct, indirect, option and existence values.

Travel Cost valuation method: A valuation technique that takes the costs people pay to travel to a national park or ecosystem as an expression of its recreational value.

Use value: Economic value based on the tangible human use of an environmental or natural resource.

Utility: A measure of the satisfaction that is gained from a good or service.

Valuation: The practice of estimating monetary values for goods and services provided by ecosystems.

Value function transfer approach: An approach to value transfer that is refined but complex. If the study case provides a WTP function, valuation estimates can be updated by substituting applicable values of key variables from the policy case into the benefit function.

Value transfer: The practice of estimating economic values for ecosystem services by transferring value information from existing studies for one location (the study site) to another (the policy site. This is also called 'benefit transfer'.

Value: This is how much a product or service is worth to someone relative to other things (often measured in money). It can be either an assessment of what it could or should be worth (valuation), or an explanation of its actual market value (price).

Willingness to accept (WTA). WTA is defined as the minimum amount of money an individual requires as compensation in order to forego a good or service.

Willingness to pay (WTP). WTP is the maximum amount of money an individual would pay in order to obtain a good or service. An individual's WTP for a good is a reflection of his or her preferences for this good relative to other goods.

Dolphins near the coast of Maui. Photo: Pieter van Beukering

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Money speaks louder than words. Putting a monetary value on environmental and social impacts usually increases the chance of these impacts being taken into account in decision making. This toolkit provides clear guidance on how the value of the environment of small islands can be estimated and incorporated into planning and development decisions. It explains why you would undertake a study, who should be involved, how to implement the study and how to use the results. It also contains guidance on how to hire external consultants if expertise is not available in-house. It has been designed primarily for government officials and NGOs, although it is also useful for others wanting to estimate the value of ecosystems and ecosystem services.

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