Valuing the Environment in Small Islands

An Environmental Economics Toolkit

JOINT NATURE CONSERVATION COMMITTEE

OTEP

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Pieter van Beukering

Luke Brander

Emma Tompkins

Emily McKenzie

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Contents

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Cover photograph:
Harvesting of seaweed in the Solomon Islands
by Pieter van Beukering

Context

In 2007, three UK Overseas Territories – Bermuda, the Cayman Islands and Montserrat – were awarded funding by the Overseas Territories Environment Programme (OTEP) to conduct environmental valuation studies. All three Territories aim to use valuation to demonstrate the benefits of the environment for human wellbeing, and to support more sustainable decision making in small islands. These valuation studies cover a variety of issues and ecosystems typical to small islands; the contexts include marine, coastal, inland mangrove wetland, and forest ecosystems, located in Territories with varying levels of development[1]. The Territories face a range of pressing challenges that environmental valuation can help to address, thereby supporting the sustainable development goals articulated in their Environment Charters[2].

Although a large number of guides already exist on aspects of environmental valuation, none of these references specifically focus on the issues and needs of small islands. This toolkit was developed to address this gap. Its core aim is to provide a practical resource to meet the pressing needs of a group of pioneering stakeholders in Bermuda, the Cayman Islands and Montserrat who will lead valuation studies, but have no, or only limited, knowledge of environmental economics. In addition, the toolkit is designed to be of use to a wider audience of stakeholders in small islands around the world who wish to learn about practical aspects of environmental valuation, but struggle to find a reference adapted to small island contexts.

The development of this toolkit was jointly funded by OTEP and the Joint Nature Conservation Committee (JNCC). OTEP is a joint programme of the UK Government Foreign and Commonwealth Office and the Department for International Development to support the implementation of the Environment Charters and environmental management more generally in the UK Overseas Territories. JNCC is the statutory adviser to the UK Government on UK and international nature conservation, including in the UK Overseas Territories.

[1] For more details on the UK Overseas Territories valuation projects see: **http://www.ukotcf.org/OTEP/docs/OTEP2007PROJECTS.pdf**
[2] For more details on the UK Overseas Territories Environment Charters see: **http://www.ukotcf.org/OTEP/docs/general_brochure.pdf**

1

Introduction

the importance, role and framework of environmental valuation

Photo: Dreamstime.com

1 Introduction

the importance, role and framework of environmental valuation

What you will learn in this section:

- Why valuation of the environment can be useful in small islands
- The role of economic valuation in ecosystem management
- The basic framework of analysis for economic valuation
- How to use this toolkit

1.1 How can environmental valuation be useful in small islands?

Money speaks louder than words. Therefore, putting a monetary value on environmental and social impacts usually increases the chance of these effects being taken into account in decision making.

Success stories

In numerous cases, economic valuation studies proved to be the crucial step towards more sustainable development in small islands. For example:

- Valuation studies demonstrated that *self-financing* is a viable option in many Caribbean protected areas, especially those that attract large numbers of visitors. Several protected areas now have effective revenue generation strategies, and as a result are among the best managed in the region. The most successful cases in the region include Nelson's Dockyard National Park (Antigua), Bonaire and Saba Marine Park, Brimstone Hill Fortress National Park (St. Kitts), and Pigeon Island National Park (St. Lucia). Economic valuation played an important role in the establishment of these self-funded systems (e.g. Dixon et al. 1993).
- Monetary damage estimates (from economic valuation studies) were included in the legislation of penalties per square metre of coral reef damaged in the Florida Keys for reasons of *damage compensation*. Similar monetary penalties are also going to be introduced in the State of Hawaii. In both cases, the penalties are based on valuation studies (Leeworthy 1997; Cesar et al. (2001)).
- Economic valuation studies have contributed to the government of the Republic of the Marshall Islands considering a *moratorium on near-shore dredging* in Majuro Atoll. By valuing the true cost of aggregate mining activities in Majuro Atoll, it was shown that the damage from unsustainable mining in terms of lost coastal protection services is approximately US$52 per m^3. These economic damage costs are far higher than the costs of only US$36 per m^3 for aggregate obtained from more sustainable offshore sites in Majuro Lagoon (McKenzie et al. 2006).

Lagoon dredge, Majuro Atoll. Photo: Emily McKenzie

The purpose of this toolkit is to show how the value of the environment can be estimated and incorporated into decisions. Specifically, it is designed to help government officials and other stakeholders recognise the value of ecosystems and ecosystem services that might be affected by their decisions and how changes to the environment will affect the longer-term sustainable development of the island.

definition

Ecosystems and ecosystem services
An ecosystem is a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit. Ecosystem services describe the benefits that ecosystems provide to people.
Source: Millennium Ecosystem Assessment

Reasons to value the environment

Understanding the economic value of the natural environment is only one of the required elements in making good decisions about projects and policies that affect the environment. However, it can help to make the trade-offs involved more explicit. There are many reasons why an economic valuation study can be extremely useful, including:

- To raise *awareness* of the value of the environment as part of a project appraisal;
- To generate a value for the environment to be used for *policy advocacy*;
- To reveal the *distribution* of costs and benefits of projects among winners and losers;
- To design the most effective tools for environmental *management*;
- To design appropriate *charging* rates for environmental use;
- To design the best method to *extract finances* from environmental goods and services;
- To calculate possible *returns on investment*;
- To compare *costs and benefits* of different uses of the environment; and,
- To calculate damages for *compensation*

.

Is yet another toolkit really needed?

Existing economic valuation guidelines offer methods to assess the total economic value of ecosystems and the goods and services they provide. None of these other guidelines, however, focus on the issue of valuing ecosystems that are unique to small islands, or provide a set of case studies and examples that are relevant to small islands. Similarly, none of the existing guidelines provide tailored assistance on how to undertake economic valuation with limited resources and limited capacity. This toolkit was developed to address this gap.

1.2 The role of economic values in ecosystem management

Economic valuation is simply a technique to reveal how valuable the natural world is to us. Generating an economic value for the natural world begins with an understanding of all the different services that the environment can provide. In order to identify ecosystem services at the beginning of a valuation study, it can be useful to group them into four categories:

- Providing services to enable people to make a living (e.g. fisheries and forestry, both subsistence and commercial);
- Supporting human life (e.g. potable water and clean air);
- Regulating other important ecosystems (e.g. sea grass beds and mangroves which act as a nursery for juvenile fish); and,
- Having cultural significance and providing opportunities for recreation (e.g. the importance and meaning of land in some Pacific and Caribbean Islands).

Often, decisions to support economic development affect the functioning or quality of ecosystems. Although such decisions can potentially enhance short-term development, they can also reduce the supply of ecosystem services that are critical to human wellbeing and sustainable development.

Placing a monetary value on the environment

Every time we make a decision that affects the way in which the natural environment functions we are implicitly putting a value on the environment. If we choose to clear land for agricultural development, or to develop new tourism facilities, then a trade-off is made between the ecosystem services that we will forgo and the benefits that will accrue under the new development. Economic valuation of affected ecosystem services makes that trade-off explicit. Valuation reveals very clearly to decision makers what will be lost by making that decision, and how the loss will affect human well-being in the short- and long-term.

For most goods or services that we buy, we make decisions based on the price of those items. The price of the items is dictated both by their *scarcity* (think of the difference in the price of Beluga caviar which is extremely scarce, and bread which is not at all scarce) and the *demand* for those items (think of house prices going up in neighbourhoods where many people want to buy a house and house prices falling in neighbourhoods where very few people want to live). Prices reflect the supply of the good and our demand for it.

For ecosystem services and the natural environment, there are often no prices that reflect their value, as the goods and services that are provided are not traded on markets e.g. clean air. As a result we tend not to take the value of ecosystem goods or services into consideration when we make decisions that affect the natural world. When we investigate the implications of projects, such as constructing hotels, dredging for aggregate, or building a new marina, we need to fully understand the environmental as well as the financial implications of this decision. Economic valuation puts a price on ecosystem goods and services and hence reveals clearly the trade-offs that have to be made.

Demand: house prices in popular neighbourhoods are higher than prices for similar houses in less popular parts of town

Economic valuation in small island contexts

Under pressure to respond to immediate problems, but hampered by a lack of high quality information and analysis, policy makers in small islands often have to make quick decisions without full knowledge of the long term implications of their decisions. Having access to reliable information that describes the costs, values, and risks of environmental change facilitates more objective, more transparent and more informed decision making. Such information should reduce the pressure on decision makers by giving them a fuller and more balanced understanding of the economic gains from environmentally sustainable policies, projects and decisions, and the potential losses from unsustainable ones.

Economic valuation does not provide the 'correct' answer, but it does provide information to facilitate more objective decision making, therefore it should always be undertaken within the context of sustainable development. The long term economic, social, and environmental impacts of decisions should always be taken into account, not just on the immediate winners and losers, but also on people and the environment downstream, and future generations. Using economic valuation in this context reveals trade-offs that will bring the greatest benefits, and hence are more likely to enable sustainable development.

1.3 Framework for analysis

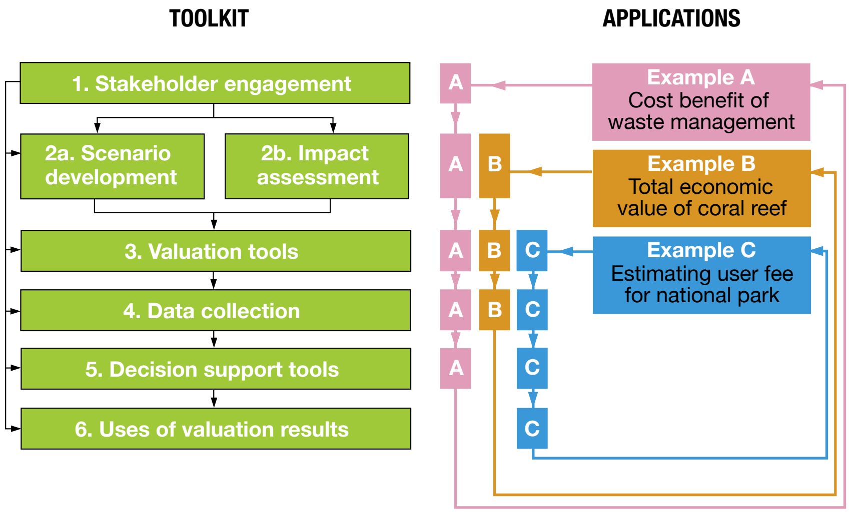
Before explaining the process of economic valuation in the small-island context, two important caveats should be remembered:

- Economic valuation is *just one element* in a decision process, along with a number of other steps that require expertise beyond the economic domain. Although the emphasis of this toolkit is on economic valuation, these other crucial elements in the decision process are also briefly explained.
- Because economic valuation is done for a variety of reasons in a variety of conditions and contexts, it is difficult to present a *uniform framework* for the economic valuation of environmental impacts for projects or policies. In other words, each new project or policy to be studied may require a slightly different approach from the previous study.

Main steps in economic valuation

Keeping these two caveats in mind, the sequence of main steps in an economic valuation and decision making process is presented in Figure 1.1.

Figure 1.1 Framework for economic analysis with several examples of applications



Step 1. Stakeholder engagement: Economic valuation focuses by definition on people's preferences. Without people, environmental goods and services do not have an economic value. Therefore, economic valuation generally requires the involvement of stakeholders at various stages of the analysis. By engaging stakeholders from the start, the final result of the economic valuation study will also be more acceptable to them. The different steps in which stakeholders may be involved include (see Chapter 3 for more details):

- *Scenario development*: stakeholders share their views on possible alternatives/futures;
- *Data collection*: stakeholders are often the main source of information;
- *Valuation methods and decision support tools*: stakeholders may be asked about their preferences in trading-off different goods and services;
- *Economic instruments*: stakeholders can share their ideas on the type of economic instrument that could be used to extract financial resources for environmental management.

Next, two steps take place simultaneously and interchangeably. These steps are scenario development (step 2a) and impact assessment (step 2b).

Step 2a. Scenario development: Economic valuation is often undertaken to influence a decision or policy. It therefore involves the evaluation of a proposed policy, project or other form of intervention. To determine the attractiveness of the proposed intervention, it is required to compare the economic feasibility of the project or policy with an alternative situation. Sometimes, the alternative involves a situation "without" the project, describing the development of the main economic, social and environmental criteria if the project is not implemented (i.e. the baseline). In other cases, the alternative involves an actual alternative project or intervention, which may also lead to changes in costs and benefits. The process of defining these alternatives is called scenario development. Be aware that without proper identification of the most relevant scenarios, the whole economic analysis may fall short in advising decision makers. Chapter 4 will elaborate this step in detail.

Step 2b. Impact assessment: After determining the scenarios, the physical impacts of each alternative need to be determined. This "impact assessment" is a process that identifies, predicts and assesses the consequences of a project or policy. Impact assessment generally generates a wide range of mostly physical data of varying nature (i.e. environmental, economic, social and cultural). The process of impact assessment is described in general terms in Chapter 4.

Step 3. Economic valuation: Economic valuation converts the physical effects identified in the impact assessment into monetary units. In this way, the range of different effects is made comparable. Because economic valuation aims to measure the wealth provided by the environment in terms of human consumption and production, the valuation is purely derived from people's preferences. The economic valuation methods developed to estimate the value of changes in the provision of environmental goods and services caused by a project or intervention are described in Chapter 5.

Step 4. Economic surveying to collect data: Although economic surveying is formally an integral part of economic valuation, we treat it separately in this toolkit because it has distinct practical implications for the economic study. Typical methods of gathering information from people include focus group discussions, key-informant interviews and household surveys. These techniques are explained in Chapter 6.

Step 5. Decision support tools: Various methods are available to combine the individually valued impacts into a single measure of each scenario's value, in order to assist the decision making process. These methods include cost-benefit analysis, multi-criteria analysis, and cost effectiveness analysis. These methods are called decision support tools or evaluation techniques. Note that evaluation techniques are different from valuation techniques because the latter values specific impacts in monetary terms, while the former combines the values in order to compare alternative scenarios. The most relevant evaluation techniques are explained in Chapter 7.

Step 6. Using valuation to influence decisions: By and large, the main reason to generate information on environmental values is to influence policy decisions about the economy, society or the environment. Valuation can be used for a number of purposes: for general advocacy; to influence specific decisions; to ensure appropriate levels of compensation for environmental damage; and, to alter incentives and extract financial revenues using economic instruments. In Chapter 8 we discuss the typical key messages, typical audience, valuation data and communication tools that are likely to be most useful and relevant for each of these different goals.

When to apply what?

You may wonder whether an economic valuation study necessarily involves all of the above steps. This is not necessarily the case. The steps that are included in the economic valuation exercise depend on a number of factors:

- The level of ambition and expected rigour of the study;
- The required level of local support for the final results;
- The budget and time available to complete the study; and most importantly,
- The goal of the valuation study.

As mentioned in Section 1.1, economic valuation can serve numerous goals, varying from policy advocacy of the economic importance of an ecosystem to calculating the appropriate user fee for a national park. In all cases, step 3 (economic valuation) and step 4 (data collection) will be mandatory. However, the preceding and subsequent steps are not always needed. This is illustrated with three examples with a varying level of comprehensiveness in the right hand side of Figure 1.1.

- *Example A* shows a comprehensive economic valuation study including a cost-benefit analysis of decisions in the field of waste management. The example concerns the choice of waste processing (such as incineration versus landfilling) to be implemented. Because the analysis will require extensive participation and cooperation from local communities and policy makers, stakeholder engagement is a necessary first step. The physical implications are also quite different between both options and therefore require accurate impact assessment and scenario analysis. Because the final choice will be based on the trade off between costs and benefits, decision support tools will also be used.
- *Example B* presents an economic valuation, which is mainly aimed at policy advocacy. In this example, the Total Economic Value (TEV) of coral reefs is estimated to demonstrate the economic importance of this threatened ecosystem. Because the outcome of the study has no direct implications for local communities, stakeholder engagement is not a priority in this study. Yet, the TEV is particularly meaningful if it compares a situation with and without conservation of the reef ecosystem. For this purpose, an elaborate impact assessment is required. The study can do without decision support tools, since the TEV of the "with and without" scenario has meaning in itself already.
- *Example C* illustrates a relatively simple valuation exercise that aims to determine the appropriate level of user fee for a national park. This will involve a survey among visitors of the national park in which respondents will be asked about their maximum willingness to pay for contributing to conservation of the reserve. The first two steps will not necessarily be required, although some stakeholder engagement may be advisable to get the support of tour operators and park managers. To introduce the planned user fee, an efficient payment system with minimal overhead costs will be needed. This stretches the economic valuation study all the way to the final step of using the results to design payment mechanisms.

Girl pouring water, Kiribati. Photo: Marc Overmars

1.4 How to use this toolkit

Who should use this toolkit

This toolkit provides information, ideas, tools and techniques for those who want to include the value of the environment in decisions but do not know where to begin. It is written to assist those with little knowledge of, or exposure to, environmental economics or valuation tools. It is primarily aimed at government officials, policy makers, and researchers on small islands who would like to learn more about environmental valuation methods. Specifically, it should assist non-economists in government and NGOs wanting to influence policy and decisions on environmental management. Those with some basic knowledge of environmental valuation techniques may find it useful to help them conduct, manage and/or use economic analysis in their jobs. Others may find it useful as a basis on which to hire and steer consultants, and indeed decide when outside consultants should be used. The toolkit may also be useful for those teaching courses on cost-benefit analysis or environmental economics on small islands.

Hiring consultants to undertake an economic valuation
If you do not feel confident to undertake an economic valuation study alone, there is a template terms of reference for consultants that is described in Chapter 9. This can be adapted as necessary to meet your needs. Go to Section 9.2 for more details.

Structure of the toolkit

Some other learning aids are used throughout the toolkit. These include:

- *Conceptual framework* – each Chapter begins with a diagram showing the reader how far they have progressed in undertaking an economic valuation exercise.

definition

Definition boxes remind the reader of important definitions. Key terms and concepts are defined for those unfamiliar with economics or valuation terminology.

example

Example boxes are used throughout the toolkit to illustrate a point or to provide details of an aspect of a particular case study.

information

Information boxes provide references to other sources the reader can go to for further information.

'Go to' indicators point the reader to places of related interest in the toolkit.

- *Visual representations* are scattered throughout the toolkit, these are small cartoons summarising the content of the section.
- *Glossary* – technical words in the text are defined in the glossary at the end of the toolkit.

2

Why do small islands require special consideration?


Photo: Praveen Wignarajah

2 Why do small islands require special consideration?

What you will learn in this section:

- The uniqueness of small island ecosystems
- Typical environmental challenges in small islands
- Typical economic development options and challenges in small islands
- Challenges associated with decision making on small islands

2.1 Introduction

definition

Small Island Developing States (SIDS)
Coastal countries that share similar sustainable development challenges, including small population, limited resources, remoteness, susceptibility to natural disasters, vulnerability to external shocks, and excessive dependence on international trade. Their growth and development is also held back by high transportation and communication costs, disproportionately expensive public administration and infrastructure due to their small size, and little to no opportunity to create economies of scale. Currently, fifty-one SIDS and territories are included in the list used by the United Nations Department of Economic and Social Affairs in monitoring the sustainable development of SIDS.

Many small islands are located in the tropics and hence are influenced annually by significant climate variability, whether in the form of tropical cyclones as in the Caribbean, Pacific and Indian Oceans; by winter storms, as in the Atlantic Ocean; or by dust storms, flooding, heat waves, and droughts. There are many small islands that also experience seismic phenomena, notably, earthquakes, volcanic eruptions and tsunamis. Most small islands have developed a natural resilience to these events and island species re-colonise areas with remarkable rapidity after such events occur. However, the combined pressure of human activity and natural hazards weakens the natural ability of small islands to recover from harmful events. Figure 2.1 describes some of the human and natural pressures affecting small islands.

Small islands exist in a very different context to larger and more geographically connected countries, making them more vulnerable to external shocks and hazards. Nonetheless they also have a unique set of characteristics that assist them in coping with these impacts. This Chapter describes the unique aspects of small island ecosystems, the main economic and environmental challenges faced on small islands, and the decision making realities.

Storm destruction Photo: Cayman Islands' Department of Environment

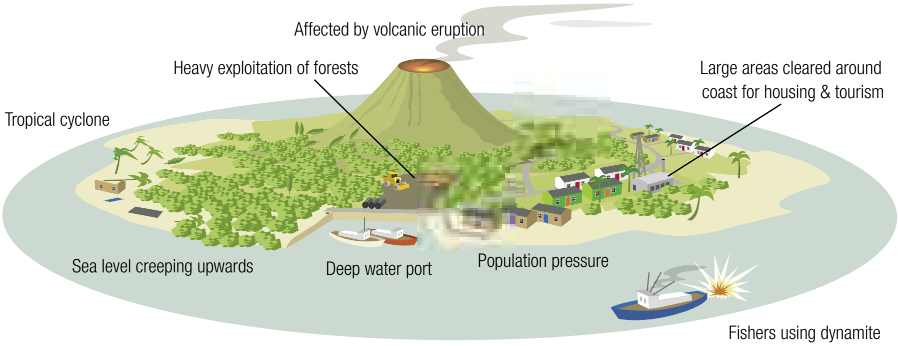
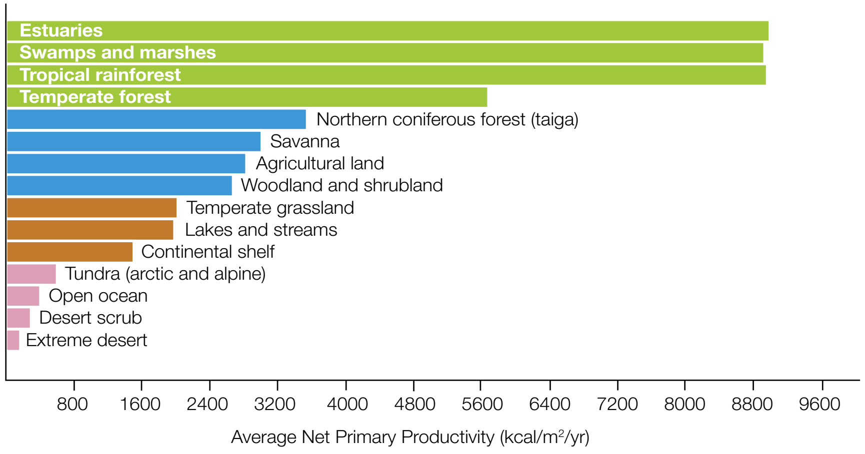


Figure 2.1 The potential pressures on ecosystems on small islands

2.2 Small island ecosystems

Island states cover 40% of the world's oceans (including their Exclusive Economic Zones), and tend to have a higher proportion of coastal area to inland area. For some of the smaller islands, the entire land area is classified as 'coastal'. This is due to the geography (often comprising mangroves, wetlands, sea grass beds, coral reefs and sandy beaches) and the small size of the island. Coastal areas, including estuaries, swamps and marshes, along with tropical rainforests are often noted for their high levels of productivity, see Figure 2.2.

Figure 2.2 Relative productivity of various ecosystems Source: Agardy and Alder (2005)



The isolation of many small islands has meant that there is often a high degree of endemism within these systems, i.e. many species are unique to specific islands. For example, Socotra (an island off Yemen), which has long been isolated from the Yemen mainland, has almost 300 endemic plants, over 30 endemic vertebrates, and more than 300 species of endemic invertebrates. Other such islands with high degrees of endemism include Madagascar, New Caledonia, and the Galapagos Islands. Since 1500, the majority of species extinctions have occurred on island systems, most often due to introduced species affecting habitats, or overexploitation. This trend has changed in recent years - now 50% of extinctions occur on continents as a result of habitat loss and degradation.

Small island ecosystems frequently experience slightly greater stress than those in mainland or larger states, in part due to their isolation, but also due to the interrelationships between terrestrial, coastal and marine ecosystems, as can be seen in highly populated small atolls such as Kiribati and the Marshall Islands. Stressors that affect one ecosystem often have profound implications for other interrelated ecosystems. This adds to the complexity in measuring the economic costs and benefits of adapting landscapes or changing land use as part of project development. Figure 2.3 shows the many elements in a typical island ecosystem.

Figure 2.3 Cross section of a small island showing variety of ecosystems, from coastal to mountain Source: Agardy and Alder (2005)

The 'Ridge to Reef' management practice, which takes into account the impact of a project or decision in one part of an island on other parts, has been adopted in several islands (Jamaica, Hawaii, and the Mariana Islands among others). One of the strengths of economic valuation is that it can play a vital role in implementing the 'Ridge to Reef' concept by ensuring that the goods and services provided by all affected ecosystems are taken into account when decisions are made about future developments on small islands.

2.3 Environmental challenges on small islands

The most pressing environmental problems on small islands often relate to human activity. Since the United Nations conference on sustainable development in small islands in 1994 in Barbados, awareness of the pressures on small islands from human activity has grown. Actions taken by small island populations to protect their livelihoods, gather food and diversify incomes all affect the environment, and the future development potential of the island. The main pressures are:

- Land clearance for development (including logging and forest clearance);
- Agricultural and industrial pollutants and run-off;
- Waste from tourism, on land and at sea, notably from cruise ships and domestic waste (including solid waste disposal);
- Invasive alien species;
- Climate change;
- Damaging fishing practices (including poisoning and dynamiting); and,
- Mining and excavation for construction material (including beach mining, reef blasting and near-shore dredging).

Land clearance for development

Forest and woodland cover varies considerably among small island states, from 94% in Suriname to less than 1% in Haiti, although according to the Food and Agriculture Organisation in 1999 small islands are generally well endowed with forests. One of the most environmentally damaging impacts of economic development in small islands is the clearance of natural vegetation. Land clearance, which is frequently required for residential housing, agriculture, industry, infrastructural or tourism development, can lead to high rates of soil erosion. In areas where there is greater vegetation prior to land clearance, there is likely to be more accelerated erosion after clearance. Consequently high tropical islands, surrounded by fringing reefs, with dense vegetation and high rainfall, such as Haiti and the Solomon Islands, are the most at risk from accelerated rates of soil erosion following land clearance. The true cost of land clearance (that considers impacts on future land and ocean productivity) has to be evaluated when estimating the costs and benefits of new development projects.

Agricultural and industrial pollutants and run-off

Industrial developments, agricultural land-use, and household activities can also introduce a variety of pollutants into the coastal environment leading to nutrient enrichment. Algae can quickly overgrow fringing reefs following increased levels of nutrient inputs from untreated, or inadequately treated, sewage, as happened in Barbados, Jamaica, Hawaii, Costa Rica and Panama. Increasing stress is being placed on potable water supplies and coastal ecosystems due to the variety of pesticides, herbicides, heavy metals, oil (from spills), nutrients from sewage and grey water runoff, that adjacent communities and industries typically input into the marine system.

Waste from tourism, on land and at sea

Tourism is central to the economies of many Caribbean, Pacific and Indian Ocean islands, including (but not limited to): Antigua and Barbuda, Aruba, Barbados, St. Lucia, the Bahamas, the British and US Virgin Islands, Jamaica, Fiji, Guam, Saipan, Cook Islands, New Caledonia, French Polynesia and the Maldives. Tourism and tourism related activities generate both solid and liquid waste. There are many detailed examples of the damages caused by releasing inadequately treated waste onto land and sea (such as Hawaii, Jamaica, and Trinidad and Tobago), and the impacts of solid waste dumping on land (Fiji, Madagascar, Samoa, and the Cook Islands). Projects are being undertaken to address the issue of waste management in many islands, including recycling initiatives in the British Virgin Islands and Puerto Rico; and the provision of central waste collection areas where waste is sorted (as in the Maldives).

Invasive alien species

Changing populations and increased demand for imported resources contribute to small islands' susceptibility to invasion by alien species. Alien species include plants, animals, reptiles, fish and disease-causing pathogens. They can harm human and animal health, affect livelihoods, and threaten biodiversity. Many small islands already face threats from invasive alien species. Changing climatic conditions potentially hasten the spread of new alien species, including those that could become the next bio-invasion. Managing this problem requires preventative actions, including surveillance and early response. Through this approach, some islands, such as Mauritius, have effectively started to eliminate invasive mammals (Norway rats, hares, ship rats, mice and rabbits) and reintroduce native species.

Climate change

Climate change will affect every country on the planet, through rising air temperature; rising sea levels; acidification of the oceans; rising sea temperatures; changing precipitation levels; and changes in the incidence and intensity of extreme weather events such as storms, floods and droughts. A rise in temperature of between 1.5°C and 4°C may not sound like a problem, however, this can bring about significant shifts in ecosystem health and functioning. For example, coral reefs thrive in warm oceans between 23°C to 25°C but their health is in jeopardy when sea surface temperatures rise above (or drop significantly below) this range. Perhaps most importantly for small islands, climate change will contribute to the thermal expansion of the oceans – this means that the sea level will rise. Small low lying islands will lose land in this process, adding additional pressure to scarce resources.

Damaging fishing practices (including poisoning and dynamiting)

Poisoning and dynamiting of fish is increasingly occurring as the financial rewards for certain types of fish increase, and traditional fishing practices are abandoned for various reasons. Small islands suffering the impacts from this type of fishing include Fiji and Tuvalu. Intensive trap fishing within reef areas, as practised in Haiti and Jamaica, has the damaging effect of removing algae eating fish from the reefs, which can lead to an increase in algal cover of the reefs. It is also suspected that hauling in fishing traps can create substantial damage, especially coral breakage.

Mining and excavation for construction material

Many small islands have relied for years on beach sand to provide aggregate for construction. The recent trend towards more concrete homes is leading to a significant withdrawal of sand from beaches in many small islands. For example, since the 1980s there has been significant sand mined for tourism construction in Tobago. Positive moves to manage this problem can be seen in Puerto Rico where there is a total ban on all sand mining from beaches, and in Guyana, which has imported sand for all government projects since 1994.

The big challenge of multiple stressors

While periodic natural events, including hurricanes, earthquakes, drought and floods occur frequently in some small islands, these are not the main environmental problems. The most intractable problems are caused by combinations of multiple human and natural stressors. Costa Rica for example experienced deforestation in the highlands, which led to soil erosion. Coupled with inappropriate agricultural practices, this land clearance contributed to declining reef quality, which had deleterious impacts on both tourism and the fishing sector. St Lucia also experienced problems of increased coastal turbidity following periods of land clearance. In other small islands, the wildlife trade coupled with the introduction of new species to eliminate local species (and the accidental introduction of new species) have added to pressures on small island ecosystems. There are many such examples of development pressures leading to environmental degradation on small islands.

A great strength of economic valuation is that it can be used to identify development options that are resilient in the face of these multiple stressors by highlighting the future costs and benefits of the development options.

2.4 Economic options for development and areas for concern

All nations aim to improve the well-being of their human populations, to grow and develop. Directly as a result of this aim, small islands face a particularly difficult balancing act. They have to find development pathways while conserving their environmental quality, and managing the challenges associated with small size and isolation. Small islands inevitably face at least one of the following challenges:

- Limited land (e.g. limited fertile land for agricultural production in Nauru, New Caledonia and Nukuoro in Federated States of Micronesia; for industrial or commercial development in Montserrat);
- Limited fresh water supplies, especially on low-lying atoll states (such as the Cayman Islands which relies on desalination; and Tuvalu and Kiribati which rely on rain water and limited groundwater);
- Limited means of generating foreign exchange (in some small islands, a large proportion of foreign exchange can come from one source, for example tourism accounts for 70% of foreign exchange in Seychelles and 60% in the Maldives; and Papua New Guinea relies on mineral exports for 72% of export earnings);
- Small domestic markets, a narrow production base and limited potential for economic diversification (e.g. reliance on tourism for 60% of GDP in Bahamas, and 45% in British Virgin Islands; a reliance on overseas remittances e.g. US Government transfers to American Samoa);
- Diseconomies of scale in production, frequently leading to import dependence (e.g. dependence on imported food in Cape Verde and Comoros); and,
- Increasing population pressure (such as in Comoros and Majuro Atoll in the Marshall Islands).

example

Example Box 2.1: Economic issues in small island states
The UN Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and the Small Island Developing States (UN-OHRLLS) has produced a listing of small island states and describes the main social and economic concerns in each. This can be found at: **http://www.un.org/special-rep/ohrlls/sid/list.htm**

The United Nations Conference on Trade and Development identifies four types of small island economies according to the way in which they manage these limitations. The four types reflect the main source of income on which the small islands rely:

1. Remittances from overseas, aid, and sales of fishing licences (e.g. Tuvalu, New Caledonia, Niue, Haiti);
2. Export of natural resources – non-renewable (e.g. bauxite/alumina from Jamaica; oil, copper, and gold from Papua New Guinea; and oil from Trinidad and Tobago) and renewable (e.g. squash, coconuts, bananas, and vanilla beans from Tonga; canned tuna from American Samoa);
3. Export of services such as tourism or offshore finance (e.g. Cayman Islands, Turks and Caicos Islands, Cook Islands);
4. Domestic manufacturing (e.g. textiles from Mauritius).

Many small island states depend on several of these income streams (see Example Box 2.2).

example

Example Box 2.2 Economic diversification options

Anguilla is a UK Overseas Territory that has few natural resources. Incomes are generated through luxury tourism, offshore banking, lobster fishing and remittances from Anguillans overseas. Growth in the tourism industry has led to growth of the construction sector, which has further bolstered economic growth.

Fiji has a variety of natural resources which it exploits: forests, minerals, fertile soils and fish, although the economy is driven by the two largest exports: sugar and tourism. There is a small but buoyant textile industry, and some new natural resource exports, such as the pepper root 'kava' which is being marketed as a homeopathic remedy for anxiety. The potential remains to further develop the mining industry to export copper as well as gold.

Montserrat has suffered from severe volcanic activity since 1995. This led to airport closure for several years and drove about two thirds of the population to leave the island. Agricultural output was affected as there is now a lack of suitable land for farming and crops were destroyed. Overseas aid and remittances from overseas are likely to be the main income source in the short term.

Samoa is a largely agricultural economy – employing two thirds of the labour force. About 90% of exports are generated from the production of coconut cream, coconut oil and copra. Development aid, remittances from overseas, and small-scale agriculture and fishing supplement this income. Tourism is starting to be developed.

Tonga depends primarily on aid and overseas remittances. However tourism and the export of agricultural products (notably, squash, coconuts, bananas and vanilla beans) are also important.

Tristan da Cunha with its population of 300 is financially self-supporting with income derived from fishing and the sale of postage stamps.

Photo: Dreamstime.com

Many small islands have been creative in their development strategies, relying on not just one, but numerous income streams. Tourism has been used as a driver of growth in several countries and established tourism industries exist in the Bahamas, French Polynesia, Jamaica, Netherlands Antilles, Maldives, British Virgin Islands, and the Seychelles.

Unfortunately, in the scramble for immediate short-term employment gains and income improvements from tourism, the concept of longer-term sustainability of the tourism industry is often overlooked. Economic valuation tools can be useful in identifying the long term costs and benefits of changing land use to make way for tourism, in identifying the costs and benefits associated with increases in imports of goods for tourists, but also the significant export of services that tourism generates. Without such valuation tools, the negative social, cultural, economic, and environmental impacts of tourism can be overlooked, to the detriment of long-term development.

In this context of finding sustainable development paths, new social challenges are arising on many small islands, see Example Box 2.3. Economic valuation offers one means of assessing the total short-term and long-term implications of dealing with these issues.

example

Example Box 2.3 Issues of concern in small islands

In 2002, the Small Islands Voice (SIV) surveyed people (through opinion surveys, town hall-type meetings, workshops, radio call-in shows, national and regional consultations, and other means) in 12 small islands to identify the main issues of concern. Topics raised include:

- Road development in Palau
- Tourism development in the Seychelles
- Beach access in Tobago
- Foreign investment in the Cook Islands
- Crime and violence in the Caribbean
- Water export in St. Vincent and the Grenadines
- Airport development in the Cook Islands
- Foreign fishing around Ascension Island
- Solid waste disposal in San Andres Island
- Climate change in Tuvalu

2.5 Decision making in small islands

Given the range of specific economic and environmental challenges faced in small islands, governance mechanisms have to be found to allocate resources effectively. The very nature of small islands, including their small size, means that decision making processes are shaped by several unique features: political realities; communal land ownership; sister islands; and available capacity.

Political realities

The political reality of decision making in small islands is very different to the politics of larger states due to the relatively powerful influence of very local issues and, at the other end of the spectrum, the intrusion of very global issues. On the positive side, the high level of interaction between politicians and constituents means that there is often a greater level of awareness at the political level about the issues of concern at the local level. Problems with transport systems, infrastructure, education or health systems are likely to be experienced by everyone, including the most senior decision makers. This ensures that topical issues rapidly gain a central position in the political arena. On the negative side, there is the potential for cronyism and nepotism, plus interference in the decision making process through personal differences and limited dialogue. This is not a unique characteristic in small islands, however it is significantly more visible than in larger countries.

External political and economic factors can profoundly stress small islands. For example, the islanders from the Chagos Archipelago were forced to leave their islands in the 1960s and 1970s as the United Kingdom and the United States governments evicted them in order to develop a military base. Other small islands in the Pacific have been significantly affected by World War II (e.g. the Republic of the Marshall Islands) and exploitation by traders (e.g Nauru, Barbados, and Banaba in Kiribati).

Communal land ownership

Land is incredibly important in most small islands. A lack of access to land resources that can be exploited profitably means the difference between subsistence living or profitable living. Several islands, over the years, have developed systems of communal land ownership that have been designed to ensure that all islanders have access to land. These land ownership systems, like any other, bring both positive and negative consequences. On the positive side, many islanders are born with the knowledge that they have access to land and land tenure rights. For example, approximately 86% of land in Fiji is owned by indigenous people through their clans (matagali). Traditional management approaches such as taboos and locally enforced fishing restrictions are still observed locally in other countries, for example, Niue, parts of Samoa, and Tonga, or are being revived (as in the Cook islands, Vanuatu). Yet in other cases, traditional management practices have deteriorated, or the obligations associated with them are not met. Consequently several have been supplanted by westernised systems.

The negative side of communal land ownership is that new arrivals to the islands and old migrants, who historically have no land rights, find themselves and their children marginalised and often existing with few entitlements. There is also an increasing number of people who are dispossessed without land, for instance where outer islanders move to their capitals in search of work. In small islands where rights to land are so critical to survival, resolving complex land disputes is an important part of a decision maker's challenge.

Kava drinking in Fiji is practiced at communal events. Photo: Ross Tompson

Sister islands

Many small island nations are not solitary islands, like Montserrat, Nauru and Reunion, but comprise a dispersed set of islands. There are small island sisters, such as Trinidad and Tobago; small islands with a handful of sisters such as American Samoa, Andaman and Nicobar, and Cayman Islands; small islands with 10s of sister islands (such as Cook Islands, British Indian Ocean Territory, Vanuatu); and islands with 100s of sisters (such as the Federated States of Micronesia and French Polynesia). Managing multiple island nations brings a whole set of additional challenges. Not only do sister islands have very different natural resource bases (for example Trinidad and Tobago), different development needs due to their proximity to the centre (such as the islands of Vanuatu), but the islands are often separated by significant distance, such as Kiribati, and St. Helena and the Dependencies. Administrations may also differ within countries, as is the experience of Rotuma in Northern Fiji. Decisions have to be taken about where to allocate limited financial resources, and inevitably (as in many larger countries) the majority of resources are focused on the central administrative area, with the periphery receiving significantly less.

Capacity available

Despite these challenges, some small island nations have proven over the centuries that they are extremely resilient to external shocks, such as the Cayman Islands recovery from the 1932 November “storm” that caused significant suffering and loss of life; and the reconstruction of East Timor after much of it was destroyed by Indonesian troops in the late 1990s. Ecosystems battered by tropical cyclones recover and regenerate annually.

Examples exist in small islands of both successes and failures of social transformation. For example, over the past decades, several small island nations have moved from being poor developing countries, to middle income, and in some cases, wealthy nations, such as the Bahamas, the British Virgin Islands, Antigua and Barbuda, the Netherlands Antilles, Trinidad and Tobago. Examples can be found of small islands that have moved from small fishing communities into international centres of commerce (such as British Virgin Islands, Cayman Islands and Turks and Caicos Islands); from subsistence farmers into mineral exporting nations (the Kingdom of Bahrain, Papua New Guinea and Trinidad and Tobago); from niche exporters of agricultural crops into international tourism destinations (such as Grenada, Jamaica, and Zanzibar). Other communities have not transformed themselves so smoothly, as the experiences in Niue and Nauru reveal, suggesting that there is not a universal resilience in small islands.

Despite the shortage of people within the labour force, those that participate often have a wide range of skills as they have to undertake several roles in their employment. While this gives individuals a breadth of knowledge that would be rare in larger countries, it also prevents individuals from gaining a more in-depth detailed knowledge of specific subject areas that comes from exposure over a long period. As a result, capacity to conduct complex impact or policy analysis is often limited. It is therefore necessary to develop guidelines, such as this toolkit, that recognise both the inherent skills available, but also this limitation.

3

Stakeholders

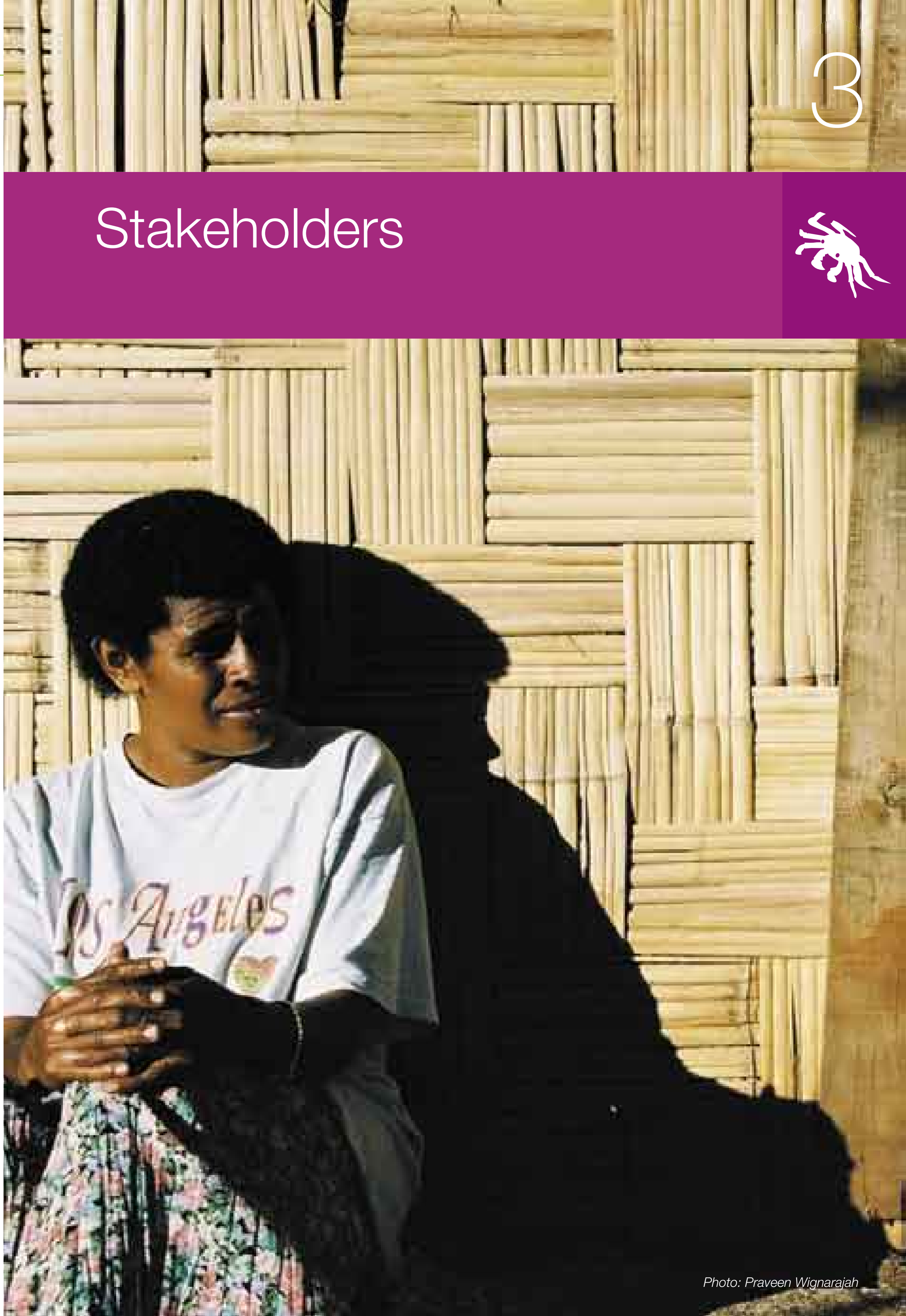
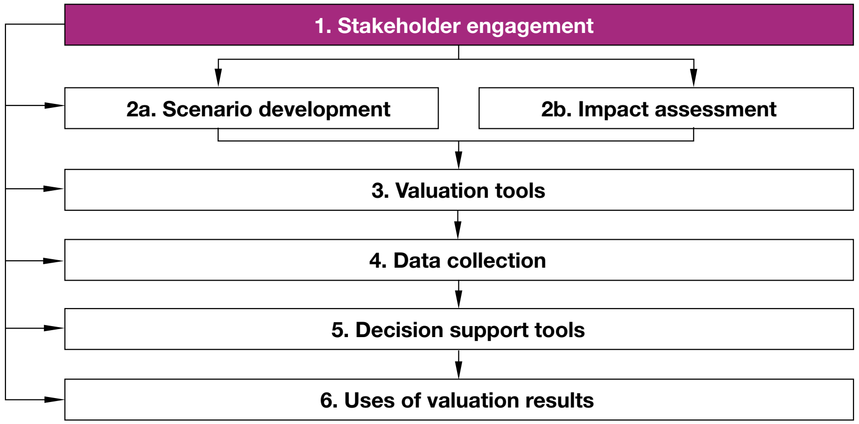


Photo: Praveen Wignarajah

3 Stakeholders

What you will learn in this section:

- The importance of stakeholder participation in economic valuation
- Which stakeholders to include in the decision process
- How to categorise stakeholders
- When to include stakeholders
- How to include stakeholders



3.1 Introduction

Best practice in economic valuation encourages the identification and engagement of stakeholders early in the process. This section will help you consider who is a stakeholder, why they should be included, who should be involved and when.

3.2 Participation in decision making

Undertaking projects that significantly affect the environment in which people live and work can create conflicts. One of the best ways to avoid conflict is to gain the support and trust of the affected groups. Discussions should be held with stakeholders about the project to ensure that the affected people:

- Have had some say in some aspects of the decision;
- Have the opportunity to voice their concerns;
- Feel that their concerns have been listened to;
- Have some sense of control over how the decision will affect them;
- Can ensure information on environmental values and uses is correct;
- Agree on and own the analysis.

Full participation by all people affected by a decision is often not possible. Therefore, at the beginning of the planning process, the level of stakeholder engagement needs to be considered carefully. Some countries have top-down decision making processes that do not require stakeholder participation, whereas others are more open to bottom-up decision making. If stakeholders are to be actively engaged there are several different methods by which to do this, see Table 3.1.

Where environmental goods and services are going to be affected by a new project or policy, there will be some stakeholders in favour of and some against the project. If the government needs to engage the group who are against the project or policy, then it is especially important to encourage involvement of stakeholder groups.

Table 3.1 Different types of participation in decision making

Forms of participation	Characteristics of each type of participation
Information giving	People participate by answering questions posed by project management using surveys. Information is then fed back to the various groups.
Consultation	Stakeholders are consulted and external agents listen to the views expressed. Solutions may be modified in light of stakeholders' responses.
Functional participation	Stakeholder groups are created to meet pre-determined objectives related to the project. This tends to happen after major decisions have been made.
Interactive participation	People participate in the decision making process, and the development and analysis of different options. Stakeholders and decision makers learn together.
Active participation	People participate by taking initiatives independent of external institutions to change systems.

There are two main benefits from early engagement:

- Reduction of potential short term conflicts among winners and losers;
- Reduction of long term compliance costs.

Already there are many countries that have adopted a participatory approach to environmental management, see Box 3.1.

example

Example Box 3.1 Stakeholder engagement in fisheries management in St Lucia

CANARI, the Caribbean Natural Resources Institute, played a central role in the evolution of the Soufriere Marine Management Area (SMMA), established in St Lucia in 1994. This followed an 18-month long process of participatory planning which brought together diverse stakeholders who had been in conflict over use of the coastal resources. After extensive engagement, the stakeholders agreed on the formation of the SMMA comprising 11 km of coast, including marine reserves, fishing priority areas, multiple use areas, recreational areas and yacht moorings. For more information see CANARI Technical Report No. 285, by Yves Renard, "Case of the Soufriere Marine Management Area (SMMA), St. Lucia"

Source: **http://www.canari.org/285smma.pdf**

3.3 Who should be involved?

Stakeholder analysis is the name for the process of collecting information about people who are affected by decisions, categorising them into groups, exploring the conflicts between them and finding where trade-offs exist. Stakeholders can be groups or individuals, and they can be described by socio-economic classifications such as income level, occupational group and employment status. Identifying stakeholders marks the beginning of the stakeholder analysis process. One method for identifying stakeholders is to think through:

- Who owns the land/resources?
- Who currently uses this area (for business/residence etc…)?
- Who plans to develop in this area?
- Who uses the area legally and illegally for any access or extractive purposes?
- Who uses the site at different times of day and different times of the year?

Stakeholders should then be grouped by their interests in and their use of the resource, e.g. on-site users, off-site, in the region, in the country and globally.

3.4 Categorising stakeholders into priority groups

Having identified the stakeholders it is then necessary to categorise them to determine whether they are a priority group to be engaged, and when and how to engage them. It is useful to think of stakeholders according to two criteria:

- Who will be affected positively or negatively by the decision;
- Who has the power to influence the decision and who has no power.

Prioritisation of stakeholders should then be made according to which stakeholders have influence and which stakeholders are impacted, see Figure 3.1. The three main stakeholder groups are: primary stakeholders, secondary stakeholders and external stakeholders.

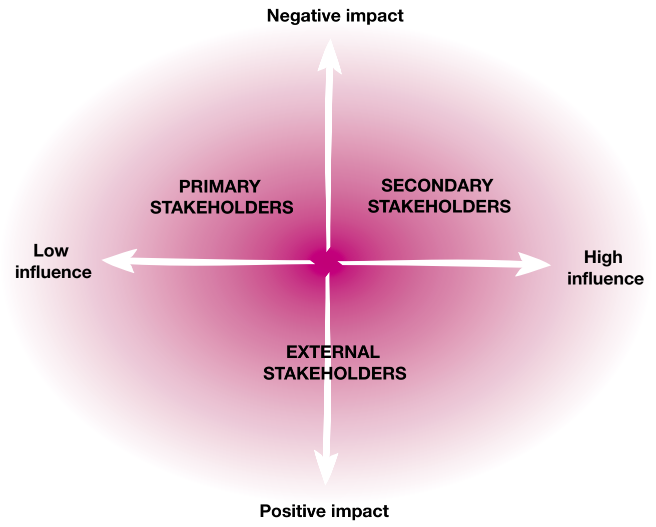


Figure 3.1 Prioritising stakeholders according to influence and degree of impact

Primary stakeholders experience the impacts of the project most severely either on their livelihoods or well-being. They often have little power to influence the outcome of the decision making process. This group is likely to include on-site resource users or residents, such as local businesses and local community groups. It is often the case that the primary stakeholders are not in a clearly defined group; they may be poor, landless or itinerant.

Secondary stakeholders are the people with the power to make the decisions and to shape the outcome, but they are unlikely to be directly impacted by the decision. This group tends to comprise government departments and ministries.

External stakeholders are those who are not impacted significantly by the project, but whose interests are affected. These people may be influential and have the power to influence the outcome and may include land developers, multinationals investing in the area, environmental NGOs or charities, trade groups and lobbying organizations.

Tug of war, Yadua, Fiji. Photo: Praveen Wignarajah

3.5 When should different stakeholders be involved?

Without support for a project there is less likelihood that it will be effective. Gaining that support takes careful consideration of when to engage each group.

Primary stakeholders: Primary stakeholders are at the heart of any decision, and hence they need to be reached as soon as possible and encouraged to participate. If possible they should be brought together to create an active steering or consultative group. Once functioning as a steering group or consultative group, the primary stakeholders themselves should decide who can be invited to join their group.

Secondary stakeholders: The managers of the resource and decision makers who can influence the final decision should be included throughout the process. Bringing all decision makers on board at an early stage ensures that they understand how the results are generated and what they mean. Secondary stakeholders should not be allowed to dominate combined stakeholder group meetings. In those meetings primary stakeholders must be treated equally and given as much time to talk as the secondary stakeholders.

External stakeholders: External stakeholders tend to be more vocal and powerful and hence can be intimidating to those with less access to resources. Discussion may be inhibited if external stakeholders are present, or they can dominate meetings by shaping the dialogue to their agenda. External stakeholders should be kept informed of the on-going process, kept up to date with actions and events and carefully managed.

A timeline for participation can be used as a very rough guide to the timing of stakeholder involvement, see Table 3.2.

Table 3.2 Timeline for participation

Activity	Time 1	Time 2	Time 3	Time 4	Time 5	Time n
Project identification	S					
Stakeholder identification	S					
Stakeholder engagement		P, S				
Steering group formed		P, S				
Scenarios developed			P, S			
Impacts assessed			S			
Steering group engages external stakeholders			P, S, E			
Data collection				P, S, E		
Economic valuation					S	
Using the decision support tools					S	
Valuation used in decisions						P, S, E

Key: Primary stakeholders = P, Secondary stakeholders = S, External stakeholders = E

3.6 How should stakeholders be involved?

Readers are advised to follow guidance from the well-developed set of references that exist on how to do stakeholder analysis and engagement. The World Bank source book on participatory decision making, and the Overseas Development Administration's 1995 'Guidance Note on How to do Stakeholder Analysis' can be very helpful in this regard.

information

Additional resources on how to do stakeholder identification and engagement
The World Bank Participation Sourcebook
http://www.worldbank.org/wbi/sourcebook/sbhome.htm
The Overseas Development Administration's guidance note
http://www.euforic.org/gb/stake1.htm

4

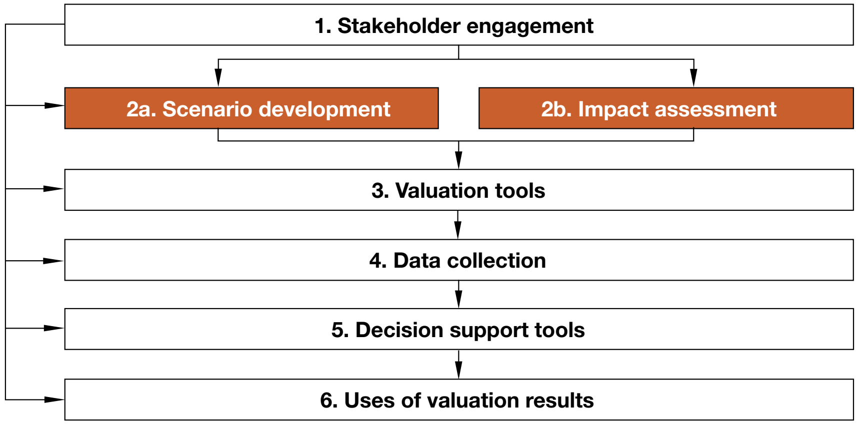
Scenario development and impact assessment

Photo: David Atkin

4 Scenario development and impact assessment

What you will learn in this section:

- Why economic valuation involves developing scenarios
- What scenarios are
- How to generate scenarios
- How to assess the impacts of the scenarios
- How to categorise and identify impacts on ecosystem services
- How to gather data for an impact assessment



4.1 Introduction

Economic valuation is often undertaken to influence a decision. It therefore generally involves the evaluation of a proposed policy, project or other form of intervention over time. In order to do this, it is important to start early on in the design process of the valuation by considering carefully the decision that the advocacy is intended to influence. To determine the attractiveness of the proposed intervention, it is required to compare the economic feasibility of the project or policy with an alternative situation. Developing scenarios is the first step in doing this.

Scenarios are simply storylines describing the future, but they play a significant role in the economic valuation toolkit. By clearly and carefully describing the range of options that are under consideration, you are drawing a boundary around the scope of the analysis. Impact assessments are based on the scenarios. The economic valuation will use the impact data. Hence, while scenarios can be quite simple, they are central to an economic valuation exercise. There are many methods of developing scenarios, ranging from the simple to the complex. Once scenarios have been developed then impacts should be assessed.

4.2 Scenario development

Scenarios, which describe alternative futures, are critical to economic valuation because it is between a set of alternatives that decision makers will have to choose. Scenarios describe key assumptions about the future and they highlight the uncertainty that exists in the decision making process. Scenarios should be:

- Understandable to the layperson
- Distinct from each other
- Possible and realistic
- Substantiated by existing information (if possible)

Ideally stakeholders will be engaged at this stage to describe their preferences and needs. Scenario planning requires the stakeholders to face critical uncertainties, especially the trends that are very important, yet at the same time unpredictable (e.g. will the building code be implemented? how quickly will the population grow? will sewage treatment facilities be built to cope with increased tourist arrivals?).

> information
>
> For more information on creating scenarios and examples of the methods used to develop them, see the UK Government Cabinet Office "Generic Scenarios: A Strategic Futures paper. December 2002, by Ruth Cousens, Tom Steinberg, Ben White & Suzy Walton
> **http://www.cabinetoffice.gov.uk/strategy/downloads/survivalguide/downloads/Scenarios.pdf**

There are three main ways in which to develop scenarios:

- Focus on the desired end state and work backwards;
- Explore the implications of existing drivers of changes;
- Consider current trends and system uncertainties.

The latter two are described in this Chapter. The 'development pressure-state-impact-response' DPSIR framework looks at drivers of change. This is best suited to situations in which there are clear and distinct drivers of change that need to be considered, e.g. increased demand for tourist accommodation; better transport links to a capital city required; new hospital required. The 'critical uncertainties' approach, which considers current trends and uncertainties, is better suited to situations where there is significant uncertainty about the impact of development e.g. whether an ecosystem is resilient to external pressure, or where damage thresholds are not known.

Basic principles in generating scenarios

Underpinning any scenario development are five questions:

1. What is the *key question* being asked?
2. What are the long-term *goals*?
3. What are the *ongoing trends* affecting the question or goals?
4. What *future changes* are expected and what is driving those changes?
5. What are the major characteristics and *developing stories* for each scenario?

The example in Box 4.1 explains how these questions should be used.

Example Box 4.1 Scenario development for sustainable residential development

Key question: How to find ways to construct high quality residential developments in a coastal area without affecting natural ecosystem functioning.

Goals: i) Permit some amount of residential homes; ii) Protect the groundwater lens and prevent its contamination; iii) Protect sea grass beds and mangrove stands; iv) Protect the access rights for recreational and informal use of the beachfront.

Ongoing trends: How is the area used on-site, off-site, nationally and internationally? For example, there may be lobster fishers using the bay or other subsistence fishers. There may be illegal squatters living on the beach; there may be informal vendors selling goods to passing tourists who frequent the bay. There may be national water shortages and protection of existing groundwater sources may be critical. Therefore access rights for existing users need to be considered, as well as the health of the mangrove and sea grass beds; and the impact of construction activity on groundwater.

Future changes: environmental (such as sea level rise associated with climate change, or invasive alien species); social (such as changing demographics); and economic (such as competition for international tourists, or expected new economic opportunities).

Stories developed will include all these elements.

Development pressure-state-impact-response approach

The 'development pressure-state-impact-response' (DPSIR) framework is useful to help create scenarios where there is a decision to be made in response to specific drivers of change, such as the development of tourism accommodation, (see the example in Box 4.2). The DPSIR framework provides one means of understanding the current pressures leading to decisions which have consequences for the environment, while revealing the key questions, the key goals and the likely future pressures. Scenarios can be developed using the DPSIR framework to describe the example presented in Figure 4.1. The stakeholders should collectively think through the implications of the current pressures being faced, in order to arrive at these scenarios.

Coastal development. Photo: Lisa Krebs, Cayman Islands

Example Box 4.2 Using DPSIR to develop scenarios for tourism development

Development pressure: In most small islands, socio-economic conditions create a constant demand for jobs and income for citizens, while other development pressures such as: climate change, population growth, small domestic markets, economic isolation, and globalisation push decision makers to take difficult decisions. In many small islands this pressure often leads to the development of a tourism industry. Tourism development frequently requires land clearance for construction activity and increases the demand for potable water.

State changes: As a result of land clearance, construction activity and waste outputs, contaminants can accumulate, land cover changes and the quality of coastal or ground water changes.

Impact: Environmental impacts occur when changes in the environment start to be felt by the island population. This could be through a decline in human well being or changes in the functioning of ecosystems on which people rely.

Response: The manner in which government responds to the situation determines the ultimate outcome. Economic valuation should help decision makers to assess the relative costs and benefits of managing the impacts of different forms of tourism, or to assess the costs and benefits of one form of tourism relative to other development options

Drivers & pressures	State changes	Impacts	Responses
Demand for residential housing Need for potable water Need to preserve mangrove nursery Need for beach access	Land clearance to build new homes Potential increase in sediment and contaminants in water Loss of mangrove area Access pathways limited	Soil erosion Loss of potable water source Storm protection diminished Reduced local beach access	Consider different density of homes Evaluate sustainability of importing water Consider replanting mangroves elsewhere

Figure 4.1 Implications of different pressures on future development

This structured thinking could then be translated into a variety of scenarios:

Scenario A: Permit sixty 2,500 sq feet new homes. Groundwater lens will be filled. Sea grass beds and mangrove stands will be cleared, but replanted elsewhere on the island

Scenario B: Permit forty 2,500 sq feet new homes at least 100 metres from the groundwater lens, creating some impact. 50% of sea grass beds and mangrove stands will be cleared, but replanted elsewhere on the island.

Scenario C: Permit twenty 2,500 sq feet new homes 500 metres from the groundwater lens with no impact. 15% of sea grass beds and mangrove stands will be cleared, but replanted elsewhere on the island

Scenario D: No new developments allowed. Groundwater lens is protected and no clearance of sea grass beds and mangrove stands. However, no economic development benefits arising from the residential development will be gained.

These are very different stories describing a range of possible options.

‘Critical uncertainty’ approach

When scenarios are being developed where little is known about the health or status of the environment or economy, this approach to scenario development may be preferred.

The critical uncertainty approach begins by considering the critical areas of uncertainty that will affect the decision being made. For example, it may not be known whether an ecosystem is resilient in the face of development, or whether an economy will continue to grow. To cope with the uncertainty associated with these issues, both ends of the spectrum need to be considered, i.e. that ecosystems will be resilient, and that ecosystems will not be resilient, similarly that the economy will continue to grow or not.

Using the example described in Box 4.1, four scenarios can be developed by making assumptions at the extremes of these uncertain parameters, see Figure 4.2.

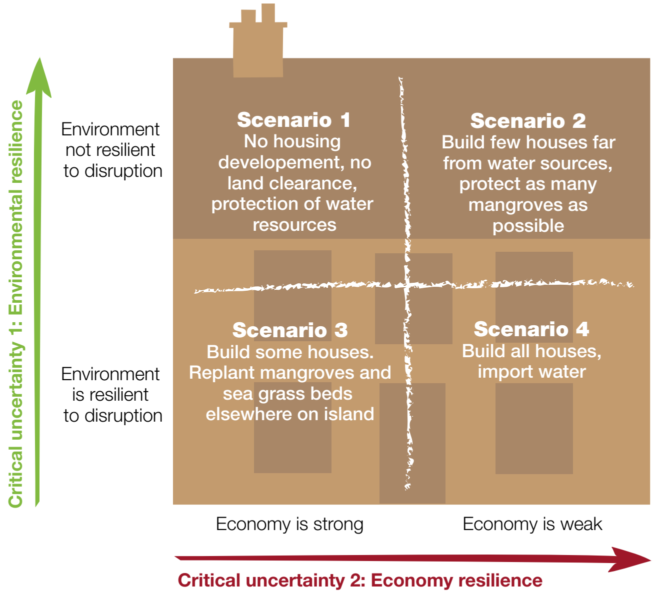


Figure 4.2 Scenario development using ‘critical uncertainty’ approach

4.3 Impact assessment

An impact assessment is simply a process that identifies, predicts and assesses the likely consequences of a project, decision or scenario. There are many different types of impact assessment, including climate, development, environmental, economic, risk, social and strategic impact assessments, among others.

information

For more information about how to do an impact assessment, see references in Section 9.4. A particularly useful example is:
UNEP’s Environmental Impact Assessment and Strategic Environmental Assessment: Towards an Integrated Approach (2004)
http://www.unep.ch/etb/publications/EnvImpAss/textONUBr.pdf

Natural roof material. Photo: Praveen Wignarajah

An impact assessment usually should include answers to the following questions:

- Where is the impacted area and what are its current physical, biological, social and economic features?
- What is the baseline condition of the physical, biological, social and economic environment likely to be affected by the scenarios?
- What are the scenarios under consideration (e.g. location, design, scale, and size of alternatives)?
- What data exists with which to assess the main effects of the scenarios on the present environment?
- How, and to what extent, will the scenarios change the environment (e.g. ecological, economic, cultural, aesthetic, health and safety, social and amenity impacts)?
- What methods are used to assess the impacts of the scenarios on the environment (including identification and forecast of impacts, and uncertainties or problems in compiling the information)?
- Who are the key stakeholders likely to be affected by the different scenarios, and how is it proposed that these groups will be engaged / consulted?
- What is the relative significance of the impacts on the environment to key stakeholders under the different scenarios?
- What measures would reduce or minimise the impacts of the alternative scenarios on the present environment?
- What monitoring programmes could detect unforeseen impacts; provide early warning of adverse effects; and promptly and efficiently address accidents that may arise under future scenarios?

The impact assessment should conclude with an evaluation of the different alternatives, including the alternative of no action.

Identify important impacts

Small island ecosystems have a number of unique features that need to be considered when undertaking an impact assessment. Examples of these are shown in Box 4.2. Assessing the impacts of a project on the environment can be challenging. A useful starting point is to consider the goods and services that ecosystems provide. The four main categories of services are: i) Provision of services that people rely on to make a living; ii) Regulation of other natural systems; iii) Support of human life; and iv) Cultural services. Care is needed when including 'supporting of human life' services to avoid double counting. Where life support functions of ecosystems are considered 'intermediate services' i.e. they enable human use of the other three services, then they should not be valued separately. However, when the support services are valued for a specific service, e.g. pest or disease control, or mangroves acting as a fish nursery then they should be included.

example

Example Box 4.2 Common features of small island ecosystems needing IA consideration

Climate, geographic and geological features

- Proximity of all developments to the coast
- Typified by tropical climates
  - o Tropical cyclones
  - o Proneness to flooding and storm surges
  - o Climate variability affecting water supply
  - o Limited ground water availability
- Susceptible to airborne pollutants, e.g. Saharan dust in the Caribbean
- Rapid spread of contaminants throughout connected island ecosystems
- Large decadal variations in climate affected by global weather patterns

Ecosystems and biological resources

- Ecosystems are both resilient within ranges, yet sensitive to additional stressors (e.g. coral reefs)
- Highly productive ecosystems in general
- Complex food chains
- Rapid recovery/regeneration rates
- Risks associated with irreversible processes (e.g. sea level rise)
- High levels of biodiversity and endemism
- Susceptibility to invasive alien species

Socio-cultural and economic features

- Mixed levels of cultural variability (some high – mostly in the Caribbean, some very low, especially in the Atlantic and the remote Pacific Islands)
- Mixed dependence on renewable resources (depending on island wealth and development strategy)
- Often very high population density on main islands
- Active exploitation of non-renewable resources

Knowledge of the systems

- Often a lack of baseline environmental information
- Traditional knowledge used in varying degrees, depending on level of participation in traditional occupations

Provision of services: The natural environment is the source of the food and water on which we all depend. It also provides timber, fibre and fuel for construction, energy use, manufacturing etc. The natural environment also provides bio-chemicals and genetic resources that are used in commercial products for agriculture, pharmaceuticals, medicines and cosmetics. For small islands, key provisioning services are sources of food, fibre, genetic resources, and natural medicines; production of sand; fuel; and freshwater.

Boy snorkelling. Photo: Praveen Wignarajah

Regulation of other natural systems: Ecosystems regulate several other systems that affect our life: the climate of the planet (and the local climate), disease transmission among animals and humans, the wastes we produce, and the way in which we are exposed to natural hazards. For small islands, key regulating services are often: erosion control; storm protection; air quality maintenance; climate regulation; water regulation; water purification and waste treatment; and pollination.

Life support: Ecosystems effectively support life on the planet through complex nutrient cycling processes. The ability of the planet to process nutrients is increasingly being affected by the growing levels of nutrients used in agriculture, and by land clearance and industrial emissions. For small islands, key supporting services are those that are necessary for the production of all other ecosystem services, such as nutrient cycling, pollination, and pest and disease control.

Cultural: Most societies have developed closely with the natural environment around them, and many cultural practices (such as sacred species or sacred forests) are important to the strength of community and support networks. For small islands, cultural benefits are often generated from: spiritual and religious use; educational benefits; aesthetic use; providing a sense of place; and for recreation and ecotourism purposes.

Clearly, without these ecosystem services, life on earth would not be easy or pleasant. The categories of ecosystem services outlined above are not the only elements in the relationship between people and the environment. Ecosystem services also affect health, community functioning, personal and community security as well as individual freedom and choice. These factors are affected by and affect the economy, where and how people live, how resources are managed locally, as well as cultural preferences. All of these factors influence how decisions are made and the changes that affect the environment in which we live. Examples of the ways in which some small islands rely on each of these services are shown in Box 4.3.

example

Example Box 4.3 Examples of small islands' reliance on ecosystem services

Provision of services that people rely on to make a living: Socotra island (located off **Yemen**) is probably the poorest and most disadvantaged area in the Yemen and the local population relies heavily on the fishery industry for a subsistence living.

Regulation of other natural systems: Trees bring rain, without which other ecosystems could not thrive. **Trinidad and Tobago** lay claim to having the oldest legally protected forest reserve. In 1776 the lower montane rainforest in Tobago was officially protected: "for the purpose of attracting frequent Showers of Rain upon which the Fertility of Lands in these Climates doth entirely depend".

Support of life: All small island populations require potable water, soil to grow food and clean air. Any project that reduces the capacity of ecosystems to sustain life needs to be carefully considered. Mining for phosphate left many homeless on the tiny population of Banaba (Ocean Island), one of the **Kiribati** islands, after parts of the island had been stripped by mining and soils depleted. Some of these islanders now live on Rabi island in Fiji.

Cultural: In **Hawaii**, land and its resources have a central role and hence value in Hawaiians lives; this stems from its cultural value. Traditional Hawaiian stories tell of the children of Sky Father and Earth Mother. The first-born was deformed, and was planted in the ground. Taro (a root crop) grew in this place (taro is now a staple of the Hawaiian diet). The Sky Father and Earth Mother had a second child, which was the first human. Hawaiians recognise that the land was there before them and therefore it needs to be treated respectfully, as one would treat an elder sibling.

The template shown in Table 4.1 should be used to initially sketch out what the impacts are likely to be. Ecosystem stress is not always generated 'on-site'. Indeed in small islands it is often the case that activities inland, up-hill, or upstream produce the most damaging effects downstream. For example, upstream land clearance can produce silt and release nutrients that affect coastal water quality, which in turn damages coral reefs. The impacts of the alternative scenarios therefore need to be considered at the different scales at which impacts are experienced: the local level, the island scale, the regional scale and also the international scale. Table 4.1 should therefore be completed for the different scales at which impacts are felt. The information from this table should then be used to structure the environmental element of the impact assessment.

Table 4.1 A template for assessing the impacts of a scenario for an economic valuation based on ecosystem services, illustrated with some examples

Ecosystem affected	Provisioning services	Regulating services	Supporting services	Cultural services
Sea grasses	Provision of natural medicines	Coastal water filtration	Juvenile fish nursery for local area And rest of island	
Mangroves	Construction materials used locally	Coastal water filtration Barrier against storms for local residents Storm barrier for tourism developments Regulate microclimate		Sacred area
Groundwater	Potable water for local residents			
Coastal water quality	Food for island residents Export of fish			Recreation Religious bathing uses
Beach				Aesthetic value Sense of pride in island

Red refers to local scale
Blue refers to island scale
Green refers to regional or international scale

Tourists go diving in Saipan. Photo: Pieter van Beukering information

Millennium Ecosystem Assessment (MA)

The Millennium Ecosystem Assessment is a useful resource to help consider the services of an ecosystem. The Millennium Ecosystem Assessment was a 5-year United Nations programme to assess the state of the world's ecosystems. The MA explains how ecosystems in different countries, landscapes and geographic regions have changed over the past 50 years; what appears to be causing damage to ecosystems; and what options exist to conserve, restore and benefit from ecosystems.
http://www.maweb.org/en/index.aspx

The scope of the impact assessment

An impact assessment that is part of an economic valuation study should ideally include all potential environmental, socio-cultural, health and economic impacts of the project and its alternatives. For any impact assessment preceding a valuation, the impact area has to be clearly defined in the scenarios. This will depend on:

- The type of project (extractive or non-extractive);
- The mobility of the resources affected (fixed or mobile);
- The nature of the resources affected (renewable or non-renewable);
- The interconnectedness of the ecosystem being impacted; and,
- Whether the project is being developed 'upstream' or 'downstream'.

In some cases, the nature of the project, the smallness of the island, and the interconnectedness of the island ecosystems will mean that the alternative scenarios and the impact assessment have to consider the whole island. The 'ridge to reef' concept has been adopted in small islands to cope with the issue of interconnectedness. Great care is needed when considering the spatial scope of the scenarios and the impact assessment as this will affect the outcome of both the assessment and the economic valuation in which it is used, see Box 4.4.

example

Example Box 4.4 Three examples to show the scope of an impact assessment.

A *beach re-nourishment project* is a good example of a non-extractive project with limited levels of connectedness, semi-fixed resources, and a reasonably well-defined 'upstream area'. In this case the factors affecting the erosion of the beach will need to be considered. These will be: the occurrence of artificial constructions affecting sand movements; natural weathering processes; 'upstream' areas feeding or starving the beach (both inland and upstream); 'downstream' areas affected by sand movements on the beach.

A marine protected area project. The ridge to reef concept may need to be drawn on, as the factors affecting water quality, levels of silt and nutrients, and run-off from land may need to be considered.

Trans-boundary protected area. Some small islands share national boundaries. Protected areas which cross national borders will require the inclusion of all ecosystems affecting the protected area, regardless of national boundaries.

5

Economic valuation

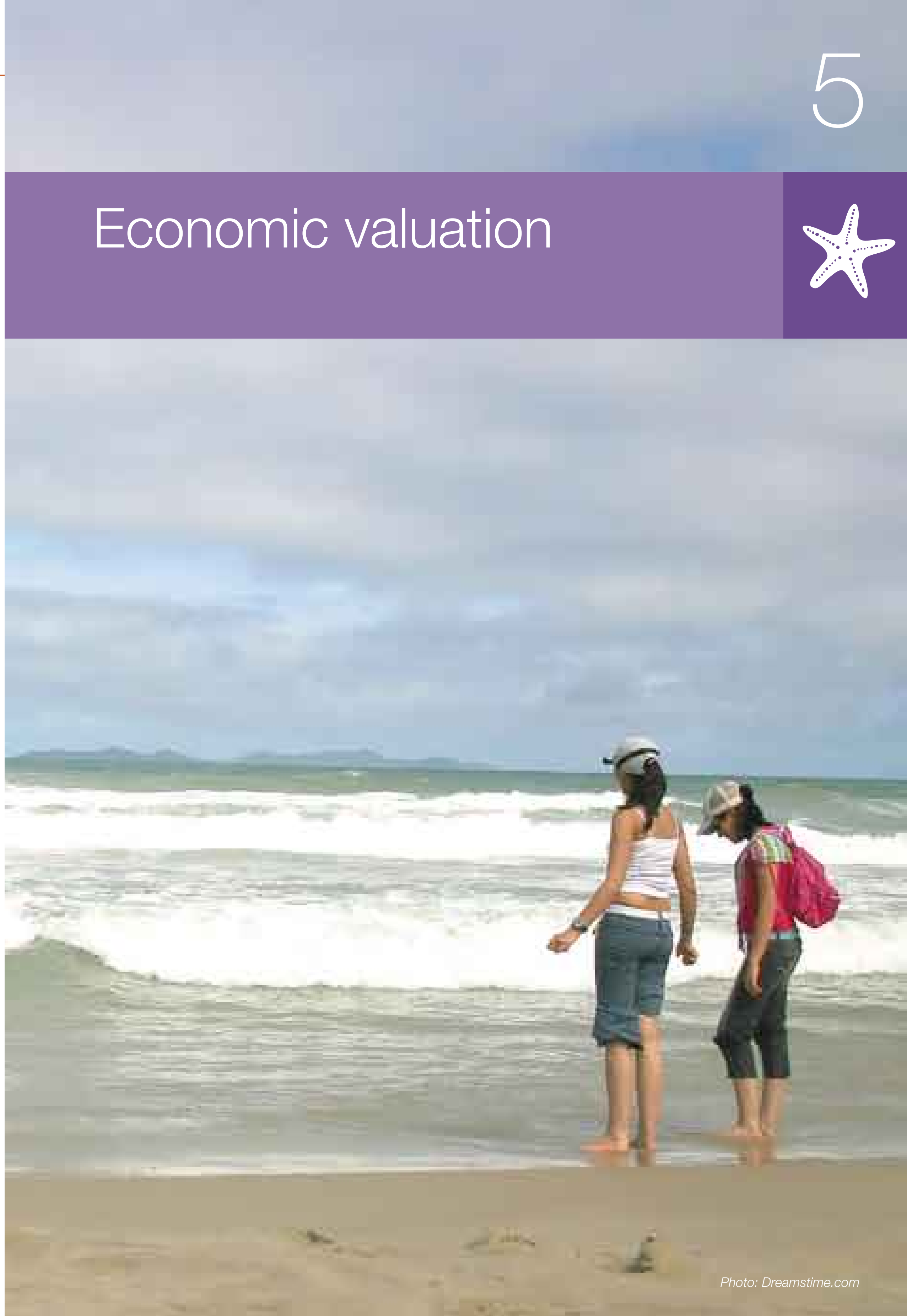
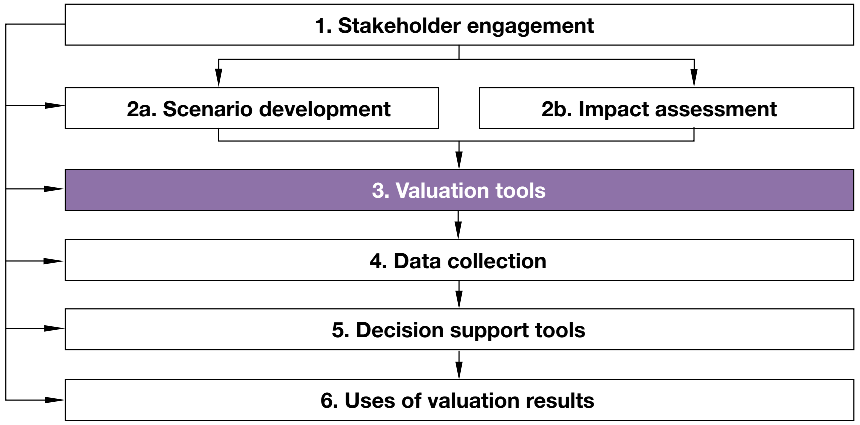


Photo: Dreamstime.com

5 Economic valuation

What you will learn in this section:

- Basic economic concepts of value that underpin economic valuation
- How to categorise valuation methods
- The economic methods that are available for valuing environmental goods and services
- The basic steps in applying each valuation method
- The specific considerations for applying these methods in a small island context



5.1 Introduction

Economic valuation of the environment is based on the view of ecosystems as a source of goods and services for consumption, and of inputs for production. Economic valuation is therefore essentially anthropocentric in the sense that it is human use or enjoyment of environmental services that determines their economic value.

5.2 Different ways of looking at monetary values

Economic value expresses the degree to which a good or service satisfies individual human preferences. These preferences can be expressed in many ways: in units of products (e.g. one bottle of wine is equal to four loafs of bread), in environmental units (e.g. consuming three shrimps equals the services provided by one square metre of wetland), or in social units (e.g. one bag of cement equals one day of manual labour). However, the most practical unit to express value is in “money”. This does not mean that goods without a market price are without value.

Monetary values can be addressed in numerous ways:

- Willingness to Pay & Willingness to Accept
- Market and non-market value
- Direct and indirect values / use and non-use value
- Financial and economic value
- Costs and benefits
- Ecological, social and economic effects
- Producer and consumer surplus

These different manners of describing monetary values are used interchangeably in environmental economics, and can therefore be confusing for those that are unfamiliar to them. Therefore, two of the most important concepts of looking at monetary value are described in the following sections.

Willingness to Pay & Willingness to Accept

Economic value can be measured by the amount of money an individual is willing to pay (WTP) for 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. For example, if a person is willing to pay at most $10 for a salmon while he is willing to pay $50 for a lobster, he must prefer having lobster to having salmon. In the absence of conventional markets, by valuing environmental goods such as clean water and clean air using the WTP for these goods, one can measure preferences for these goods in a way that makes them comparable to marketed goods.

An alternative measure of economic value is the 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. Whether a WTP or a WTA measure is most appropriate is essentially a question of property rights – i.e. who has the legal rights over the use to which a resource is put. A WTP measure implies that the property rights to the resource in question do not lie with the individuals being asked to value it; they have to pay to obtain the use of a good or service from the resource. A WTA measure implies that the individuals being surveyed hold the property rights; they have to be compensated for the loss of the good or service. Which measure is most appropriate, is therefore not an economic, but rather a legal or perhaps even an ethical matter. In practice, WTP is the most commonly used measure to value environmental goods and services.

Property right
A property right is the exclusive authority to determine how a resource is used, whether that resource is owned by government or by individuals. All economic goods have a property rights attribute. This attribute has three broad components and does not need to be held by a single person or collective:
1. The right to use the good
2. The right to earn income from the good
3. The right to transfer the good to others

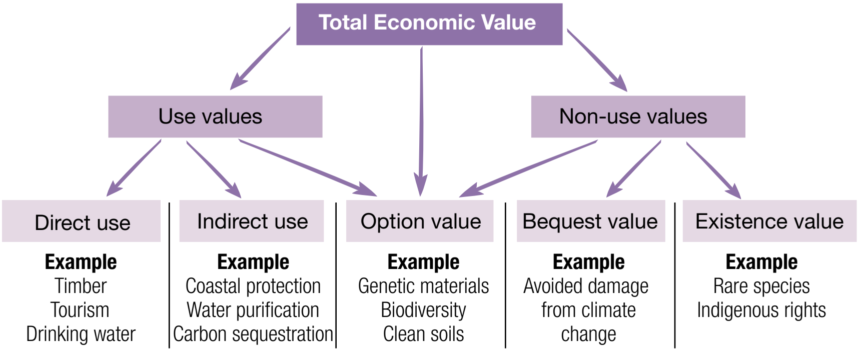
Source: Wikipedia

(In)direct use & non-use values

The value of a natural resource depends not only on whether it can be physically used, but also on other benefits it can provide to people. This is reflected in the concept of the so-called Total Economic Value (TEV) of an ecosystem or environmental resource. TEV recognises that there are two main sources of value: use value and non-use value. Usually, option value is added to this as a third component of the TEV. Goods can be used directly, indirectly or may have a value that is not necessarily linked to use (see Figure 5.1).

Direct use values refer to ecosystem goods and services that are used directly by human beings. Direct use values can be both consumptive and non-consumptive. Consumptive or extractive uses include, for example, timber for fuel and construction, harvesting of food products, and collection of medicinal products. Non-consumptive or non-extractive uses include, for example, the enjoyment of recreational and cultural activities that do not require harvesting of products but still involve the direct presence of the people appreciating it. Direct use values are relatively easy to value because their prices are often traceable in markets.

Figure 5.1 The composition of Total Economic Value



definition

(Non)Consumptive or (non)extractive uses
Consumptive or extractive use refers to utilisation of resources that are not returned to the ecosystem from which the resource is withdrawn. Non-consumptive or non-extractive uses utilise the services of an ecosystem without extracting any elements from that ecosystem.

Indirect use values are derived from ecosystem services that provide benefits outside the ecosystem itself. Examples include mangrove forests that may provide storm protection to neighbouring villages, water filtration by forests benefiting people far downstream, and carbon sequestration benefiting the entire global community by abating climate change. Indirect use values are more difficult to value because of the complexity of estimating the level of the service provided in relation to the ecosystem and identifying who benefits.

Non-use values refer to the value that people derive from goods and services independent of any present or future use that people might make of those goods. Non-use values can be subdivided into bequest, option and existence values.

- *Bequest value* refers to benefits from ensuring that certain goods and services will be preserved for future generations. For example, many of us are concerned with future damages from global warming and would be willing to pay to reduce them, despite the fact that the vast majority of the damages are expected to affect the Earth after our generation is gone. Policies associated with either long-term or irreversible impacts can lead to losses that consist primarily of bequest value. Bequest value is particularly relevant in the Pacific context where it is common for land to be passed on from one generation to the other and forms part of a person's identity.

- *Existence value* reflects benefits from simply knowing that a certain good or service exists. For example, some people derive satisfaction from the fact that many endangered species are protected against extinction. Many people are willing to pay for protection of these species' habitats, even those species located in remote, hard to access areas. Although those people placing the value will most likely never travel to these places, or see the species, they nonetheless value the knowledge that such species exist.

Option value arises from uncertainty about the future demand for or supply of the good. It should be noted that option value is generally treated differently from other non-use values in current literature. In fact, some economists consider option value as a type of use value. Whatever the label may be, option value can best be thought of as an insurance premium one may be willing to pay to ensure the supply of the environmental good later in time. For example, people may be willing to pay for preserving biodiversity or genetic materials to ensure the option of having related services in the future.

example

Example Box 5.1: The value of the Buff/Pencar watershed in Jamaica

To justify improved watershed management, the Buff Bay/Pencar watershed in Jamaica was valued both in terms of direct and indirect uses. The results are shown in the Table below. The indirect use values, such as water supply and carbon sequestration, are valued at around US$50-54 million. Typically, the direct use value, which consists of net-benefits of coffee, banana, timber, and agro-forestry products, is much lower – it is valued at only US$27 million. Although indirect use values are often substantial, the services that provide these values are not usually traded on the market, and thus their importance is often considered less than those services that provide direct use values.

Table 5.1 Total Estimated Direct Use and Non-Use Values (US$, 2004 prices)

1. Direct Use Values	US$ million	2. Indirect Use Values	US$ million
a. Coffee	13.5	a. Water Supply	17.5-20.3
b. Bananas	6.5	b. Water Quality	n.e.
c. Timber	3.2	c. Soil Conservation	n.e.
d. Agro-forestry	4	d. Biodiversity Protection	n.e.
e. Recreation/Tourism	0.03	e. Carbon Storage	33
Sub-total	*27.23*	*Sub-total*	*50.5-53.3*

n.e.: Not Estimated *Source: Pantin and Reid (2005)*

5.3 Categorisation of valuation techniques

A number of economic valuation methods have been developed to estimate the value of changes in the provision of environmental goods and services. These methods are divided into direct market price methods, revealed preference methods, and stated preference methods. These categories are briefly explained below before each specific valuation method is explained in detail. In addition to the 'primary' valuation methods, the value of environmental goods and services at one location can be estimated based on the results of valuation studies of environmental services at other locations, thereby transferring values from one site to another. This technique is called 'value transfer' or 'benefit transfer' – in these guidelines we will use the term 'value transfer' because the values being transferred could be benefits or costs.

Direct market price methods should be used when markets for environmental goods and services exist. By observing how much of an environmental good is bought and sold at different prices, it is possible to infer directly how people value that good. The benefits of an increase in the quantity of an environmental good or service should be estimated using data on these market transactions. Unfortunately, direct markets for environmental goods and services do not often exist. In this case, alternative methodologies for valuing environmental resources should be used.

Revealed preference (RP) methods are based on actual consumer or producer behaviour and identify the ways in which a non-marketed good influences actual markets for some other good. Preferences and values are 'revealed' in complementary or surrogate markets. RP methods use data on actual choices made by individuals or firms in related markets.

Revealed preference methods include:
- Replacement cost
- Damage cost avoided
- Mitigating expenditure
- Net factor income
- Production function method
- Hedonic pricing method
- Travel cost method

Stated preference (SP) methods use surveys to ask people to state their preferences for hypothetical changes in the provision of environmental goods or services. This information on preferences is then used to estimate the values that people attach to the environmental goods and services in question.

Stated preference methods include:
- Contingent valuation
- Choice modelling / conjoint analysis

5.4 Selecting valuation methods

The economic valuation methods identified above are suited to valuing different environmental goods and services. 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. This balancing act will be particularly important in those small islands where these constraints are severe.

Table 5.2 gives an indication of which methods are suited to the valuation of a number of commonly valued environmental resources, goods and services in small islands. No single method is necessarily the best for valuing all resources and for all small island contexts. For each application it is necessary to consider which method(s) is the most appropriate. Sometimes a number of different methods should be used in conjunction in order to estimate the value of different services from a single ecosystem.

The selection of which method to apply to value a specific environmental service will be context specific and dependent on a number of factors, including whether or not the environmental service is traded directly or indirectly in a market, the stakeholders that hold values for the service, the available budget for conducting a valuation study, and the availability of existing information on the value of similar resources. Table 5.3 provides an overview of which valuation methods have commonly been used to value specific ecosystem services. The methods are listed in order of technical complexity, from most straightforward to most complex.

Table 5.2 Valuation methods, typical applications, examples and limitations

Valuation method	Approach	Applications	Examples	Limitations
Market prices	Observe prices directly in markets	Environmental goods and services that are traded in markets	Timber and fuel wood from forests; clean water from wetlands	Market prices can be distorted e.g. by subsidies. Environmental services often not traded in markets
Replacement cost	Estimate cost of replacing environmental service with man-made service	Ecosystem services that have a man-made equivalent that could be used and provides similar benefits to the environmental service.	Coastal protection by mangroves; water storage and filtration by wetlands	Over-estimates value if society is not prepared to pay for man-made replacement. Under-estimates value if man-made replacement does not provide all of the benefits of the environmental service.
Damage cost avoided	Estimate damage avoided due to ecosystem service	Ecosystems that provide protection to houses or other assets	Coastal protection by mangroves/ reefs; river flow control by wetlands	Difficult to relate damage levels to ecosystem quality.
Net factor income	Revenue from sales of environment-related good minus cost of other inputs	Ecosystems that provide an input in the production of a marketed good	Filtration of water by wetlands; commercial fisheries supported by coral reef	Over-estimates ecosystem values
Production function	Estimate value of ecosystem service as input in production of marketed good	Ecosystems that provide an input in the production of a marketed good	Filtration of water by wetlands; commercial fisheries supported by coral reef	Technically difficult. High data requirements
Hedonic pricing	Estimate influence of env. characteristics on price of marketed goods	Environmental characteristics that vary across goods (usually houses)	National parks, air pollution, proximity to waste dumps	Technically difficult. High data requirements
Travel cost	Travel costs to access a resource indicate its value	Recreation sites	National parks, marine protected areas	Technically difficult. High data requirements
Contingent valuation	Ask survey respondents directly for WTP for environmental service	Any environmental good or service	Species loss, natural areas, air pollution	Expensive to implement
Choice modelling	Ask survey respondents to trade-off environmental and other goods to elicit WTP	Any environmental good or service	Species loss, natural areas, air pollution	Expensive to implement. Technically difficult
Value transfer	Use values estimated at other locations	Any environmental good or service	Species loss, natural areas, air pollution	Possible transfer errors. Can be as technically difficult as primary valuation

Source: adapted from Pagiola et al (2004), Table 3.1

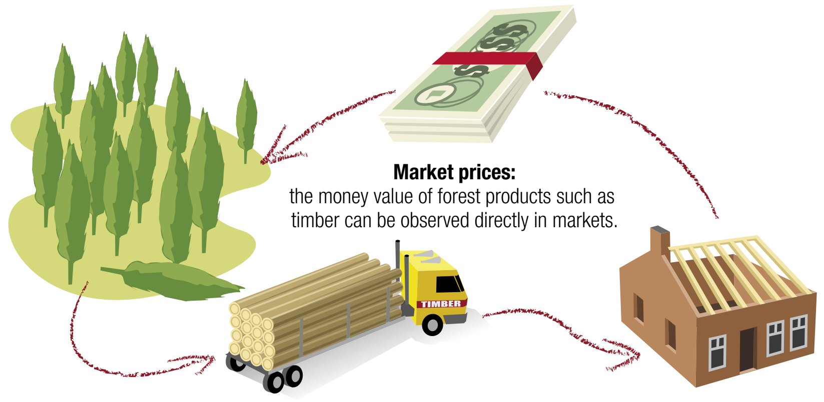
Table 5.3 Ecosystem services and commonly applied valuation methods

Ecosystem service	Valuation method
Food, timber, fuel wood	Market prices
Water filtration	Replacement cost, net factor income, production function
Water storage	Replacement cost, net factor income, production function
River flow control	Replacement cost, damage cost avoided, production function, net factor income
Coastal protection	Replacement cost, damage cost avoided, production function, net factor income
Support to fisheries	Net factor income, production function
Recreation site	Market prices, contingent valuation, travel cost, hedonic pricing, choice modelling
Visual aesthetics	Contingent valuation, hedonic pricing, choice modelling
Biodiversity	Contingent valuation, choice modelling
Non-use/existence values	Contingent valuation, choice modelling

5.5 Market prices

The most straightforward and commonly used method for valuing any good or service is to look at its market price, i.e. how much it can be bought or sold for. In a competitive market without distortions (e.g. taxes or subsidies) price is determined by the relative demand for and supply of the good or service in question, and reflects its marginal value (i.e. the value of a small change in the provision of that good or service). Market prices are therefore useful for valuing environmental goods and services that are directly traded in markets, for example products such as timber, fuel wood, fish, and other foods.

The major advantage of this technique is that it is relatively easy to apply, as it makes use of generally available information on prices and only requires simple modelling and few assumptions. A major disadvantage is that many environmental goods and services are not traded directly in well-functioning markets and so readily observable prices for them are not available. If markets for environmental goods and services do exist but are highly distorted, the available price information will not reflect true social and economic values and cannot be used. It is therefore necessary to be aware of the causes of market distortions in order to recognise where price information is unreliable. The main sources of market distortion are: taxes and subsidies; non-competitive markets; imperfect information; and government controlled prices. **The market price method is straightforward and inexpensive to apply and is relevant for environmental valuation in the small island context when market prices exist for ecosystem goods and services.**



Step by step

There are three main steps involved in collecting and analysing the data required to use the market price method to value changes in environmental goods and services:

Step 1: Collect data on or specify the change in the quantity of the good or service

See scenario development and impact assessment sections in Chapter 4.

Step 2: Collect data on its market price. Identify if price is distorted and if necessary correct distortions by finding comparable product or services in similar circumstances at undistorted prices;

Step 3: Multiply price by the change in quantity to determine the value of the change.

Potential sources of data on both the quantity and price of marketed goods include government statistics, income and expenditure surveys, and market research studies. If secondary sources of data are not available, it may be necessary to collect data directly by means of a survey of consumers and producers. It should be noted that prices and quantities of the good/service being researched might vary by season and location. Care should therefore be taken to collect data that covers an adequate period of time and sample of locations in order to account for such variations. See Chapter 6 for more details on data collection.

Example Box 5.2 Economic importance of the Caroni swamp in Trinidad and Tobago

The Caroni swamp in Trinidad and Tobago consists of tidal lagoons, marsh land, and mangrove forests. This wetland provides a number of important ecological and economic functions, including habitat and nursery support to fisheries, forestry products, and recreational opportunities such as bird watching and sport fishing. The extraction value of the timber and fuel wood taken from the mangrove forest has been estimated as the market value of these products, which is around US$4 per hectare of mangrove per year.

Source: Ramdial (1975)

example

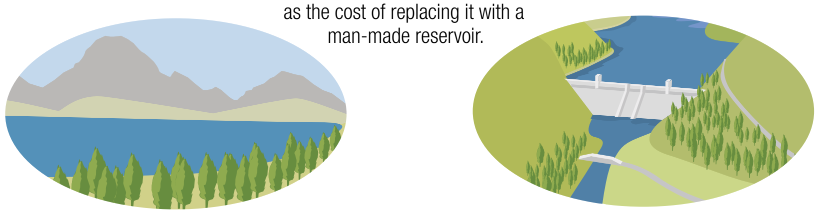
5.6 Replacement cost

The replacement cost method estimates the value of ecosystem services as the cost of replacing them with alternative man-made goods and services. For example, the value of a wetland that acts as a natural reservoir can be estimated as the cost of constructing and operating an artificial reservoir of a similar capacity.

The replacement cost technique assumes that the costs incurred in replacing lost environmental assets with man-made alternatives can be interpreted as an estimate of the value of the goods and services received from the environmental asset. Basically, it is assumed that the amount of money society spends to replace an environmental asset is roughly equivalent to the lost benefits that asset provides to society.

The replacement cost method is particularly useful for valuing ecosystem services that have direct man-made or artificial equivalents, such as water storage or waste water processing. The method is also relatively simple and inexpensive to apply. It does not require the use of detailed surveys or complex analysis.

The replacement cost method does not, however, produce a strictly correct measure of economic value, as it is not based on people's preferences for the goods and services being valued. Instead, this method assumes that if people pay to replace a lost ecosystem service, then that service must be worth at least the cost of replacement. Therefore this method is most appropriately applied in cases where replacement expenditures have been, or will be, made. Identifying technically feasible but economically or socially unviable replacement options may result in high over-estimates of ecosystem values. A key weakness of this technique is that it is often difficult to find exact replacements for ecosystem goods and services that provide an equivalent level of benefits. If the man-made infrastructure provides a lower (higher) level of service, the value of the ecosystem may be under (over) estimated. **The replacement cost method is a useful valuation tool in the small island context for valuing ecosystem services such as water storage and purification, and coastal protection in a straightforward way.**



Step by step

The basic steps in applying the replacement cost method are:

Step 1: Identify the services provided by the ecosystem being valued and assess the scale at which these services are utilised. It is important to assess the extent to which ecosystem services are actually used rather than the total capacity of the ecosystem to provide those services.

See scenario development and impact assessment sections in Chapter 4.

Step 2: Identify man-made goods, services, or infrastructure that can replace the ecosystem services at the scale at which they are utilised. The replacement infrastructure should provide an equivalent level of service as the ecosystem and be a feasible option.

Step 3: Estimate the costs of the man-made replacement goods, services, or infrastructure. Data on the cost of alternative man-made goods, services, and infrastructure should be collected from secondary sources or ascertained through expert consultation and professional estimates.

Example Box 5.3: Value of mangroves for coastal protection

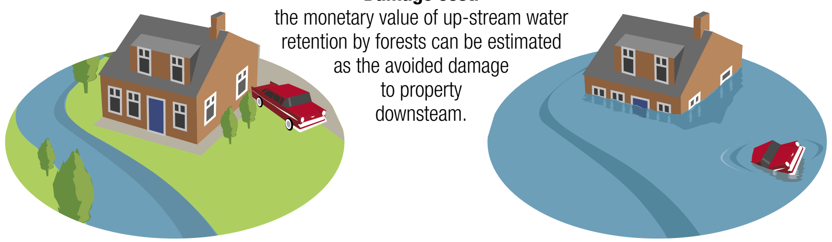
The coastal protection provided by mangroves in Southern Thailand has been valued using the replacement cost method. An important ecological function of mangroves is to serve as a windbreak and shoreline stabiliser. The value of this service has been estimated by calculating the cost of replacing this mangrove function with constructed breakwaters. The unit cost of constructing breakwaters to prevent coastal erosion is estimated to be around \$875 per metre of coastline. Based on ecological studies, it is considered necessary to preserve mangrove forests with a width of at least 75m along the coastline to stabilise the shore to the same degree as breakwaters. Given the above per-unit cost of breakwater construction, and assuming that a breakwater is 1m wide, the value of a 75m-width stand of mangroves is approximately US\$11.67 per m^2 or US\$116,667 per ha.

Source: Sathirathai and Barbier (2001)

5.7 Damage cost avoided

Ecosystems frequently provide protection for other economically valuable assets. The damage cost avoided method uses either the value of property and assets protected, or the cost of actions taken to avoid damages, as a measure of the benefits provided by an ecosystem. For example, if a coral reef provides protection to coastal areas from storm damage, the value of the coastal protection function of the reef may be estimated as the damages avoided or by the avoided expenditures by coastal residents to protect their properties.

The damage cost avoided method is particularly useful for valuing ecosystems that provide some form of natural protection. A potential weakness of the method is that in most cases estimates of damages avoided remain hypothetical. They are based on predicting what might occur under a situation where ecosystem services decline or are lost. Even when valuation is based on real data from situations where such events and damages have occurred, it is often difficult to relate these damages to changes in ecosystem status, or to be sure that identical impacts would occur if particular ecosystem services declined. **The damage cost avoided method provides a relatively straightforward approach to estimate the value of natural protection services in small islands.**



Step by step

There are four main steps involved in collecting and analysing the data required to use damage cost avoided techniques to value ecosystem goods and services:

Step 1: Identify the protective services provided by the ecosystem and assess the extent to which protection levels would change under the specific ecosystem loss scenario being considered. This involves obtaining information on the likelihood of a damaging event occurring and the extent of damage under different scenarios of ecosystem loss.

See scenario development and impact assessment sections in Chapter 4.

Step 2: Identify the infrastructure, properties, or human population that would be affected by this change in protection, and determine the boundary beyond which effects will not be analysed.

Step 3: Estimate the additional scale of damage under the ecosystem loss scenario.

Step 4: Estimate the cost of these damages using information on the value of the assets at risk.

Data on the probability of damaging events occurring is likely to be available based on historical records and expert consultation. Data on the value of assets at risk is also likely to be generally available, particularly data on property values. Predicting and quantifying the change in the scale of damage under different ecosystem loss scenarios is, however, usually a more complex exercise, and may require detailed data and modelling.

Example Box 5.4: Value of coastal protection by coral reefs in Guam

Coral reefs function as natural breakwaters; they absorb much of the incoming wave energy and help protect the shoreline from wave attack. In the absence of reefs, rates of coastal erosion and beach loss (and associated economic damage) would be significantly higher. This coastal protection function is especially crucial for Guam because it is located within the "typhoon belt" and therefore frequently subjected to tropical typhoons (tropical cyclones). Historic trends show that these storms are becoming more frequent and intensive; at the same time, the potential economic damage has increased due to continuous coastal development. Using GIS, the potential flooding zones caused by storms (and subsequent number of damaged buildings) were determined for two scenarios: 'with reefs' and 'without reefs'. With coral reefs intact, the average damage each year amounts to US$4.3 million. Without the presence of reefs, this damage would increase to a level of US$12.7 million per year. Therefore, the coastal protection value of coral reefs in Guam is estimated at US$8.4 million per annum.

Source: van Beukering et al. (2007).

5.8 Net factor income

The net factor income method estimates the value of ecosystem services as an input in the production of a marketed good. It estimates the value of an ecosystem input as the total surplus between revenues and the cost of other inputs in production. For example, the value of a coral reef in supporting reef based dive recreation should be calculated as the revenue received from selling diving trips to the reef, minus the labour, equipment and other costs of providing the service. **This method is likely to be useful in the small island context for valuing many ecosystem services such as the support of tourism, fisheries, and other industries. It is a relatively simple method to apply and uses generally available data.**

Step by step

The basic steps in applying the net factor income method are:

Step 1: Identify the ecosystems and services under consideration.

See scenario development and impact assessment sections in Chapter 4.

Step 2: Identify the production process(es) to which the ecosystem provides inputs.

Step 3: Calculate the revenue from production by multiplying the output by the market price.

Step 4: Calculate the cost of production by multiplying the unit cost of each input by its quantity.

Step 5: Calculate the net factor income by subtracting the cost of production from the revenue.

Example Box 5.5: Value of dive related tourism in Bonaire

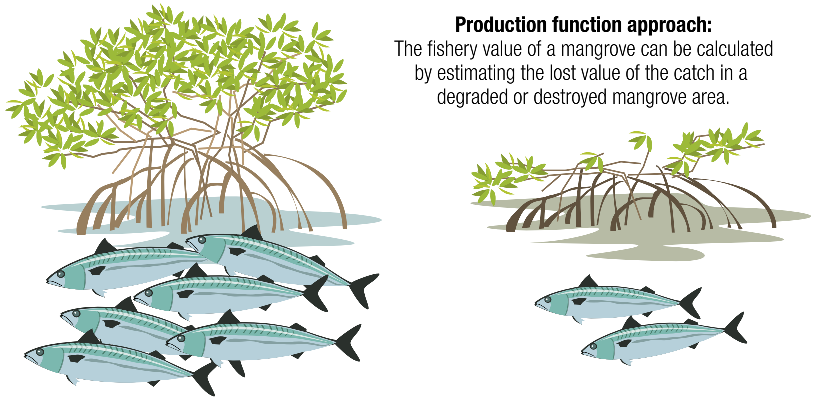
The value of reef related tourism in Bonaire in 1991 has been calculated using data provided by the Bonaire Department of Revenue and the Tourism Corporation Bonaire. Net annual benefits of dive related tourism were estimated to range between US$7,924,000 and US$8,799,000. These figures are based on net profits that accrue to reef related businesses owned and operated by Bonaireans or permanent residents and taxes levied on foreign owned reef related businesses.

Source: Pendleton (1995)

5.9 Production function

The production function 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. This method is different from the net factor income method in that it estimates a functional relationship between inputs and output, i.e. shows how output changes with changes in input. The net factor income method, on the other hand, takes the quantities of outputs and inputs as given.

A production function describes the relationship between inputs and outputs in production. For example, the production of fruits and nuts from a forest may be described as a function of hours spent harvesting (labour) and the area and quality of the forest. A change in the availability of an ecosystem input may result in both a change in total output and a change in the use of other inputs. For example, a reduction in the area of forest may result in either a decrease in the harvest of fruit or an increase in the number of hours spent harvesting a given quantity. Either way the harvester suffers an economic loss. By calculating the change in the value of production (the surplus between revenues and the cost of production) given a change in ecosystem input, you will be able to observe the value of that input. The production function valuation method can be applied either to the activities of firms or to households and individuals. **The production function valuation method is technically difficult to apply and has substantial data requirements. As such, it is less relevant to the small island context unless the necessary expertise and data are available. The net factor income method offers a more straightforward way of estimating the value of ecosystem goods and services as inputs in production.**



Production function approach:
The fishery value of a mangrove can be calculated by estimating the lost value of the catch in a degraded or destroyed mangrove area.

In valuing changes in inputs/outputs, it is essential to distinguish between changes in quantity that are sufficient in scale to result in changes in price, and those that do not result in price changes. If the change in output or resource input is small relative to their respective total market shares, then you should assume that prices will remain constant after the change in output. If the change in output is large relative to the total market, this may induce changes in the price of the affected good/service, and you must establish the change in price likely to result. This requires us to consider the underlying supply and demand of the affected good/service.

Step by step

The basic steps in applying the production function method are:

Step 1: Identify the ecosystems and services under consideration.

See scenario development and impact assessment sections in Chapter 4.

Step 2: Identify the production process(es) to which the ecosystem provides inputs.

Step 3: Estimate the production function(s) using data on production inputs (labour, capital, materials, ecosystem input etc.) and outputs, using statistical analysis.

Step 4: Estimate the net revenues (or producer surplus) before the change in environmental service input – i.e. by plugging the original level of inputs into the estimated production function. The original revenue should be calculated by multiplying output by the market price; and the cost should be calculated by multiplying the unit cost of each input by its quantity.

Step 5: Estimate the net revenues after the change in environmental service input in the same way.

Step 6: Calculate the change in net revenues by subtracting the new net revenues from the original net revenues.

definition

Producer surplus
Producer surplus is a measure of producer welfare. It is the difference between what producers are willing to supply a good for and the price they actually receive.

example

Example Box 5.6: Mangroves supporting fisheries in Thailand

Mangroves are considered to be ecologically and economically important due to their role as breeding grounds and nursery habitats for off-shore fisheries. This case study uses the production function approach to analyse the influence of mangrove habitat change on artisanal marine demersal and shellfish fisheries in Thailand. A production function was estimated using data for the five coastal zones of Southern Thailand for the period 1983-1993. The estimated function relates fish catch to the level of fishing effort and the area of mangrove forest. The welfare losses resulting from mangrove deforestation at a rate of 30km^2 per year are estimated to range from US$12,000 to US$408,000 per year depending on the responsiveness of demand to changes in the price of fish and shellfish.

Source: Barbier et al (2002)

5.10 Hedonic pricing

Explanation

The hedonic pricing method should be used to estimate economic values of ecosystem services that directly affect the price of marketed goods. The basic premise of the hedonic pricing method is that the price of a good is related to its characteristics, including its environmental characteristics. The hedonic pricing method is often used to value environmental amenities that affect the price of residential properties (hedonic property value studies). For example, a house that is close to an aesthetically pleasing natural area may be worth more than a similar house that is further away. Such differences in house characteristics and prices may be used to identify the value of natural amenities using statistical methods.

Hedonic property value studies assume that individuals perceive housing units as bundles of attributes and derive different levels of utility from different combinations of these attributes. When transaction decisions are made, individuals make tradeoffs between money and attributes. These tradeoffs reveal the marginal values of these attributes and are central to hedonic property value studies.

Hedonic property value studies use statistical regression methods and data from real estate markets to examine the increments in property values associated with different attributes. Structural attributes (e.g., number of bedrooms and age of house), neighbourhood attributes (e.g., population demographics, crime, and school quality), and environmental attributes (e.g., air quality and proximity to hazardous waste sites) may influence property values. When assessing an environmental improvement, it is essential to separate the effect of the relevant environmental attribute on the price of a housing unit from the effects of other attributes. **The hedonic pricing method is less relevant in the small island context due to the complexity of the analysis and the need for large amounts of data. Hedonic property value models require data on a large number of house sales, which might not be available in small housing markets.**

Hedonic pricing: the monetary value of environmental amenities can be estimated by comparing the prices of houses with different surroundings.

definition

Regression analysis

In statistics, regression analysis examines the relation of a dependent variable to specified explanatory 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.

Step by step

The basic steps in applying the hedonic pricing method to value environmental amenities using house price information are:

Step 1: Identify the ecosystems and services under consideration.

See scenario development and impact assessment sections in Chapter 4.

Step 2: Collect data on residential property sales in the region of the natural area being valued. The required data include house prices and locations; and structural, neighbourhood, accessibility and environmental property characteristics.

Step 3: Statistically estimate a function that relates house prices to property characteristics, including the distance to the natural area. The function indicates how much more a property close to the natural area is valued compared to a similar property that is located further away.

example

Example Box 5.7: Amenity value of coastline in Guam

The view and presence of a clean beach and a healthy coral reef is perceived as a benefit by those living nearby. As such, houses and hotels in the vicinity of a healthy marine system are generally more valuable than comparable properties further from the coast. This amenity-associated value was estimated through a statistical analysis of a database containing information on more than 800 house sales in Guam during 2000-2004. It showed that with every additional kilometre from the coast, the value of a given house declined by US$17,000. By extrapolating this relationship, the annual amenity value of coastal attributes in Guam was estimated at US$9.6 million.

Source: van Beukering et al. 2007.

5.11 Travel cost method

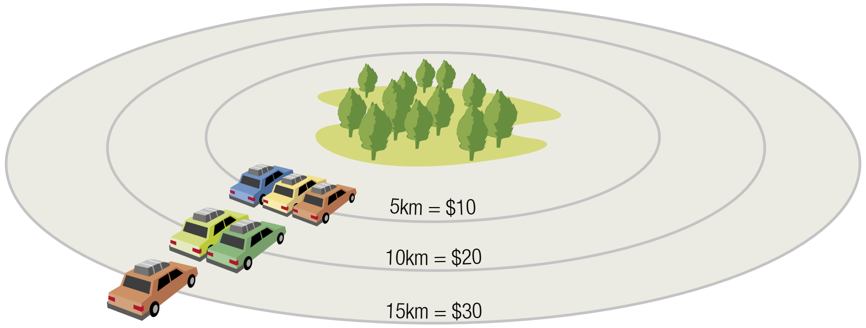
The travel cost method is used to estimate the value of ecosystems or sites that are used for recreation. The premise behind this method is that the travel expenses that people incur to visit a site represent the "price" of access to the site. Travel expenses include the actual travel costs (e.g. price of using public transport, petrol and maintenance for travel by private car, aeroplane ticket etc.), time costs, and admittance fees. With this information, peoples' willingness to pay to visit a site should be estimated based on the number of trips that they make at different travel costs. For example, for a forest that is used for recreation, information on the number of people that visit the site and the time and cost they spend travelling to reach it can be used to estimate the economic value of the recreational service that is provided.

The travel cost method is frequently used to value site-specific levels of environmental resource provision and, to a lesser extent, quality. Basically, information on visitors' total expenditure to visit a site is used to estimate the demand for the services provided by the site. This demand information is then used to measure the average benefits to visitors, which is subsequently aggregated over the affected population to derive a measure of total benefit. It can also be used to measure the benefits/costs resulting from changes in the services (quantity and/or quality) provided by the site.

The travel cost method is dependent on a relatively large data set. Data are usually collected through visitor interviews and questionnaires, which require sampling to cover different seasons or times of the year, and to ensure that various types of visitors from different locations are represented. The locations of origin of visitors to a site are often grouped into zones of increasing distance from the site. Complex statistical analysis and modelling are required in order to construct information on visitor demand.

Travel cost surveys are typically expensive and time consuming to carry out. An additional source of complication is that several factors make it difficult to isolate the value of a particular ecosystem in relation to travel costs, and these must be taken into account in order to avoid over-estimating ecosystem values. Visitors frequently have several motives or destinations on a single trip, some of which are unrelated to the ecosystem being studied. They also usually enjoy multiple aspects and attributes of a single ecosystem. **The travel cost method may be relevant for valuing recreational sites in small islands that are visited by foreign tourists (e.g. coral reefs, national parks) but otherwise it is a less relevant method in the small island context.**

Travel cost: the value of a recreational site can be estimated from the number of visitors and the cost of travelling there



Step by step

The basic steps in applying the zonal travel cost method are:

Step 1: Identify the ecosystems and services under consideration.

See scenario development and impact assessment sections in Chapter 4.

Step 2: Define a set of zones surrounding the recreational site being valued. These may be defined by concentric circles around the site, or by geographic divisions that make sense, such as administrative districts surrounding the site at different distances. Travel costs to the site should be approximately equal for any location within each zone.

Step 3: Within each zone, sample visitors to collect information about the costs incurred in visiting the ecosystem, motives for the trip, frequency of visits, site attributes and socio-economic variables such as the visitor's place of origin, income, age, and education.

Step 4: Calculate the average travel cost from each zone using the average round-trip travel distance and the cost per km, and the average travel time and cost per hour.

Step 5: Estimate a demand function for visiting the site using statistical analysis and the data collected. This function relates the number of site visits to the cost of visiting. The higher the cost of visiting the site, the less likely it will be that tourists will visit the site from these far zones.

Step 6: Collect information on the number of visitors from each zone, and the number of visits made in the last year.

Step 7: Estimate the total economic benefit of the site to visitors by calculating the consumer surplus, or the area under the demand curve at the current number of visits.

definition

Consumer surplus

Consumer surplus is the difference between the price consumers are willing to pay and the actual price. If someone is willing to pay more than the actual price, their benefit in a transaction is how much they saved when they didn't pay that price.

example

Example Box 5.8: Recreational value of Hawaiian coral reefs

Figure 5.2 shows the zonal distribution of visitors to the coral reefs of Hawaii in 2001 in ascending order of travel distance. The regions of origin of the 'marine active' tourists are divided into 14 zones with increasing distances from the point of departure of the visitor to the Hawaiian coral reefs.

Next, the travel costs have been determined for the visitors from the different zones. Three types of travel-related costs are included: (1) the actual costs of transportation; (2) the costs related to the travel time; and (3) the local expenditures. Because most visitors to Hawaii come by plane, the researchers simply measured the average cost of a round trip economy ticket.

Since time is a scarce resource and has an opportunity cost (i.e. time spent in one activity could be spent on another), time needs to be included in the estimation of travel costs. If individuals are giving up working time in order to visit a site, their wage rates are the correct measure of their opportunity cost. However, most recreation time is spent at the expense of alternative recreational activity. This means the opportunity cost should be measured with reference to the marginal value of other recreation activities foregone. The researchers for this case study assumed a wage rate of one-third of the actual wage rate of the visitors, which was taken from a survey of divers and snorkelers. Local spending was determined by multiplying an estimate of daily expenditures by the length of stay of the visitors from the different zones. The variation between the individual zones is shown below.

Example Box 5.9 Total travel costs per visitor in 2001 (in US$ per visitor)

Zone #	Zone name	Travel costs	Travel time cost	Local spending	Total travel costs
1	Pacific Coast	425	88	1,337	1,849
2	Japan	560	65	1,362	1,987
3	Mountain	550	125	1,477	2,152
4	West South Central	600	113	1,300	2,013
5	East North Central	650	175	1,778	2,603
6	Canada	580	108	1,745	2,432
7	West North Central	575	163	1,435	2,172
8	South Atlantic	625	173	1,748	2,546
9	East South Central	660	156	1,693	2,509
10	Middle Atlantic	650	211	1,585	2,446
11	New England	700	217	1,946	2,863
12	Other Asia	875	131	2,799	3,804
13	Oceania	900	149	2,541	3,590
14	Europe	1,000	184	1,634	2,817

This information, together with data on visitation rates per zone, were used to estimate a demand curve for Hawaiian tourism. The consumer surplus per individual in each of the zones could then be calculated. This gives the general consumer surplus of visitors to Hawaii. To capture the reef-associated consumer surplus, the consumer surplus per individual needs to be multiplied by the number of 'marine active tourists' and by the importance of reefs in their overall Hawaii experience. From the survey, it was determined that the latter was on average 18%, meaning that 18% of their expenditures could be attributed to coral reefs. This leads to a total reef-associated consumer surplus of US$ 97 million.

Source: Cesar et al. 2002.

5.12 Contingent valuation

The contingent valuation method is a stated preference method and involves directly asking people, in a survey, how much they would be willing to pay for specific environmental services. The contingent valuation method can be used to estimate economic values for all types of ecosystem service. The term "contingent" denotes that valuation is based on a specific hypothetical scenario and description of the environmental service. For example, in the case that a wetland provides habitat for a popular species of animal, respondents to a survey might be asked to state how much additional tax they are willing to pay to preserve the wetland in order to avoid a decline in the population of that species. In some cases, people are asked for the amount of compensation they would be willing to accept to give up a specific environmental service rather than their WTP to avoid its loss.

See Section 5.2 for more information on WTP and WTA.

The idea is that a hypothetical, yet realistic, market for buying or selling the use and/or preservation of a good or service can be described in detail to an individual, who then participates in the hypothetical market by responding to a series of questions. These questions relate to a proposed change in the quality or provision of the good or service.

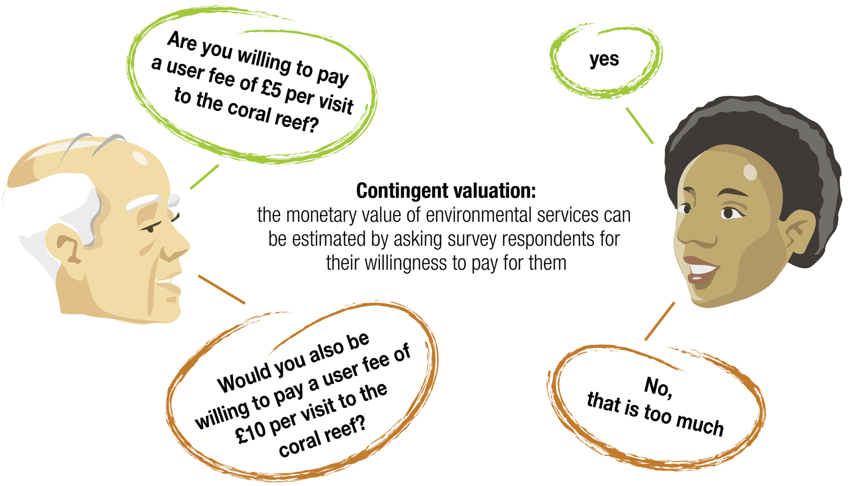
The responses to these questions are then analysed to estimate the average value the respondents associate with the proposed change. This value can subsequently be aggregated over the affected population to derive a measure of total benefit (or cost).

Most contingent valuation studies are conducted via face-to-face interviews or postal surveys with individuals, but sometimes interviews are conducted with groups. A variety of question formats are used in order to elicit respondents' statement or bids of their WTP/WTA for particular changes in the provision of ecosystem goods or services. The two main variants of question format used in contingent valuation are:

1. *Dichotomous choice* – in which respondents are presented with a bid amount and asked whether or not they are willing to pay/accept it. In the so-called 'double bounded' dichotomous choice format, respondents are presented with a second bid amount and again asked if they are willing to pay/accept, thereby establishing a range in which WTP/WTA falls.
2. *Open-ended* – in which respondents are simply asked to state how much they are willing to pay or accept.

A major advantage of the contingent valuation method is that it can be applied to estimate values for all types of environmental goods and services, including non-use values and also changes in ecosystem services that have not yet occurred. Because contingent valuation does not rely on actual markets or observed behaviour, it can in theory be applied to any situation, good or service.

A weakness of this method is that responses to willingness to pay questions are hypothetical and may not reflect true behaviour. Hypothetical scenarios described in contingent valuation questionnaires might be misunderstood or found to be unconvincing to respondents, leading to biased responses. The most common forms of bias are related to strategic behaviour, survey design, payment instrument, and the bid amount starting point. It is important to carefully design and pre-test contingent valuation questionnaires in order to avoid or mitigate these biases.



Another disadvantage of the contingent valuation method is that it requires complex data collection and sophisticated statistical analysis and modelling. The large-scale surveys that are necessary for contingent valuation can also be expensive to conduct.

Contingent valuation may be a useful valuation tool in the small island context given its flexibility for valuing different environmental goods and services but it involves complex data analysis and relatively expensive data collection. This method is therefore only applicable when the necessary expertise and budget is available.

Step by step

The basic steps in applying the contingent valuation method are:

Step 1: Define the valuation problem in terms of which ecosystem services are to be valued and what the relevant population is.

See Scenario development and impact assessment sections in Chapter 4.

Step 2: Design the survey. This involves a number of steps including deciding what type of survey will be used (mail, telephone, face-to-face), the question format, payment vehicle, the WTP question, and pre-testing.

Step 3: Survey implementation. This includes selecting the survey sample, which in most cases should be a random sample from the relevant population.

Step 4: Analysing the results. This includes cleaning the data and dealing with non-responses to the survey and protest bids. Mean WTP per person should be calculated from the cleaned data – and extrapolated to the relevant population size to give a total value for the ecosystem in question.

example

Example Box 5.10: Contingent valuation for protected coral reefs in the Philippines

This case study explores the demand by local and international divers for dive trips to protected coral reef areas in the Philippines. A small scale survey was carried out among dive tourists on and near Anilao, Mactan Island, and Alona Beach during the summer months of 1997. The survey method was mixed, namely in-person, self-administered, or a combination, depending on the situation and the respondent's interest in clarifying questions.

The questionnaire used the following 'payment card' elicitation format: "How much would you be willing to pay as a daily, per person entrance fee to a marine sanctuary where fishing is prohibited, in addition to the other costs of the trip? US$0, US$1, US$3, US$5, US$10, other (please specify)"

The results show a positive willingness to pay to enter marine sanctuaries. Estimated annual potential revenues range from US$0.85–1 million on Mactan Island, from US$95–116 thousand in Anilao and from US$3.5–5.3 thousand on Alona Beach. These revenues could be used to support coral reef conservation and possibly the creation of alternative employment opportunities for locals who would be barred from fishing, which is their traditional income generating activity.

In addition to questions on willingness to pay to enter a marine sanctuary, the survey also sought to elicit information on the type of organization to which divers would prefer to make payments. The categories of organization that were offered were: national government agency, an environmental NGO, local tourism association, a fishing community, local government (municipality) or 'other'. Most tourists interviewed preferred NGOs as the most trustworthy organization type to collect and manage entrance fees. Government agencies at the local and national levels were the least trusted by the respondents.

Source: Arin and Kramer (2002)

5.13 Choice modelling

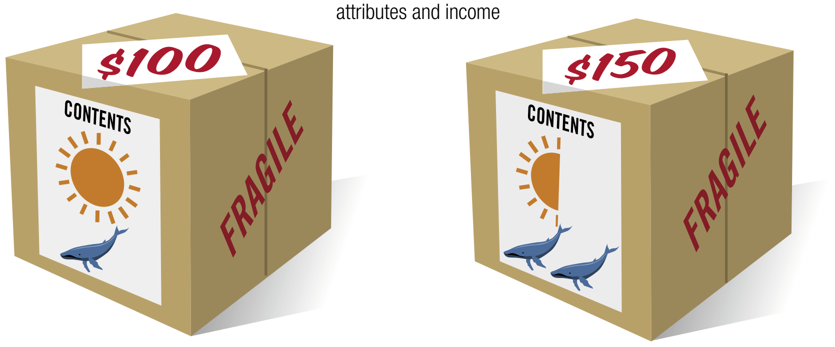
Choice modelling is also a stated preference method and is similar to contingent valuation in that it can be used to estimate economic values for virtually any ecosystem good or service. It is also a hypothetical method – it asks people to make choices based on a hypothetical scenario. Choice modelling is based around the idea that any good can be described in terms of its attributes or characteristics. Changes in attribute levels essentially result in a different good, and choice modelling focuses on the value of such changes in attributes. Values are inferred from the hypothetical choices or tradeoffs that people make between different combinations of attributes. Choice modelling is different from contingent valuation in that it asks respondents to select between a set of alternatives, rather than asking directly for values. Values should be derived from the responses by including a money indicator (e.g. price of the good) as one of the characteristics.

The choice modelling valuation method addresses a number of the difficulties associated with traditional valuation methods. For example, rather than simply asking respondents how much they are willing to pay for a single improvement in a given non-market good, a choice model forces respondents to repeatedly choose between complex, multi-attribute profiles which describe various changes in non-market benefits at a given cost (e.g. a change in tax paid). In a typical choice model study, respondents are presented with a series of choice sets composed of two or more multi-attribute alternatives (one alternative is often the status quo). For each choice set, a respondent evaluates the alternatives and chooses a preferred option. The alternative options in each choice set are described using a common set of attributes, which summarise the important aspects of the alternatives.

Because it focuses on tradeoffs among alternatives with different characteristics, contingent choice is especially suited to policy decisions where a set of possible actions might result in different impacts on natural resources or environmental services. For example, a restored wetland will improve the quality of several services, such as floodwater storage, drinking water supply, on-site recreation, and biodiversity. In addition, while contingent choice can be used to estimate dollar values, the results may also be used simply to rank options, without focusing on dollar values.

Choice modelling is an efficient means of collecting information, since choice tasks require respondents to evaluate multi-attribute profiles simultaneously. In addition, economic values are not elicited directly but are inferred by the trade-offs respondents make between monetary and non-monetary attributes. As a result, it is less likely that Willingness to Pay (WTP) information gathered using this method will be biased by strategic response behaviour. A further advantage of the choice model approach is that research is not limited by pre-existing market conditions, since the levels used in a choice experiment can be set to any reasonable range of values. As such, the choice modelling is useful to use as a policy tool for exploring proposed or hypothetical futures or options (for example, in a decision support tool based on the results). Finally, and perhaps most importantly in the context of non-market valuation, choice experiments allow individuals to evaluate non-market benefits described in an intuitive and meaningful way, without being asked to complete the potentially objectionable task of directly assigning dollar figures to important values such as culture.

Choice modelling:
the monetary value of environmental services can be estimated from the trade-offs people make between environmental attributes and income



Box one contains extremely good weather and one whale will be spotted during the holiday. The package costs $100

Box two contains mildly good weather and two whales will be spotted during the holiday. The package costs $150

Choice modelling may be a useful valuation tool in the small island context given its flexibility for valuing different environmental goods and services but it involves complex data analysis and relatively expensive data collection. This method is therefore only applicable when the necessary expertise and budget is available.

Step by step

The basic steps in applying the choice modelling method are:

Step 1: Define the valuation problem in terms of which ecosystem services are to be valued and who the relevant population is.

See Scenario development and impact assessment sections in Chapter 4.

Step 2: Design the survey. This involves a number of steps including deciding what type of survey will be used (mail, telephone, face to face), determining the choice set (i.e. what characteristics will respondents be required to choose between), choosing the payment vehicle (the monetary characteristic), and pre-testing. Ideally, focus groups followed by pre-testing should be used to set and test the relevant levels of the characteristics used.

Step 3: Survey implementation. This includes selecting the survey sample, which in most cases should be a random sample from the relevant population.

Step 4: Analysing the results. The statistical analysis for contingent choice is generally more complicated than that for contingent valuation and requires the use of statistical analysis to infer willingness to pay from the tradeoffs made by respondents. The average value for each of the characteristics included in the choice set should be estimated, and this is then extrapolated to the relevant population in order to calculate a total value for the ecosystem site under different scenarios.

example

Example Box 5.11: Local willingness to pay for coral reef conservation in Guam

Guam's coral reefs provide important cultural, recreational, and non-commercial fishery values that are not easy to measure using direct market methods. However, it is extremely important to include non-market values in economic assessments to ensure that governments and policy makers are aware of the full value associated with natural assets such as coral reefs.

The choice experiment implemented for this research project investigated three important non-market benefits associated with Guam's coral reefs: local recreational use, abundance of culturally significant fish species, and non-commercial fishery values. In addition, a pollution attribute and a reef fishery management attribute were also included in the choice experiment as two factors affecting reef health. The pollution attribute measured preferences for controlling land-based sources of pollution (including sedimentation, run-off, and sewage outflow), while the reef management attribute measured preferences for eliminating destructive fishing practices. Income tax was included as the monetary variable in the choice experiment to provide a suitable payment vehicle for willingness to pay calculations (Figure 5.3).

Attributes	Option 1	Option 2	Current situation
REEF RECREATION *Number of recreation areas provided by coral reefs*	20% less	20% more	No change
FISH CATCH *Reef fish & seafood caught on the average fishing trip is enough for:*	One meal	meal + sharing + selling	One meal
CULTURAL FISH *Amount of cultural fish (e.g. baby Rabbitfish & baby Goatfish)*	20% less	20% more	No change
REEF MANAGEMENT PRACTICES	None (outside the MPAs)	Measures taken	None (outside the MPAs)
POLUTION FROM LAND *Change in the amount of pollution entering reef (e.g. sediment, sewage)*	20% more	20% less	No change
INCOME TAX *Change in the amount of income tax that you pay on a yearly basis*	$40/year less	$40/year more	No change
Which of the options do you prefer?	☐ Option 1	☐ Option 2	☐ Current situation

Value of non-use benefits: The results of the choice model indicate that significant economic values are associated with the three non-market benefits included in the survey. Guam's residents appear to place a similar value on the reefs' ability to provide local recreational benefits and supply culturally significant fish species. In addition, the results indicate that maintaining reef fish and seafood stocks at a level that can support the culture of food sharing is very important. One other interesting result emerged. The WTP for sufficient fish catches to share with family and friends was valued at US$92 per fisherman.

example

Typically, if the fish catch was big enough so as to also allow for the sale of fish, the WTP dropped to US$32. This negative value associated with the sale of fish implies that the sharing of fish is significantly more important than earning additional income.

Attitude towards management: Although Guam's residents generally support a ban on some of the more exploitative fishing methods (such as night scuba spear fishing), they are more concerned about the effects of pollution and managing pollution as a threat to the reefs. The importance of the pollution attribute is not surprising since pollution has negative effects on both consumptive (e.g. fishing) and non-consumptive benefits (e.g. snorkeling, beach use) of coastal waters. In addition, many residents are likely to have had some exposure to the negative effects of pollution: several recreational and fishing areas around Guam were recently closed due to contamination.

Source: van Beukering et al. (2007).

5.14 Value transfer

Value transfer involves borrowing an estimate of WTP from one site (the study site) and applying it to another (the policy site). What is borrowed is a mean value that is unadjusted or a mean value that has been modified to 'suit' the new site. The attraction of value transfer is that it avoids the cost and time involved in conducting primary valuation studies.

The value transfer approach to environmental valuation was developed for situations in which the time and/or money costs of primary data collection for original direct and indirect studies are prohibitive. With value transfer, environmental benefit estimates from existing case studies (i.e., the study sites) are transferred to a new, policy case study (i.e., the policy site). **Given the limited resources that may be available for conducting valuation studies on small islands, under certain circumstances (see below) value transfer can provide a fast and affordable process to estimate values for environmental services.**

There are a number of conditions that need to be satisfied in order for value transfer to provide valid estimates. First, the 'primary' value from the study site must be theoretically and methodologically valid. Second, the populations in the study and policy sites must be similar. Third, the difference between pre-policy and post-policy quality (or quantity) levels must be similar across study and policy sites. Fourth, the study and policy sites must be similar in terms of environmental characteristics. Fifth, the distribution of property rights and other institutions must be similar across sites. The accuracy of value transfer will become questionable if any of these conditions are violated.

There are two general sources of error in the values estimated using value transfer: (1) errors associated with estimating the original measures of value at the study site(s); and (2) errors arising from the transfer of these study site values to the policy site. As with all types of information, transfer studies are most useful to the end-user when sources of uncertainty are identified and, where possible, quantified.

Step by step

Step 1: *Describe the scenarios.* Identify the ecosystem goods and services that are to be valued at the policy site. Describe the characteristics and consequences of the policy scenario including the population that is affected. Information on the affected population will generally be used to convert per person (or household) values to an aggregate benefits estimate.

Step 2: *Identify existing, relevant studies*. Conduct a thorough literature review to identify valuation data relating to the specific good(s)/ service(s) identified in Step 1.

information

Several good databases of valuation data are available. The most comprehensive database is the Environmental Valuation Reference Inventory (available at the EVRI web-page **http://www.evri.ec.gc.ca/evri/**). Other useful online resources are Envalue (**http://www.environment.nsw.gov.au/envalue/**), the Ecosystem Services Database (**http://esd.uvm.edu/**). Source documents for UK values are listed in the Environmental Valuation Source List for the UK (**www.defra.gov.uk/environment/evslist/index.htm**).

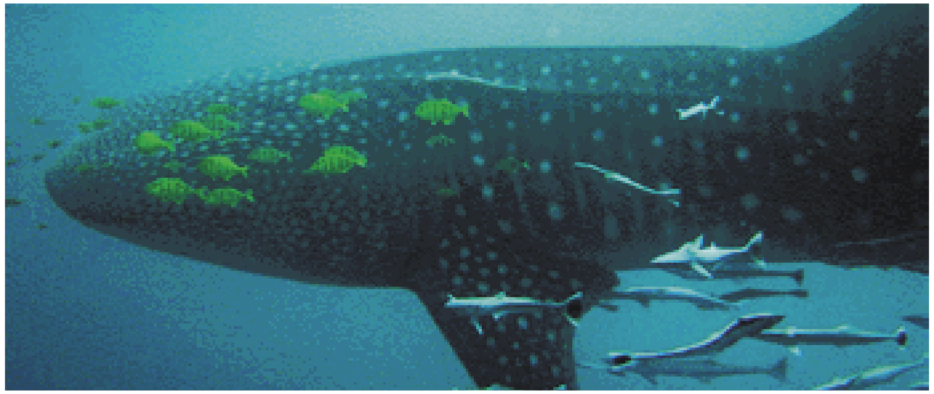
Step 3: *Review available studies for quality and applicability*. Assess the relevance (suitability) of the study site values for transfer to the policy site, considering the similarity of the policy site to the study site, the similarity of impacts considered, baseline environmental quality, the affected populations, etc. The quality of the collected primary valuation literature should also be reviewed. Indicators of quality will generally depend on the method used. The analyst should also determine whether adjustments can be made for important differences between the policy case and the study case.

Step 4: *Transfer the benefit estimates.* Transfer the value measures from the study site(s) to the policy site. There are four types of value transfer studies: point estimate, value function, meta-analysis, and Bayesian techniques.

See glossary for further details

Step 5: Determine the 'market' over which impacts at the policy site are aggregated to obtain a measure of total cost or benefit. This can account for the spatial extent of the effect, the number of affected individuals/households residing in the geographical market, and possible substitutes for the affected good or service in question. Value estimates are generally aggregated over the affected population or the area of ecosystem affected to compute an overall benefits estimate.

Step 6: *Address uncertainty.* Value transfer involves judgments and assumptions. Throughout the analysis, the researcher should clearly describe all judgments and assumptions and their potential impact on final estimates, as well as any other sources of uncertainty inherent in the analysis.



Whale shark in the Seychelles. Photo: Pieter van Beukering

example

Example Box 5.12: The economic value of the World's wetlands

Value transfer has been used to estimate the economic value of the World's wetlands. Using 246 separate observations of wetland value from 89 studies, a value transfer function was estimated. Wetland values have been reported in the literature in many different metrics, currencies and refer to different years (e.g., WTP per household per year, capitalized values, marginal value per acre, etc). In order to enable comparison, these values have been standardized to US$ 2000 per hectare per year. This standardization included a *purchasing power parity (PPP)* conversion in order to account for different price levels in different countries. The average annual wetland value in this data set is just over US$ 3,000 per hectare. The median value, however, is US$ 170 per hectare per year showing that the distribution of estimated values is skewed with a long tail of high values.

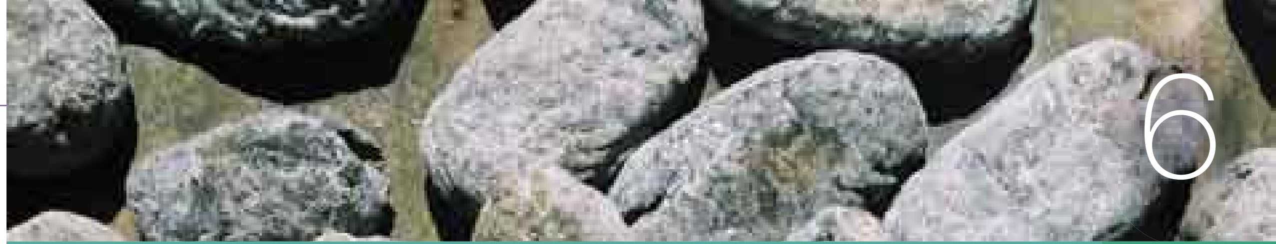
The value transfer function was estimated by computing a functional relationship between the standardized wetland values and a number of important explanatory variables, including wetland type, income per capita, population density, wetland size and continent. Given information on the same characteristics of other wetland sites that are of policy interest, this estimated value function could then be used to predict the value of those wetlands. Values were transferred to around 3,800 wetland sites around the world to estimate the global economic value of wetlands.

Table 5.4 presents the global economic values of wetlands, aggregated by wetland type and continent. The total economic value of 63 million hectares of wetland around the world is estimated at US$3.4 billion per year.

Table 5.4 Total Economic Value of Global Wetlands by Continent and Wetland Type (thousands of US$ per year, 2000)

	Mangrove	Unvegetated Sediment	Salt/ Brackish Marsh	Freshwater Marsh	Freshwater Woodland	Total
North America	30,014	550,980	29,810	1,728	64,315	676,846
Latin America	8,445	104,782	3,129	531	6,125	123,012
Europe	0	268,333	12,051	253	19,503	300,141
Asia	27,519	1,617,583	23,806	29	149,597	1,818,534
Africa	84,994	159,118	2,466	334	9,775	256,687
Australasia	34,696	147,779	2,120	960	83,907	269,462
TOTAL	**185,667**	**2,848,575**	**73,382**	**3,836**	**333,223**	**3,444,682**

Source: Schuyt and Brander (2004)



6

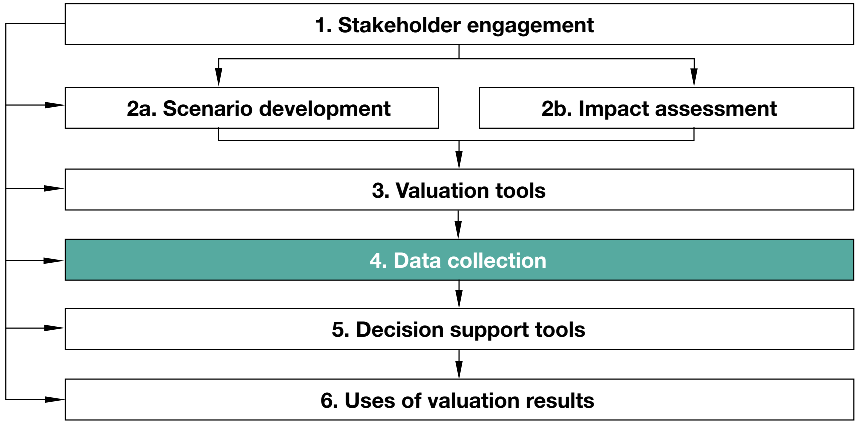
Collecting and using different types of data

Photo: Praveen Wignarajah

6 Collecting and using different types of data

What you will learn in this section:

- How different types of data should be collected and managed
- Where to go to find relevant data
- The level of caution you should use in communicating the data



6.1 Introduction

Once the scenarios have been developed and the economic valuation method(s) selected, the next challenge is to gather data to assess the physical impacts under the alternative scenarios and to estimate the economic value of the impacts. Data are also needed to identify people's preferences for different scenarios and within the valuation. In this section you will learn about the different types of data that have to be collected to undertake the impact assessment and the economic valuation, we also briefly explain how to develop questionnaires and sampling.

Of the ten valuation methods described in this toolkit, all require data to be collected. However, they all require very different data to be collected (see Table 6.1). Broadly there are three main types of data that will be used: (a) *market prices* that can be found from private sector sources, government statistics or international organizations; (b) *local social, environmental and economic information* that can be found through local surveys, or government statistics where they exist; and (c) preference data that are generated by asking people through *questionnaire surveys*. The categories are described below.

6.2 Secondary data collection (including market prices)

For any valuation exercise, it is first necessary to investigate what information already exists – this involves a literature search of the economic, social and environmental reports relating to the ecosystem under consideration. Most governments collect information about the way the society, economy and environment function. This could be in the form of national assessment reports, statistical databases or local scale interview reports or discussion papers. University research reports may be available describing impacts of similar projects in comparable countries (using the concept of value transfer). Alternatively, local expert opinions can be used, as can historical records and surveys. It may be the case that a government department is collecting biophysical data about the ecosystem, alternatively this information could be found in reports from extractive businesses operating in the area, or customs and excise departments that have export data available, e.g. for tropical forest exports, or marine life.

Fishermen. Photo: Marc Overmars

Table 6.1 Data requirements and data sources for different valuation methods

Valuation method	Data requirements	Possible sources of data	Examples of sources of data
Market prices	Market prices of goods and services, e.g. for timber	• Survey international organisations relating to ecosystem service, e.g. World Meteorological Organisation, World Fish Centre, World Resources Institute • Survey local and international commodity markets	• The International Tropical Timber Organisation Market Information Service: **http://www.itto.or.jp/live/PageDisplayHandler?pageId=235** • FAO: **http://www.fao.org/DOCREP/003/X6825E/X6825E14.htm** • Private companies, for example: **http://www.wood-info.com/1073.htm**
Replacement cost	Market prices for man-made equivalent, e.g. replacing sea grasses as juvenile fish nursery with fish farms	• Search information from international organisations • Search for project proposals for similar projects in other countries	• The state of the world's fisheries and aquaculture: **http://www.fao.org/docrep/009/A0699e/A0699e00.htm** • World Fish Centre data bases: **http://www.worldfishcenter.org/cms/list_article.aspx?catID=42&ddlID=65**
Damage cost avoided	Probability assessments. Market prices of assets at risk, e.g. coastal protection of infrastructure by mangroves	• Insurance companies • International organizations • Voluntary organizations	• Flood risk maps (e.g. as produced by SOPAC): **www.sopac.org/tiki/tiki-download_file.php?fileId=807** • Disaster frequency, e.g. Caribbean storm frequency: **http://www.nhc.noaa.gov/** **http://stormcarib.com/climatology/** • For market prices, see 'Market prices' and 'Replacement cost'
Net factor income	Market price (revenue) minus cost of provision e.g. dive tourism receipts minus costs	• Survey dive shops locally • Cost data: Materials (rented or purchased); Tools and supplies; Hired labour (and own, family or exchange labour); Licence fees paid; Equipment, materials and other supplies	• Search online
Production function	Market price and output of marketed good, price and quantity of other inputs e.g. fish price and sales, wages, labour used, price of nets, number. nets used.	• Survey of local costs of labour and price of goods and services sold including: Final market prices; Transportation and other intermediary costs	• Government statistics office for socio-economic data at the neighbourhood scale • See market prices
Hedonic pricing	Environmental characteristics that vary across goods, e.g. pollution and houses	• Market prices of houses • Physical survey of neighbourhood attributes; Demographic and economic data on population and communities; Income levels; Rural credit conditions; Level and types of employment	• Local realtors and estate agents • Government statistics office for socio-economic data at the neighbourhood scale, e.g. for the Cayman Islands **http://www.eso.ky/pages1.php?page=populationandvitalstatistics**
Travel cost	Maps Market prices of costs of travel to site No. of visitors	• Surveys • Maps • Market prices • Government statistics	• Government statistics office for socio-economic data • Google earth **http://earth.google.com/**
Contingent valuation	Population information Survey questionnaire	• Questionnaire can be directly delivered or mailed out	• Best practice in CV studies can be found at **http://www-agecon.ag.ohio-state.edu/class/aede831/haab/cvblue.pdf**
Choice modelling	Population information Survey questionnaire	• Biophysical data: Types of products; Biophysical structure; Harvesting, yield or use rates; Rates of biological productivity • Face to face questionnaire	
Value transfer	Existing valuation data	• Multiple	• EVRI database: global database of environmental economic valuation studies **http://www.evri.ca/english/default.htm**

Examples of sources of information on market prices

i. *Economic*
International Monetary Fund: World Economic Outlook
http://www.imf.org/external/pubs/ft/weo/2007/01/data/index.aspx
Also, **http://www.imf.org/external/data.htm**

ii. *Social trends*
United Nations Statistics Division
http://unstats.un.org/unsd/databases.htm

iii. *Environmental goods and services*
Crop information, fish and reef information and genetic information
http://www.cgiar.org/impact/genebanksdatabases.html

6.3 Economic, social and environmental primary data

When you have sufficient time and resources, primary data should also be collected directly and indirectly.

Once the boundary of the project area has been agreed, data collection can be undertaken 'in the field' or remotely, such as through remote sensing or through the use of satellite imagery. Ecosystem surveys should consider both the structure and the function of the ecosystem under consideration. For example for a forest, biomass, productivity and sedimentation data may be collected.

Where more resources are available, it may be possible to develop computer simulations of the possible changes to the ecosystem, or even to undertake small controlled pilot experiments to see what happens to ecosystems when stressors are introduced in reality. Such options are more expensive and may only be possible where students are available to undertake research, or where formal collaborations have been established with external research institutes who can provide the resources and the expertise to undertake the experiments.

When adequate resources are available, economic information should also be gathered through direct data collection such as site surveys.

See Chapter 9 for an indication of likely resource requirements to undertake various types of economic valuation studies.

For example, the traditions and customs of local groups associated with use of a specific resource can be recorded, as can the benefits that are gained from access to the resource. When such socio-economic data are being collected it is useful to ensure that the survey is replicable at a later date by using a robust methodology and keeping copies of the questionnaires. The data collection process must be as scientifically rigorous as possible to ensure that the data are perceived as accurate and reliable.

Where budgets and time are limited, there exist a set of techniques known as rapid research approaches. While such techniques are often not as reliable or robust as either literature surveys, or primary data collection, they can be useful. Some of the rapid research approaches are:

- Desk estimates of economic losses based on observable market prices
- A short field visit to estimate changes in productivity through discussions with local resource users
- Interviews with extractive users to find out how they use the resource and also how much they benefit financially or otherwise from this
- Wealth mapping exercises with local users

Sources of information on local social, economic and environmental impacts

i. Background information reports on the state of the environment
UNEP Environmental Data Report; World Resources Institute (with UNDP and UNEP); World Bank World Development Report; UNDP Human Development Report. Many countries now also have to produce environmental reports as part of their obligations under international conventions, therefore other sources are: National Environmental Action Plans (NEAP) and National Conservation Strategies.

ii. National databases
National government e.g. agriculture departments, departments of environment, meteorological offices; private or public utility companies; private companies. These can provide GIS data, e.g. maps of major vegetational zones. Models of river basins, aquifers and coastal waters can be invaluable in predicting future water supplies, water pollution, and the impact of proposed hydraulic works.

iii. Environmental Impact Assessments (EIAs)
These can be commissioned specifically to report on the impact of a project, they often provide raw data. The terms of reference should be carefully developed to ensure that adequate data are provided from the EIAs for economists and other assessors to undertake their own assessments.

Gathering data for impact assessment

Data are required to evaluate the impacts of the scenarios. It is therefore necessary to collect baseline data and also to make assessments of how trends will change under the different scenarios.

Using existing data
Baseline information describes the conditions that exist at the time when the project or decision is being considered. This information will describe the ecosystems, the society and the economy in varying levels of detail and with differing degrees of quantification. In collating baseline information it is often useful to incorporate traditional knowledge about the ecosystem functions and how it is managed, as well as scientific knowledge.

Information about the economy, society and the environment can be found in a variety of places. The first port of call should be the government statistics department to see if data describing the baseline conditions have been collected. The next stops should include previous research reports and international data banks – such as the Pilot Analysis of Global Ecosystems (PAGE).

To find a range of online sources of data that may be useful in the valuation exercise go to Section 9.4

Field studies and interviews with stakeholders and other local people may be necessary to supplement the scientific information. Traditional resource users often have a very deep understanding of the nature of the resource in question, how the resource has changed over time, and locally critical factors that affect its use. Local users, with significant experience in resource use and local management, can be a central information source.

Where no quantitative data exist, it may be necessary to engage experts who can provide qualitative judgements on the state of the environment, or on the potential impacts of projects on the environment. Researchers, consultants, or government experts may be able to provide qualitative data or anecdotal information about the resource in question.

The relevance of information
Not all information should be equally weighted, and an impact assessment must make some assessment of the quality and of the importance of the information. The quality of the data used must be addressed in the impact assessment.

The relative importance of the data should be evaluated either directly through discussions with stakeholders or indirectly through an assessment of standards and the physical characteristics of the impacts. In the first case, stakeholders can be engaged and their main concerns elicited – this information can then be used to weight the various impacts. In the second case, the significance of the impacts should be assessed in relation to existing standards. In this case, the number of people affected as well as the characteristics of the impact need consideration, i.e. the magnitude, extent, duration and reversibility of the impact. Some combination of both approaches can be used in a hybrid method, which develops a weighted significance index.

Once the impacts of the scenarios have been assessed, these impacts need to be assigned a monetary value. The alternative methods for valuation are described in Chapter 5.

6.4 Questionnaires

Eliciting information from individuals about their preferences for environmental goods and services should be achieved through direct or indirect surveys. A very brief introduction to surveys and questionnaire design follows, readers are strongly encouraged to visit the LSMS website for more information, see Information Box below.

information

Survey and questionnaire design
There is a significant body of literature that already exists describing how to do a survey and elicit information. One of the best resources available is the World Bank Living Standards Measurement Study (LSMS) resource kit. This kit includes:
1. Tools for managers of new surveys
2. How to plan and implement a survey
3. How to identify the appropriate sample of the population to survey
4. Questionnaire templates
5. Programmes to assist in the analysis of survey data

See: **http://www.worldbank.org/LSMS/**

All surveys need to be designed to maximise the proportion of people willing to answer the questionnaire, and to generate accurate and relevant information. To achieve this, careful consideration needs to be given to the design of the questionnaire. The designer must be very clear about the purpose of the survey and the data that are required. The data required will usually be in the form of independent and dependent variables.

definition

- *Dependent variables*: this is the information in which you are primarily interested, e.g. a tourist's willingness to pay for an environmental good or service?
- *Independent variables:* these explain why some people may be willing to pay more or less than others, and could relate to: income, age, gender, and other specific factors. Identifying the independent variables is essential to ensure that the economic value generated is accurate.

Questionnaires can be designed using open or closed format:
- *Open ended*: This type of question allows a range of answers to be given and might be phrased as 'how much would you be willing to pay to prevent the loss of an ecosystem good or service, e.g. mangroves, or fish?' While this type of data is easier to manage, there are many biases that can creep into this type of questioning.
- *Closed*: This type of question limits the options available to the respondent, e.g. 'would you be willing to pay $20 to ensure the quality of this area of bathing water is maintained?' There are many more advanced variations of this type of question and the analysis of this data is more complicated.

Questionnaires need to be designed with budget and timeframe in mind, but also to ensure that they are easy and quick to complete, simple to code, and straightforward to analyse. There are several basic principles central to designing questionnaires, which are covered in the sources below.

- Use short and simple sentences
- Ask for only one piece of information at a time
- Avoid negative questions where positive ones could be used
- Ask precise questions providing a clear frame of reference
- Structure the questionnaire so that sensitive issues are tackled carefully and last
- Shorter questionnaires receive a higher response rate than long ones
- Question order is important: Go from general to particular; go from easy to difficult; go from factual to abstract; start with closed format questions; start with questions relevant to the main subject; do not start with demographic and personal questions; always pilot test and evaluate first drafts of questionnaires (i.e. "pre-test till you drop")

information

There are many excellent sources of information on designing questionnaires, see for example: **http://www.leeds.ac.uk/iss/documentation/top/top2.pdf**
http://www.statcan.ca/english/edu/power/ch2/questionnaires/questionnaires.htm
http://www.qmuc.ac.uk/psych/RTrek/foundation/f9.htm

6.5 Sampling

It is inevitable that the survey will require the identification of a sample of a population, e.g. of tourists, household residents, or local businesses. Ideally all stakeholders who may be affected by the different scenarios would be included in a survey, however this is usually not possible due to the costs and the time involved in such an exercise. Consequently a smaller sample is drawn to represent the entire population (e.g. of home owners in the local area). The survey is then carried out among this sample and the results extrapolated to the wider population. If the sample does not reflect the wider population then the economic value derived could be misleading. It is therefore important to correctly identify the sample.

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

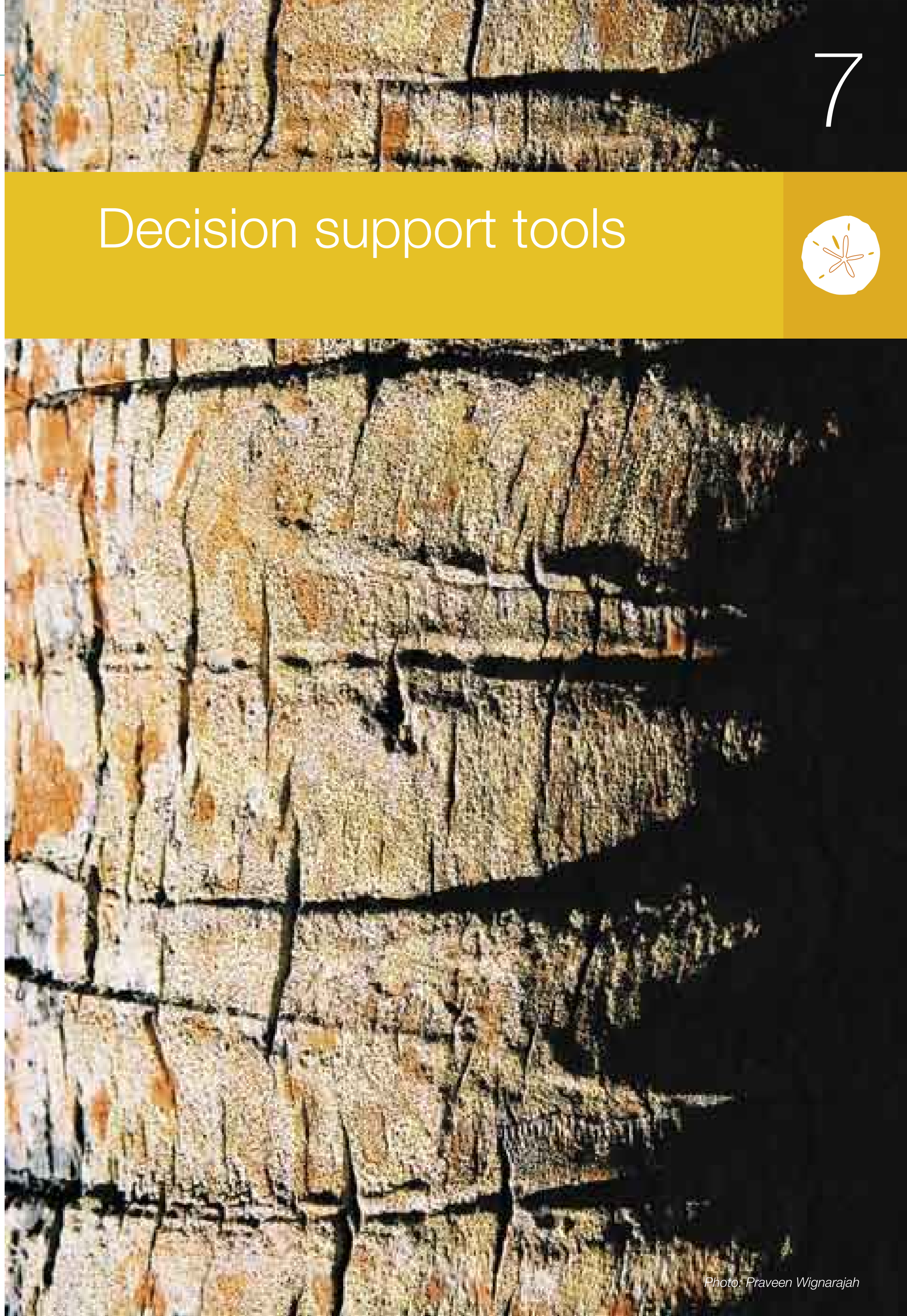
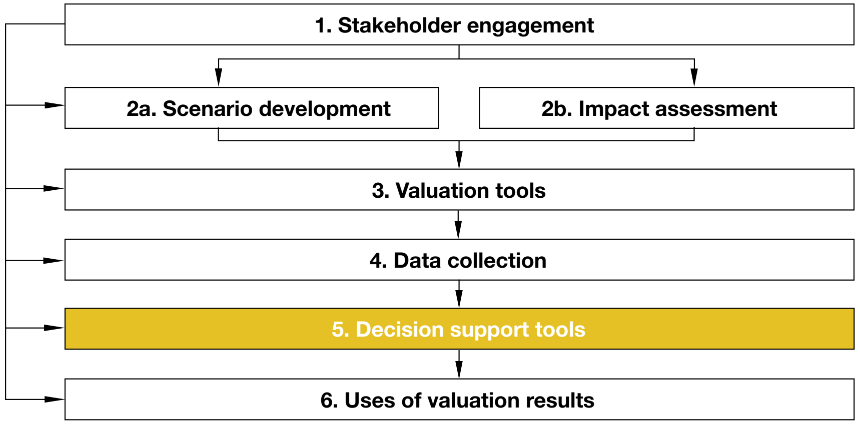


Photo: Praveen Wignarajah

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:

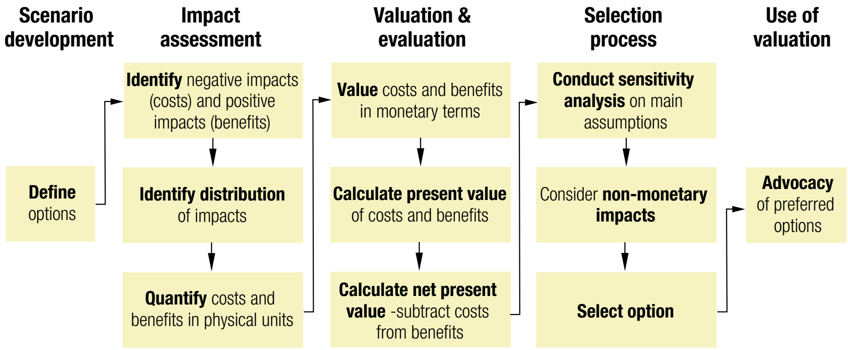


Figure 7.1 Methodological steps in cost-benefit analysis

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 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.

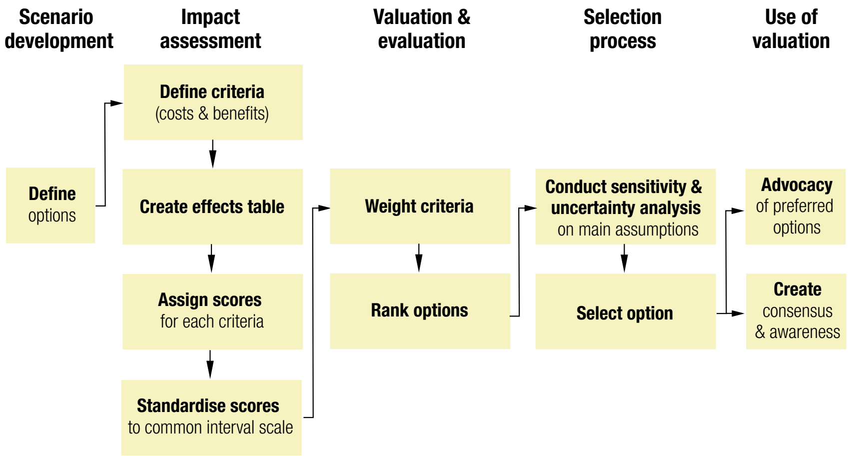
Upgrading the sewerage plant is estimated to cost US$13 million in capital investments and US$0.5 million per year in operating costs. The net present value of reducing nutrients by up-grading the sewerage plant is calculated to be $170 million using a discount rate of 5% over a time-period of 50 years. 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.

Table 7.2 Distribution of NPV among stakeholders (in %)

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)

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 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.

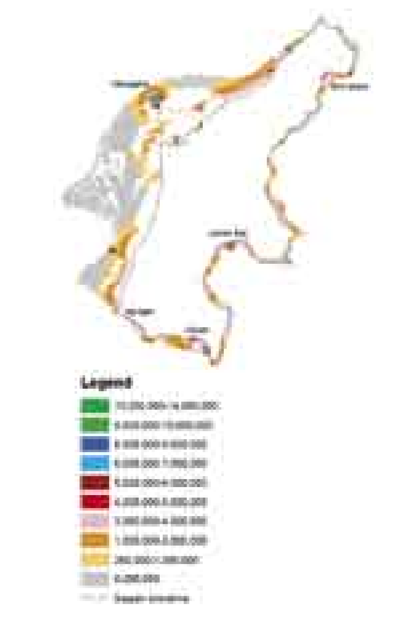


Figure 7.3 Total Economic Value

Figure 7.4 Threats to Saipan's reefs

Source: Van Beukering et al. (2006)

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.

8

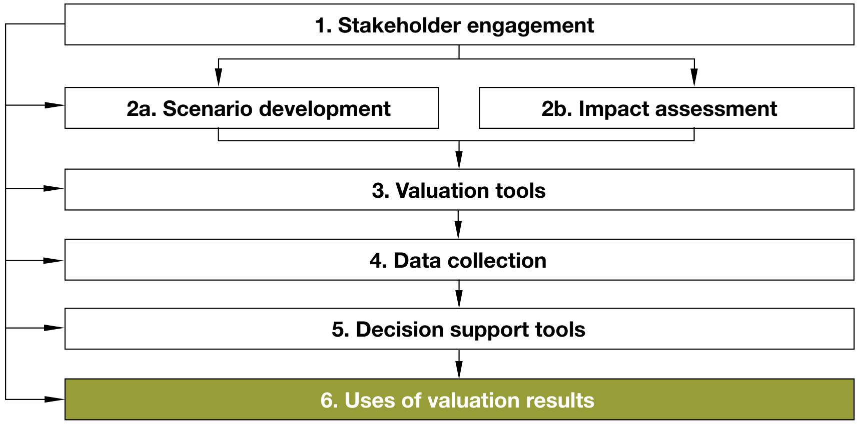
Using valuation to influence decisions

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.

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

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

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.

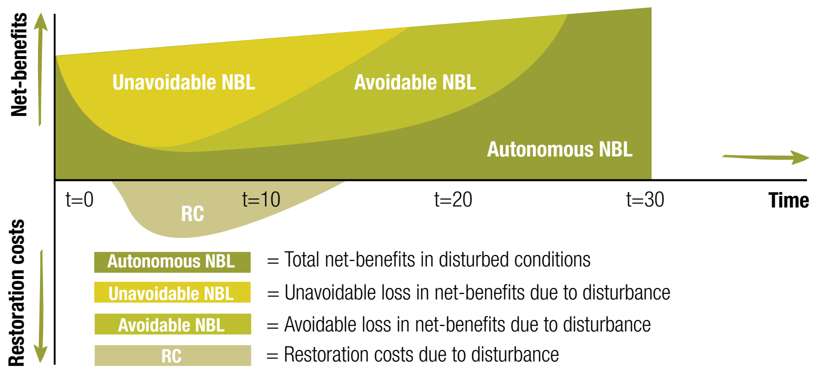


Figure 8.1 Illustration of damage assessment

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).*

9

Practical information

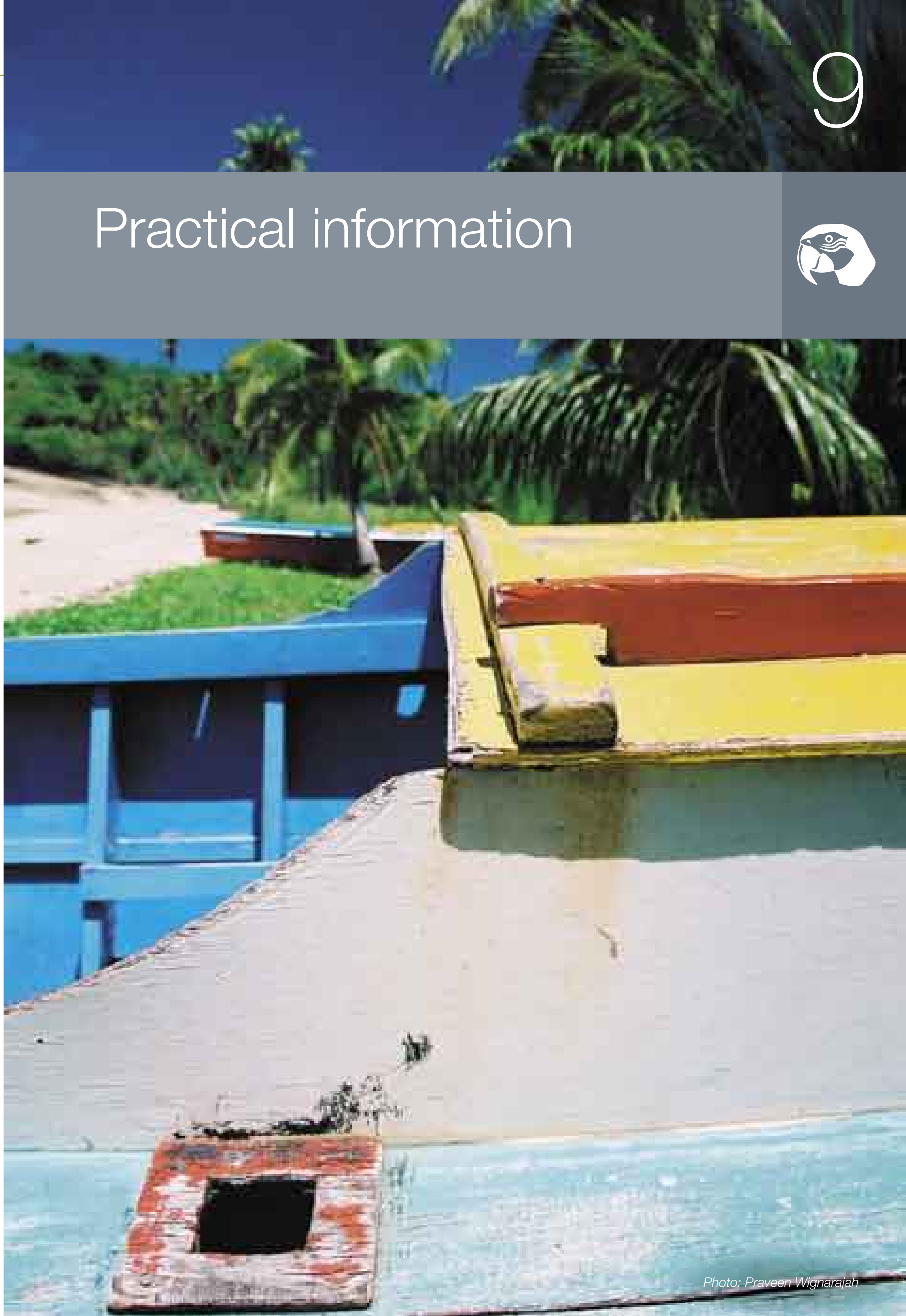


Photo: Praveen Wignarajah

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.

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.**

information

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.

Information

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.

Information

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.

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

	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

[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.

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

	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

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**
- Assessing the Economic Value of Ecosystem Conservation. (2004) By World Bank, Washington, DC. **http://129.3.20.41/eps/othr/papers/0502/0502006.pdf**

Coastal zone

- Collected Essays on the Economics of Coral Reefs. (2000) By Cesar, H.S.J. (editor), published by CORDIO, Kalmar University, Sweden 244 pp. Not available online.
- 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**
- The Value of Forest Ecosystems (2001). By Pearce, D.W. and Corin G T Pearce. CBD Technical Series, Series No. 4. The Secretariat Convention on Biological Diversity, Montreal. **http://www.biodiv.org/doc/publications/cbd-ts-04.pdf**
- Financial viability of forest certification in industrial plantations: a case study from the Solomon Islands (2004) By Pesce, F. and Lal, P. Technical report, Environmental Management and Development Occasional Paper no.5, ANU. **http://dspace.anu.edu.au/bitstream/1885/42624/1/emd_op5.pdf**

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**
- The Economic Valuation of Mangroves: A Manual for Researchers (2003) By Bann, C. EEPSEA. **http://network.idrc.ca/uploads/user-S/10305674900acf30c.html**

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**
- Measuring Economic Benefits for Water Investments and Policies (1996) By Young, R.A. Technical Paper 338, Washington DC: World Bank. Not available online.

Specific references used in this toolkit

Agardy, T and Alder, J. (2005) Chapter 19 Coastal Systems. In Millennium Ecosystem Assessment, Volume 1: Ecosystems and human well-being: current state and trends. Island Press. pp. 513-549

Agardy, T. and J. Alder (2005) Coastal Systems. Ecosystems And Human Well-being: Current State And Trends. Findings of the Condition and Trends Working Group. Millennium Ecosystem Assessment. Island Press

Arin, T. and R.A. Kramer (2002) Divers' Willingness to Pay to Visit Marine Sanctuaries: An Exploratory Study. Ocean and Coastal Management, vol. 537.

Barbier, E., I. Strand, and S. Sathirathai (2002) Do open access conditions affect the valuation of an externality? Estimating the welfare effects of mangrove-fishery linkages in Thailand. Environmental and Resource Economics, vol. 21.

Brown, K., E. Tompkins and W.N. Adger (2001) Trade-off Analysis for Participatory Coastal Zone Decision-Making. CSERGE, UEA.

Cesar, H.S.J., Beukering, P.J.H. van & Pintz, S. (2002). The Economic Value of Coral Reefs in Hawai'i. Hawai'i Coral Reef Initiative (HCRI), University of Hawai'i, Honolulu.

Constanza et al. (1997) The value of the world's ecosystem services and natural capital. Nature vol. 387.

Dixon, J.A., L.F. Scura and T. van't Hof. (1993) Meeting Ecological and Economic Goals: The Case of Marine Parks in the Caribbean. The World Bank

Leeworthy, V.R. and P.C. Wiley (1997) A Socioeconomic Analysis of the Recreation Activities of Monroe County Residents in the Florida Keys/Key. NOAA

McKenzie, E, Woodruff, A. and McClennen, C (2006) Economic Assessment of the True Costs of Aggregate Mining in Majuro Atoll Republic of the Marshall Islands. SOPAC Technical Report 383, SOPAC. Suva, Fiji

Pagiola, S., von Ritter, K., and Bishop, J. (2004) Assessing the Economic Value of Ecosystem Conservation. World Bank Environment Department Paper No. 101. In collaboration with The Nature Conservancy and IUCN-The World Conservation Union.

Pantin, D. and V. Reid. (2005). Economic Valuation Study: action-learning project on incentives for improved watershed services in the Buff Bay/ Pencar Watershed. CANARI Who Pays for Water Project Document no.2. 82pp.

Pendleton, L.H. (1995) Valuing coral reef protection. Ocean & Coastal Management (26).

Ramdial, B.S. (1975) The social and economic importance of the Caroni swamp in Trinidad and Tobago. University of Michigan PhD dissertation

Sathirathai, S. and E. Barbier (2001) Valuing mangrove conservation in Southern Thailand. Contemporary Economic Policy. Issue 2, pp 109-122

Schuyt, K. and L. Brander (2004) The economic value of the World's wetlands. WWF-International.

UNEP (2004) Environmental Impact Assessment and Strategic Environmental Assessment: Towards an Integrated Approach.

van Beukering, P., H.S.J. Cesar and M.A. Janssen (2003). Economic valuation of the Leuser National Park on Sumatra, Indonesia. Ecological Economics, vol 44.

van Beukering, P.J.H. (Ed.) W. Haider, M. Longland, H. Cesar, J. Sablan, S. Shjegstad, B. Beardmore, Yi Liu and G.O. Garces (2007) The economic value of Guam's coral reefs. University of Guam Marine Laboratory Technical Report No. 116. p.100.

Van Beukering, P.J.H. & H.S.J. Cesar (2004) Ecological Economic Modeling of Coral Reefs: Evaluating Tourist Overuse at Hanauma Bay and Algae Blooms at the Kihei Coast, Hawaii. Pacific Science, 58(2). 243-260.

Van Beukering, P.J.H., W. Haider, E. Wolfs, Yi Liu, K. van der Leeuw, M. Longland, J. Sablan, B. Beardmore, S. di Prima, E. Massey, H.S.J. Cesar, Z. Hausfather, J. Gourley (2006) The Economic Value of the Coral Reefs of Saipan, Commonwealth of the Northern Mariana Islands. CEEC report. p.153

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

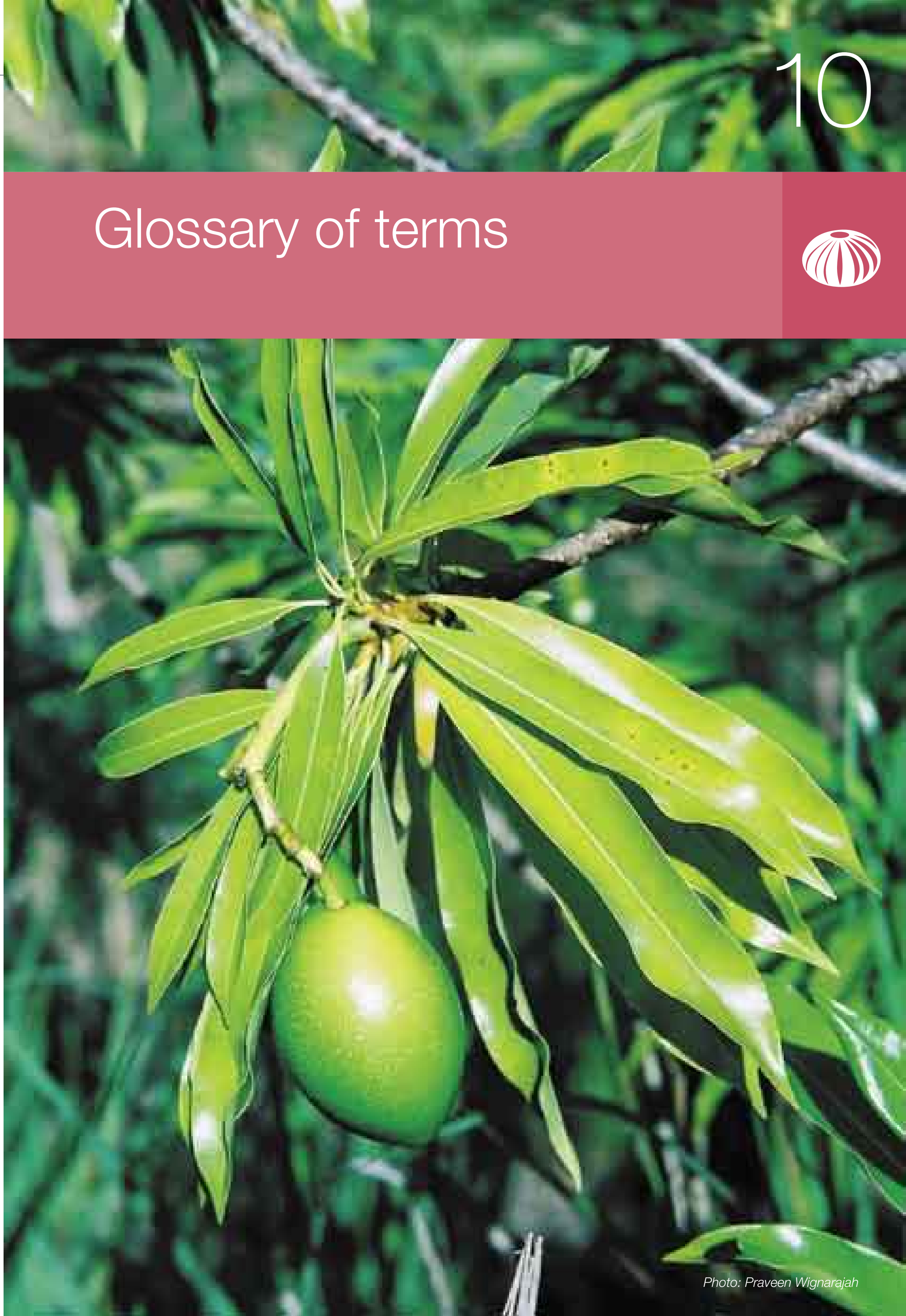
- *Global Conference On The Sustainable Development Of Small Island Developing States*: Report of the Global Conference On The Sustainable Development Of Small Island Developing States, Bridgetown, Barbados, 25 April-6 May 1994: **http://www.un.org/documents/ga/conf167/aconf167-9.htm**
- *Small island 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

Index

Design by Rocket Design, rocketdesign@btconnect.com

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.

This toolkit is part of the Joint Nature Conservation Committee's 'Environmental Economics with the Overseas Territories in the Caribbean' (EEWOC) project. The project aims to build capacity in UK Overseas Territories in the Caribbean in using economic tools to help make policies and decisions more sustainable. The development of this toolkit was jointly funded by the Overseas Territories Environment Programme (OTEP) and the Joint Nature Conservation Committee (JNCC). OTEP is a joint programme of the UK Government Foreign and Commonwealth Office and the Department for International Development to support the implementation of the Environment Charters and environmental management more generally in the UK Overseas Territories. JNCC is the statutory adviser to the UK Government on UK and international nature conservation, including in the UK Overseas Territories.

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Paper copies can be requested from
The Communications Team
Joint Nature Conservation Committee
Monkstone House
City Road
Peterborough PE1 1JY
UK
Email: communications@jncc.gov.uk
Tel: +44 (0)1733 562626
Fax: +44 (0)1733 555948

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