Valuing the Environment in Small Islands

An Environmental Economics Toolkit

JOINT NATURE CONSERVATION COMMITTEE

OTEP

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

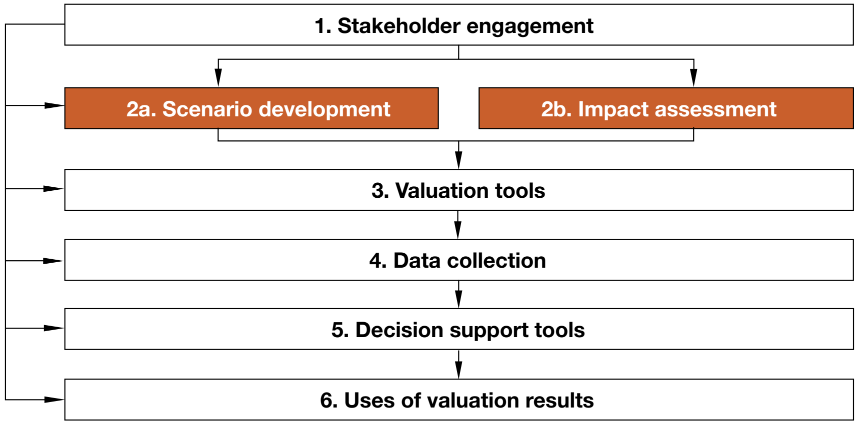
Scenario development and impact assessment

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?).

> 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**

information

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

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

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

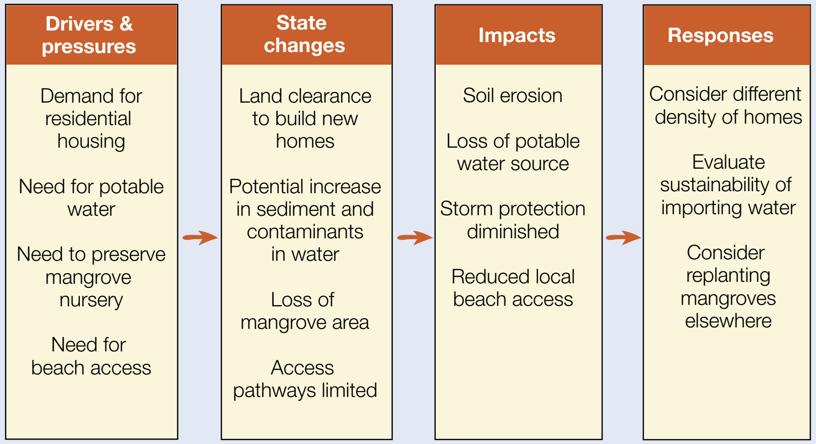


Figure 4.1 Implications of different pressures on future development

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.

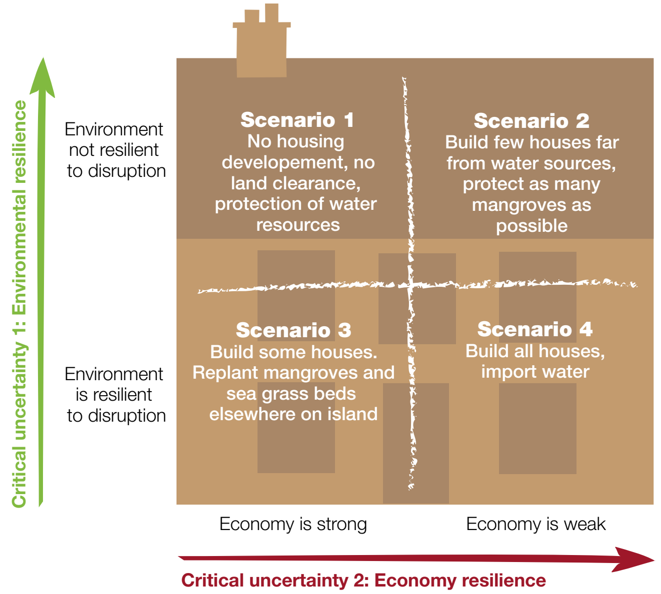


Figure 4.2 Scenario development using 'critical uncertainty' approach

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.

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

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

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

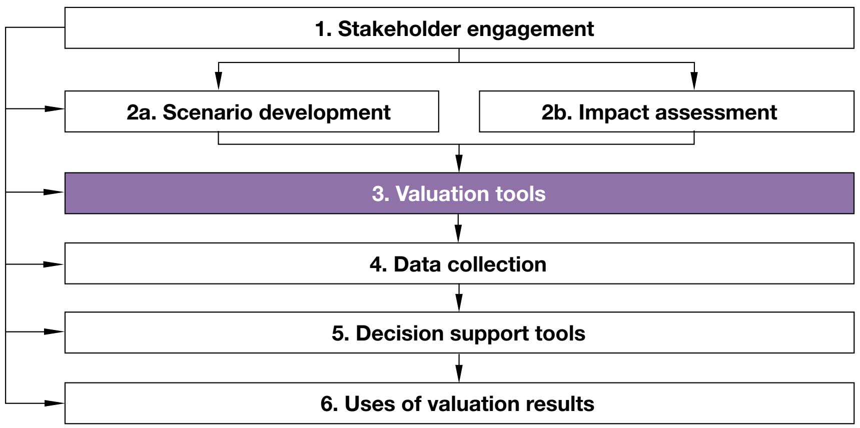
Economic valuation

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

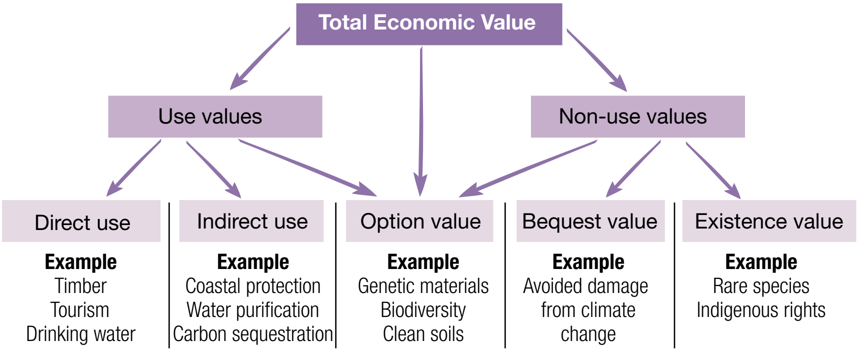
definition

(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

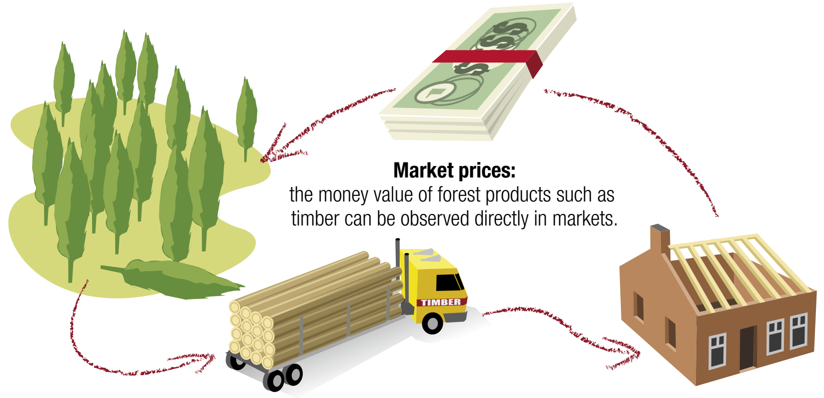
Table 5.3 Ecosystem services and commonly applied valuation methods

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

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)

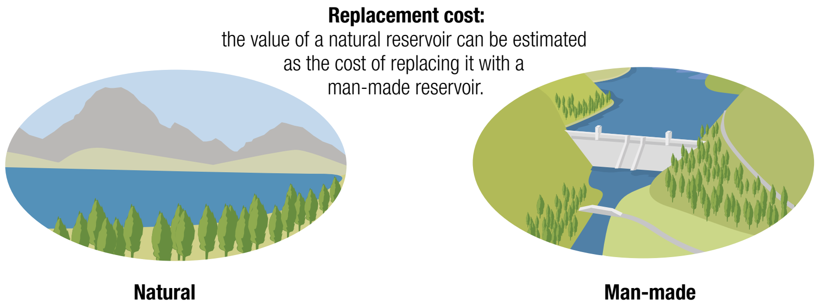
5.6 Replacement cost

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

Example Box 5.3: Value of mangroves for coastal protection

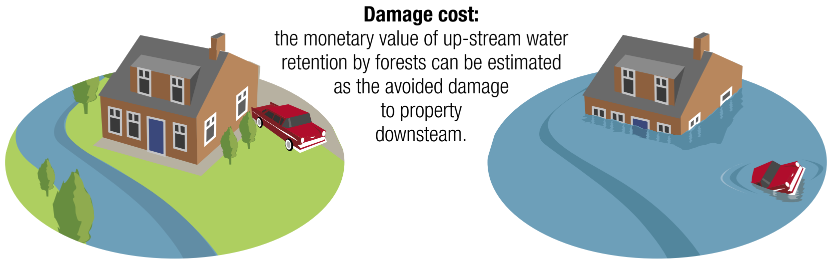
The coastal protection provided by mangroves in Southern Thailand has been valued using the replacement cost method. An important ecological function of mangroves is to serve as a windbreak and shoreline stabiliser. The value of this service has been estimated by calculating the cost of replacing this 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

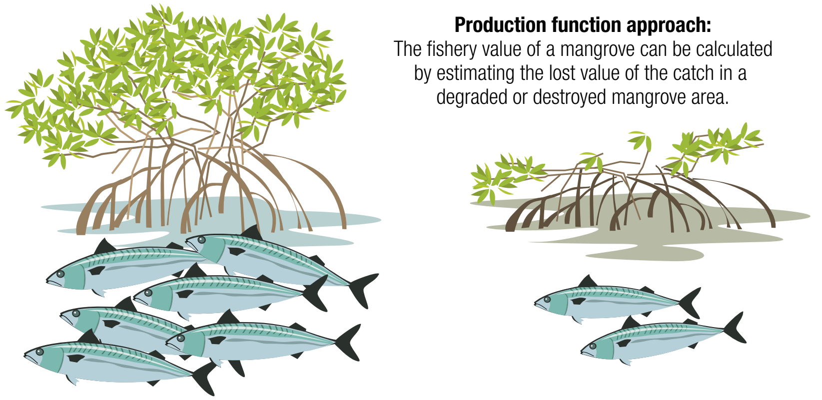
The value of reef related tourism in Bonaire in 1991 has been calculated using data provided by the Bonaire Department of Revenue and the Tourism Corporation Bonaire. Net annual benefits of dive related tourism were estimated to range between US$7,924,000 and US$8,799,000. These figures are based on 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

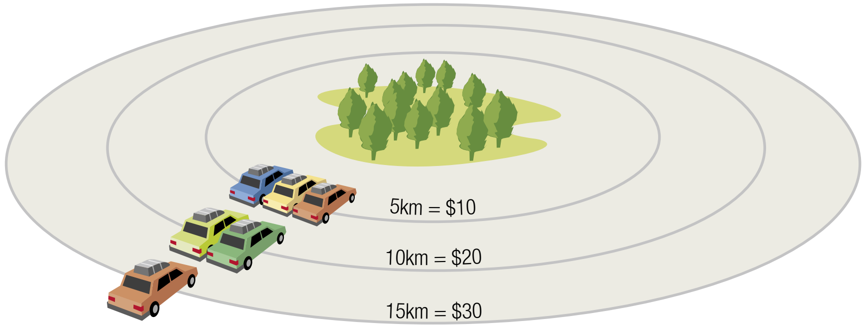
The travel cost method is used to estimate the value of ecosystems or sites that are used for recreation. The premise behind this method is that the travel expenses that people incur to visit a site represent the "price" of access to the site. Travel expenses include the actual travel costs (e.g. price 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

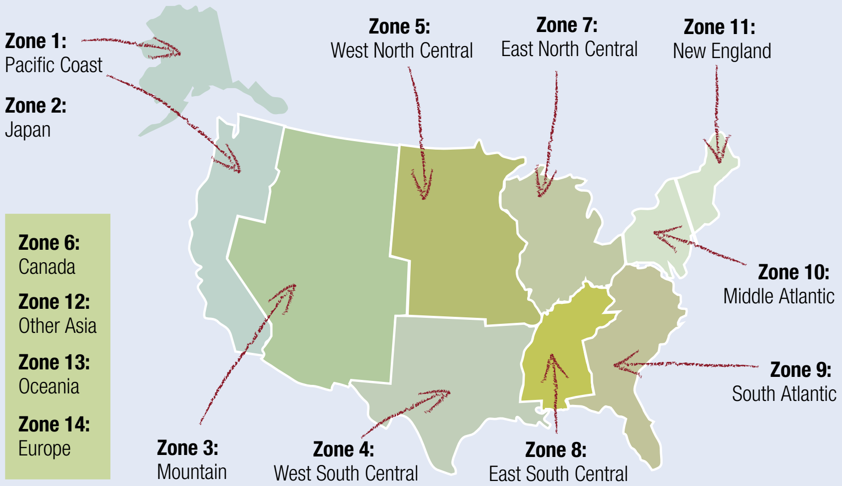
Consumer surplus is the difference between the price consumers are willing to pay and the actual price. If someone is willing to pay more than the actual price, their benefit in a transaction is how much they saved when they didn't pay that price.

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

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.

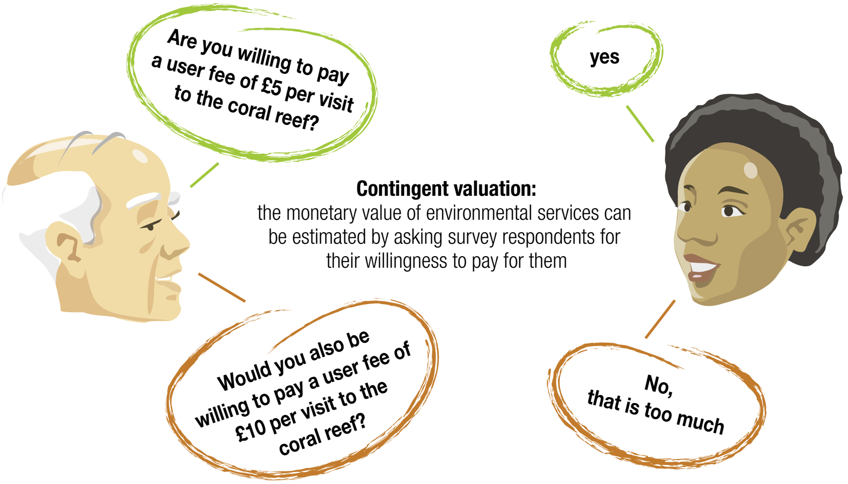
The responses to these questions are then analysed to estimate the average value the respondents associate with the proposed change. This value can subsequently be aggregated over the affected population to derive a measure of total benefit (or cost).

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

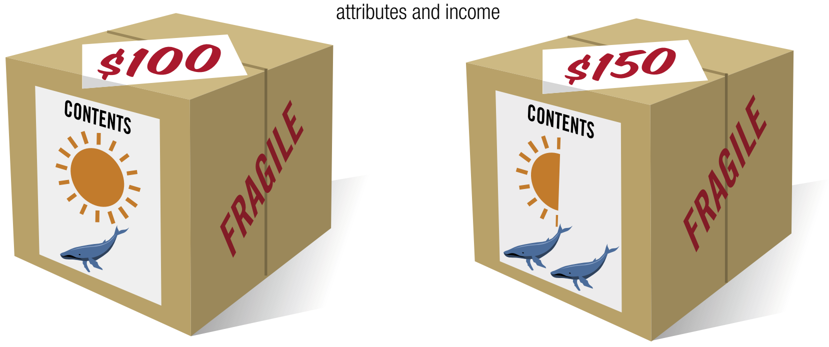
Choice modelling is also a stated preference method and is similar to contingent valuation in that it can be used to estimate economic values for virtually any ecosystem good or service. It is also a hypothetical method – it asks people to make choices based on a hypothetical scenario. Choice modelling 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 *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**).

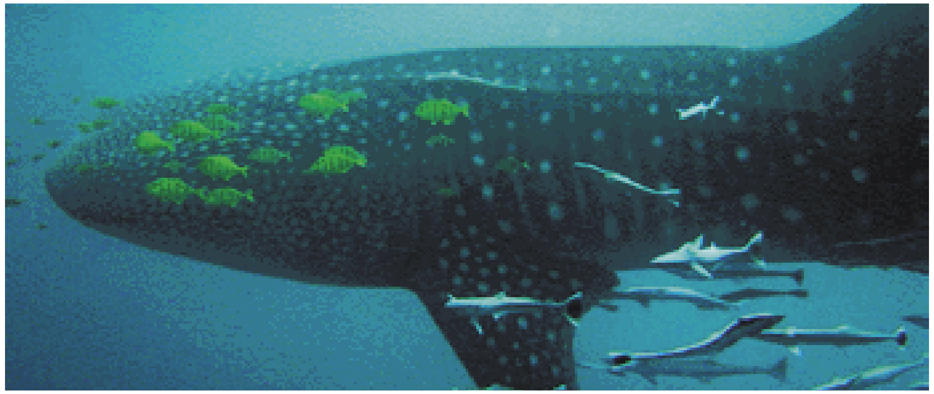
Step 3: *Review available studies for quality and applicability*. Assess the relevance (suitability) of the study site values for transfer to the policy site, considering the similarity of the policy site to the study site, the similarity of impacts considered, baseline environmental quality, the affected 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 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.

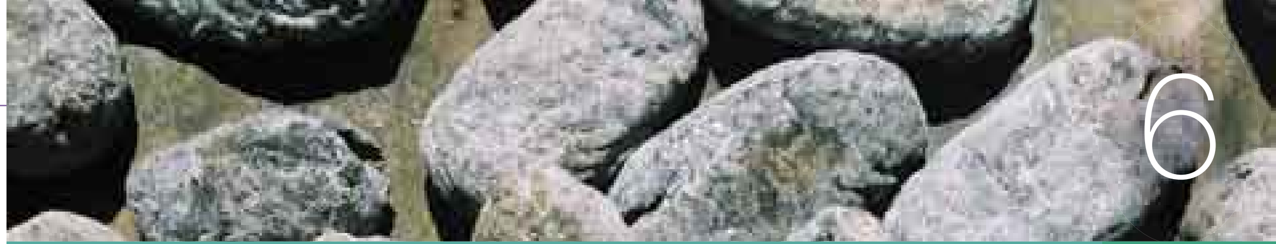
The value transfer function was estimated by computing a functional relationship between the standardized wetland values and a number of important explanatory variables, including wetland type, income per capita, population density, wetland size and continent. Given information on the same characteristics 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

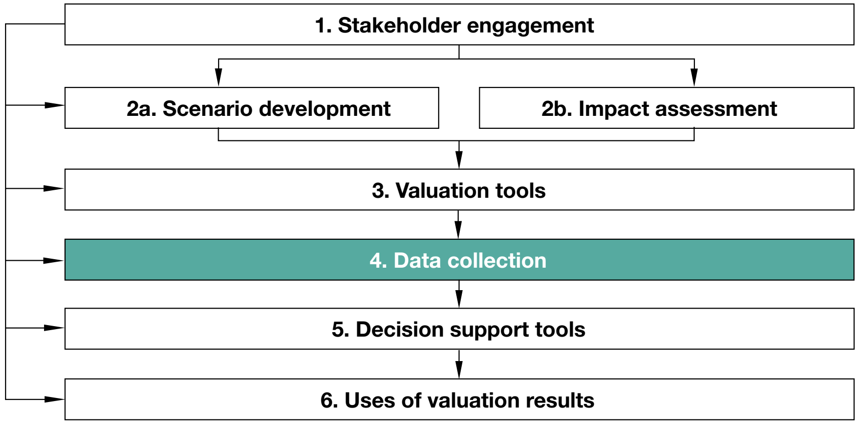
Collecting and using different types of data

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

Valuation method	Data requirements	Possible sources of data	Examples of sources of data
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

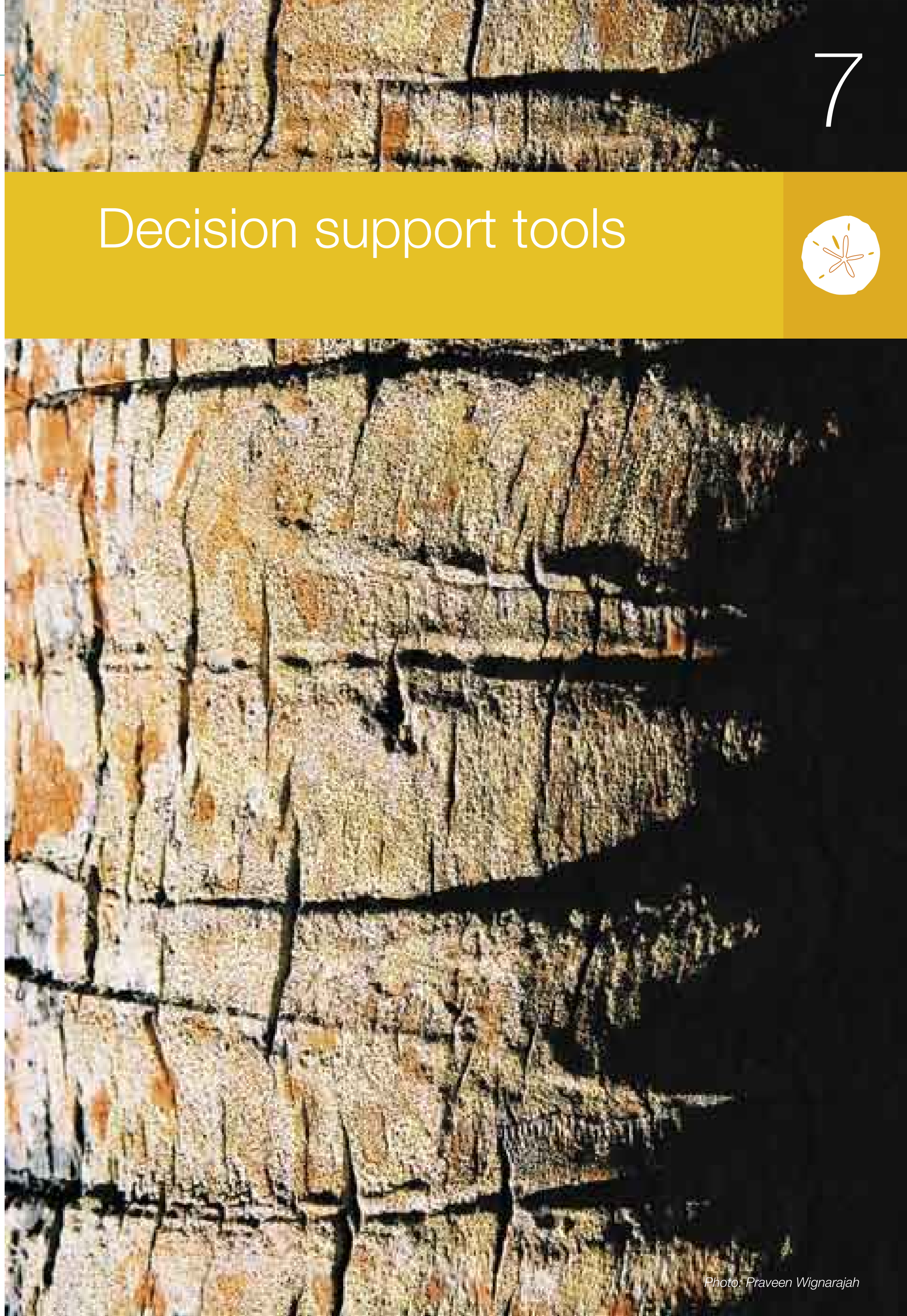


Photo: Praveen Wignarajah