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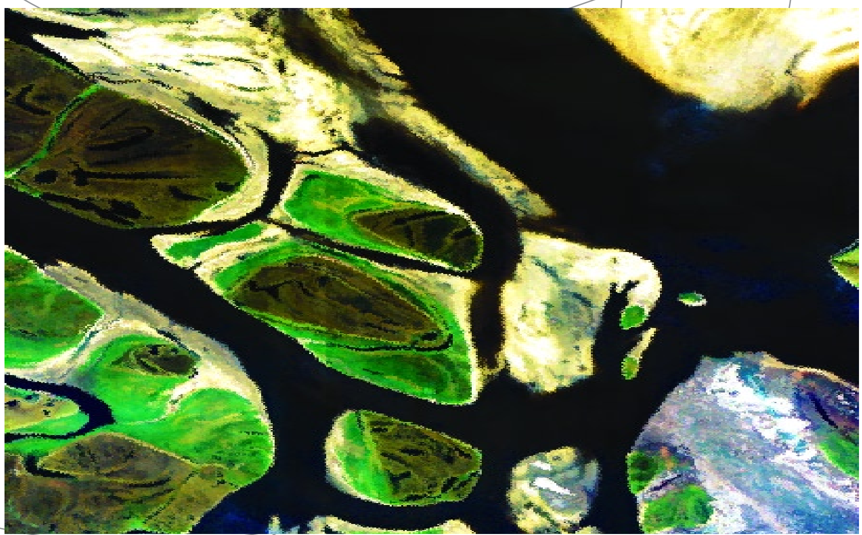

Valuing wetlands

Guidance for valuing the benefits derived from wetland ecosystem services

De Groot, Stuip, Finlayson, and Davidson

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Valuing wetlands:

Guidance for valuing the benefits derived from wetland ecosystem services

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Contents

Foreword

Wetlands and the ecosystem services they provide are hugely valuable to people worldwide: this has been a key finding of the Millennium Ecosystem Assessment (MA), its report to the Ramsar Convention (2005. *Ecosystems and Human Well-being: Wetlands and Water*), and the Ramsar Scientific and Technical Review Panel's (STRP) significant messages arising from the MA.

The value of these wetlands and their associated ecosystem services has been estimated at US$14 trillion annually. Yet many of these services, such as the recharge of groundwater, water purification or aesthetic and cultural values are not immediately obvious when one looks at a wetland. Planners and decision-makers at many levels are frequently not fully aware of the connections between wetland condition and the provision of wetland services and the consequent benefits for people, benefits which often have substantial economic value. Only in very few cases have decisions been informed by the total economic value and benefits of both marketed and non-marketed services provided by wetlands. This lack of understanding and recognition leads to ill-informed decisions on management and development, which contribute to the continued rapid loss, conversion and degradation of wetlands - despite the total economic value of unconverted wetlands often being greater than that of converted wetlands.

The Ramsar Convention has long recognized the importance of wetland economic valuation in contributing to well-informed planning and decision-making, and in 1996 Ramsar's 6th meeting of the Conference of the Contracting Parties (COP6) included in the Convention's first Strategic Plan a specific Operational Objective (2.4) on promoting the economic valuation of wetland benefits and functions through dissemination of valuation methods. To support this, the 1997 book *Economic valuation of wetlands: A guide for policy makers and planners* was published by the Ramsar Secretariat (Barbier *et al.* 1997).

Economic valuation of ecosystems is a rapidly developing discipline, and there are now many different methods available for undertaking different aspects and purposes of wetland valuation. In order to assist Contracting Parties in having economic valuation information better available for decision-making on wetlands, Ramsar's COP8 (Valencia, 2002) requested the STRP to prepare guidance on practical methods for wetland valuation. This report, the preparation of which has been led by Rudolf de Groot and Mishka Stuip of Wageningen University and the Foundation for Sustainable Development (FSD) in the Netherlands provides this guidance, and updates information on available methodologies from those in Barbier *et al.* (1997).

The report also responds to the Convention on Biological Diversity's (CBD) request (in Decision VII/4) to develop for inland waters a set of tools to assess the socio-economic and cultural values of biological diversity to complement the guidelines for the rapid ecological assessment of biodiversity in inland water, coastal and marine areas. The rapid ecological assessment guidelines were published jointly by the CBD and Ramsar Secretariats (as CBD Technical Series No. 22 and Ramsar Technical Report No. 1) in March 2006, so as to make the guidance as widely available as possible to respective Contracting Parties and their focal points. Likewise this guidance for valuing wetlands is being jointly published by Ramsar and CBD – it thus forms a significant further development in the collaboration and harmonization between Ramsar and CBD in implementing their 3rd Joint Work Plan and in Ramsar's role as the lead implementation partner of the CBD for wetlands

The Convention on Biodiversity (CBD) has also done substantial work on the valuation of biodiversity in general, including wetlands as well as other ecosystems, in the context of its programme of work on incentive measures. The CBD Conference of Parties (COP8) identified options for the application of tools for validation of biodiversity and biodiversity resources and functions (Decision VIII/25 annex). The CBD Secretariat published a report on the valuation of forest ecosystems in 2001 (SCBD 2001), as well as a compilation and analysis of tools and methodologies for the valuation of biodiversity in general , which has important inter-linkages and is complementary to the present report (SCBD 2005).

The present guidance for valuing wetlands gives advice on when and why wetland valuation should be undertaken and sets out a five-step framework for the integrated assessment and valuation of wetland services, with descriptions of available methods for undertaking each of these steps. These are supplemented by case studies from around the world of where different aspects of wetland valuation have supported decision-making, and by sources of further information on wetland valuation.

We urge all those involved in establishing the full economic value of wetlands and their services, and in assessing the trade-offs between maintenance of wetlands and their conversion in decision-making, to use the guidance in this report to ensure that the broadest implications of any further destruction or conversion of the vital wetland resource are fully understood, as a contribution to the commitments made by countries under the Ramsar Convention for securing the wise use of all wetlands.

Heather MacKay
Chair of Ramsar Scientific & Technical Review Panel

C. Max Finlayson
former Chair of Ramsar Scientific & Technical Review Panel

Nick Davidson
Deputy Secretary General, Ramsar Convention Secretariat

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This report was prepared for the Ramsar Scientific & Technical Review Panel (STRP) as part of the work of its 2003-2005 Working Group 1 on wetland inventory and assessment. We are grateful to the members of, and observers to, the STRP and its Working Group 1 for their help, their advice, and their review of the draft of the guidance, and in particular the following people: Teresita Borges (Cuba), David Coates (CBD Secretariat), Lijuan Cui (China), Lucy Emerton (IUCN), Hand Haake (CBD Secretariat), Heather MacKay (South Africa), Randy Milton (Canada), Tatiana Minaeva (Russia), Dave Pritchard (BirdLife International/RSPB), Roel Slootweg (The Netherlands), Doug Taylor (Wetlands International), and Rebecca Tharme (IWMI). We are particularly grateful to the government of Sweden for providing financial support for the preparation of the report.

Summary

This report outlines a framework which should assist readers to conduct an integrated assessment of wetland ecosystem services, and it sets out five key steps in undertaking a wetland valuation assessment. These are: Step 1: Analysis of policy processes and management objectives *(why undertake the valuation?).* Step 2: Stakeholder analysis and involvement *(who should do the valuation, and for whom?)*. Step 3: Function analysis (identification & quantification of services) *(what should be valued?)*. Step 4: Valuation of services *(how to undertake the valuation?).* Step 5: Communicating wetland values *(to whom to provide the assessment results?)*. Subsequent sections provide more detailed guidance on undertaking each of these steps and the available methods for their application.

This guidance is supplemented by case studies from around the world of where different aspects of wetland valuation have supported decision-making, and by sources of further information on wetland valuation. More and better information on the socio-cultural and economic benefits of ecosystem services is needed to:

i) demonstrate the contribution of wetlands to the local, national and global economy (and thus build local and political support for their conservation and sustainable use);

ii) convince decision-makers that the benefits of conservation and sustainable use of wetlands usually outweigh the costs and explain the need to better factor wetlands into development planning (through more balanced cost-benefit analysis);

iii) identify the users and beneficiaries of wetland services to attract investments and secure sustainable financial streams and incentives for the maintenance, or restoration, of these services (i.e., make users pay and ensure that local people receive a proper share of the benefits);and

iv) increase awareness about the many benefits of wetlands to human well-being and ensure that wetlands are better taken into account in economic welfare indicators (e.g., in Gross National Product (GNP) calculations) and pricing mechanisms (through internalization of externalities).

Additional support and information is being developed and provided through the Internet on www.nature-valuation.org. This Web site provides access to existing databases, literature, and case studies, and is being regularly updated. It also provides access to a discussion platform for exchange of information and experiences on valuation of wetland services.

Background and purpose

Why is this guidance needed?

Since its inception, the Ramsar Convention has stressed that the true value of wetlands and the services they provide to people should be recognized, as well as their importance to the maintenance of biological diversity. In particular, the preamble to the Convention's text adopted in 1971 recognized "that wetlands constitute a resource of great economic, cultural, scientific, and recreational value, the loss of which would be irreparable".

During the 2002-2005 triennium, the Convention's Scientific and Technical Review Panel (STRP) reviewed the suite of Ramsar guidance on wetland inventory, assessment and monitoring and recognized that amongst the important gaps was up-to-date guidance on wetland valuation to complement and update the work of Barbier *et al.*(1997) prepared for the Ramsar Convention. Subsequently the eighth meeting of the Conference of the Contracting Parties (Ramsar COP8, 2002) requested the STRP to develop further guidance on a range of issues on inventory, assessment, monitoring and management of Ramsar sites and other wetlands, in order to support defining and reporting on the ecological character of wetlands (Resolution VIII.7, available on http://www.ramsar.org/res/key_res_viii_index_e.htm). This report has been prepared to response to the specific request in Resolution VIII.7 for practical advice and guidance for "evaluating the values and functions, goods and services provided by wetlands".

Valuation of wetlands forms one of the many types of wetland assessment which can and should be used for different purposes and at different scales in support of wetland wise use, management and decision-making. These, their purposes, and the relationships between them have been summarized in the Convention's *Integrated Framework for Wetland Inventory, Assessment and Monitoring*, which is available as Resolution IX.1 Annex E (http://www.ramsar.org/res/key_res_ix_index_e.htm). Figure 1 [next page] shows how wetland valuation fits into this Framework, and this is also described in Finlayson et al. (2005).

This report provides practical guidance for identifying and determining the value of the ecosystem services (ecological, socio-cultural, and economic) provided by wetlands, and it discusses the advantages and disadvantages of different valuation methods. References to practical information (Web sites, literature) and examples (case studies) of wetland valuation and how this information can be used to support the wise use of wetlands have also been provided (see Ramsar Convention Secretariat 2004 and Finlayson et al. 2005 for further information on the wise use of wetlands).

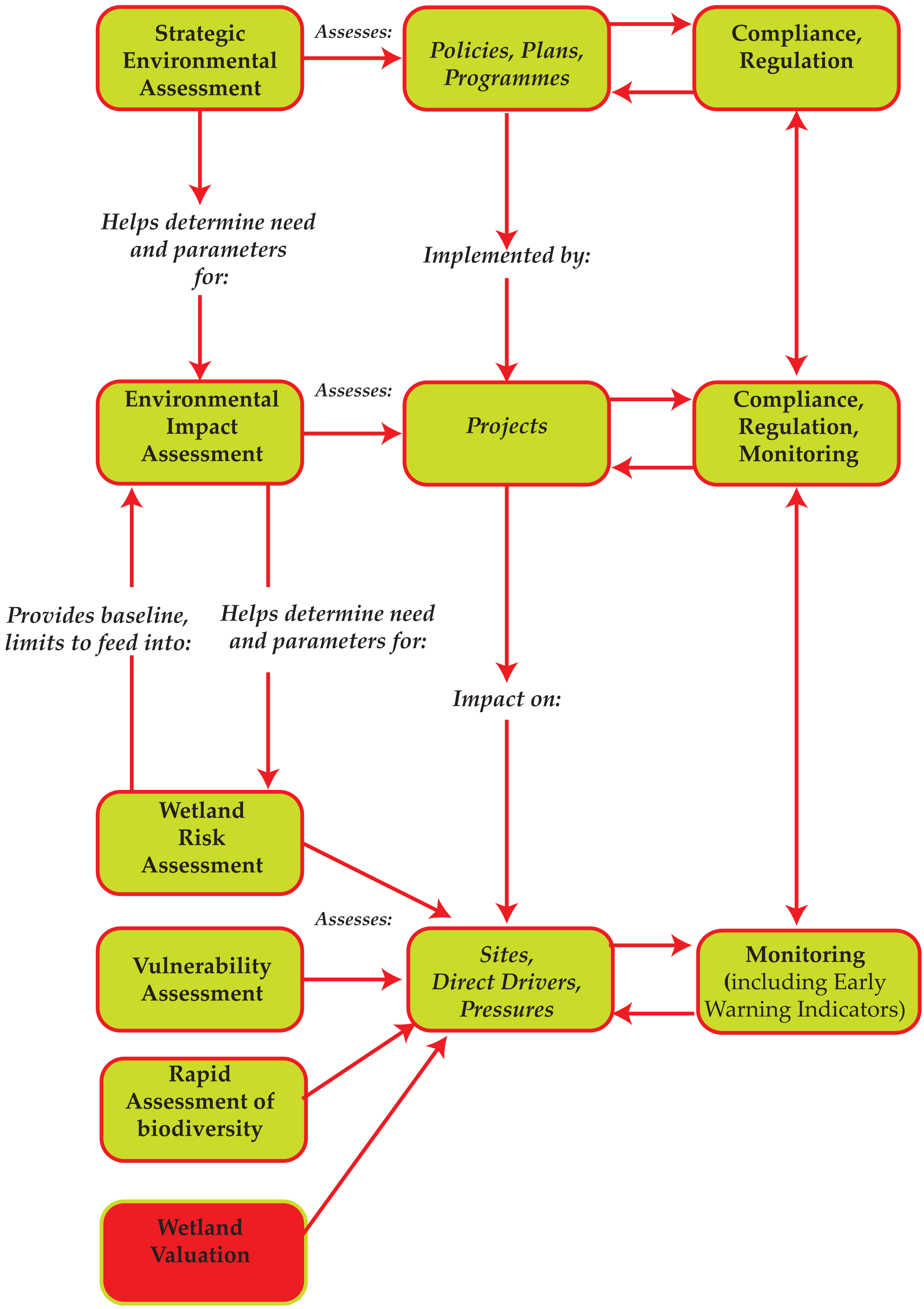
The report uses the definitions of wetland inventory, assessment and monitoring adopted by the Ramsar Convention and included in the *Integrated Framework for wetland inventory, assessment, and monitoring*. These are:

- *Wetland Inventory*: the collection and/or collation of core information for wetland management, including the provision of an information base for specific assessment and monitoring activities.
- *Wetland Assessment:* the identification of the status of, and threats to, wetlands as a basis for the collection of more specific information through monitoring activities.
- *Wetland Monitoring:* the collection of specific information for management purposes in response to hypotheses derived from assessment activities, and the use of these monitoring results for implementing management. The collection of time-series information that is not hypothesis-driven from wetland assessment is here termed *surveillance* rather than monitoring (refer to Resolution VI.1).

Under these definitions wetland inventory provides the basis for guiding the development of appropriate assessment and monitoring. Wetland inventory is used to collect information to describe the ecological character of wetlands; assessment considers the pressures and associated values and risks of adverse change in ecological character; and monitoring, which can include both survey and surveillance, provides information on the extent of any change. Taken together, they provide the information needed for establishing strategies, policies and management interventions to maintain the ecological character of a wetland, including incorporation of the outcomes of economic valuations.

In addition, the report uses the terminology and draws on materials developed by the Millennium Ecosystem Assessment (MA) concerning ecosystems and ecosystem services. The MA defines ecosystem services as "the benefits that people receive from ecosystems" (Millennium Ecosystem Assessment 2003). However, it should be noted that the current terminology adopted by Ramsar Contracting Parties at COP9 in 2005 as part of their updating of definitions of wise use and ecological character is slightly different, using the term "ecosystem benefits/services" (see Ramsar Resolution IX.1 Annex A).

Figure 1. The relationships between wetland valuation and the other wetland assessment tools available through the Ramsar Convention (from Ramsar Resolution IX.1 Annex E).



What is valuation?

In order to make better decisions regarding the use and management of wetland ecosystem services[1], their importance to human society must be assessed. The importance or "value" of ecosystems is viewed and expressed differently by different disciplines, cultural conceptions, philosophical views, and schools of thought (see Box 1).

'Valuation' is defined by the *Millennium Ecosystem Assessment* (2003) as "the process of expressing a value for a particular good or service…in terms of something that can be counted, often money, but also through methods and measures from other disciplines (sociology, ecology and so on)".

Box 1. Definitions of "Value"

The Millennium Ecosystem Assessment (2003) defined value as "The contribution of an action or object to user-specified goals, objectives, or conditions" (after Farber et al. 2002). According to the Oxford English Dictionary the term "value" is used in three main ways:

i) ***Exchange value***: the price of a good or service in the market (= market price);

ii) ***Utility***: the use value of a good or service, which can be very different from the market price (e.g. the market price of water is very low, but its use value very high; the reverse is the case, for example, for diamonds or other luxury goods);

iii) ***Importance***: the appreciation or emotional value we attach to a given good or service (e.g. the emotional or spiritual experience some people have when viewing wildlife or natural scenery or our ethical considerations regarding the existence value of wildlife).

These three definitions of value roughly coincide with the interpretation of the term value by the three main scientific disciplines involved in ecosystem valuation:

a) ***Economics***, which is mainly concerned with measuring the exchange value or price to maintain a system or its attributes (Bingham et al. 1995);

b) ***Ecology***, which measures the role (importance) of attributes or functions of a system to maintain ecosystem resilience and health (Bingham et al. 1995), and

c) ***Sociology***, which tries to find measures for moral assessments (Barry & Oelschlaeger 1996).

Why is wetland valuation important?

Because of the many services and multiple values of wetlands, many different stakeholders are involved in wetland use, often leading to conflicting interests and the over-exploitation of some services (e.g., fisheries or waste disposal) at the expense of others (e.g., biodiversity conservation and flood-control).

In addition, there are many structural shortcomings in economic accounting and decision-making procedures (see Box 2 [next page]), leading to incomplete cost-benefit analysis of planned interventions in wetland systems. As a result, wetlands (and most natural ecosystems) are still undervalued and over-used: in 1999, 84% of Ramsar-listed wetlands had undergone or were threatened by ecological change, mainly caused by drainage for agriculture, settlement and urbanization, pollution, and hunting, and it has been estimated that in some locations 50% of wetlands have been lost since 1900 (Finlayson *et al.* 2005). During the first half of the 19th century, this loss mostly occurred in the northern temperate zone; since the 1950s, however, tropical and sub-tropical wetlands, particularly swamp forests and mangroves, have also been rapidly degraded and lost (Finlayson & Davidson 1999; Finlayson & D'Cruz 2005).

Increasingly, it is being shown that sustainable, multi-functional use of an ecosystem is usually not only ecologically more sound, but also economically more beneficial, both to local communities and to society as a whole (Balmford *et al.* 2002). To ensure more balanced decision-making (i.e., that multiple uses and values are considered), it is crucial that the full importance (value) of wetlands should be recognized. Such information has often not fully been taken into account when decisions are being made

1 Throughout this report, the term "services" is used to include both goods and services (Millennium Ecosystem Assessment 2003).

Box 2. Reasons why wetlands are still under-valued and over-used (adapted from Vorhies 1999; Stuip *et al*. 2002)

Wetland values are often not taken into account properly or fully in decision making, or are only partially valued, often leading to degradation or even destruction of a wetland.

Reasons for under-valuation include:

- **Market failure**: public goods. Many of the ecological services, biological resources and amenity values provided by wetlands have the qualities of a public good; i.e., many wetland services are seen as "free" and are thus not accounted for in the market (e.g., water-purification or flood-prevention).
- **Market failures**: externalities. Another type of market failure occurs when markets do not reflect the full social costs or benefits of a change in the availability of a good or service (so-called externalities). For example, the price of agricultural products obtained from drained wetlands does not fully reflect the costs, in terms of pollution and lost wetland services, which are imposed upon society by the production process.
- **Perverse incentives** (e.g., taxes/subsidies stimulating wetland over-use). Many policies and government decisions provide incentives for economic activity that often unintentionally work against the wise use of wetlands, leading to resource degradation and destruction rather than sustainable management (Vorhies 1999). An example might be subsidies for shrimp farmers leading to mangrove destruction.
- **Unequal distribution of costs and benefits**. Usually, those stakeholders who benefit from an ecosystem service, or its over-use, are not the same as the stakeholders who bear the cost. For example, when a wetland is affected by pollution of the upper catchment by runoff from agricultural land, the people living downstream of the wetland could suffer from this. The resulting loss of value (e.g., health, income) is not accounted for and the downstream stakeholders are generally not compensated for the damages they suffer (Stuip *et al.* 2002).
- **No clear ownership**. Ownership of wetlands can be difficult to establish. Wetland ecosystems often do not have clear natural boundaries and, even when natural boundaries can be defined, they may not correspond with an administrative boundary. Therefore, the bounds of responsibility of a government organization cannot be easily allocated and user values are not immediately apparent to decision-makers.
- **Devolution of decision-making away from local users and managers**. Failure of decision-makers and planners to recognize the importance of wetlands to those who rely on them, either directly or indirectly.

about economic development and hence degradation of wetlands still continues (Barbier *et al.* 1997; Finlayson & D'Cruz 2005; Finlayson *et al*. 2005). Thus, better communication of wetland values, and the costs and benefits of alternative uses of wetlands, to decision-makers and the general public is crucial.

When should valuation be undertaken?

Whenever decisions are made, and at all decision-making levels (including personal, corporate, and government decisions), judgments are inevitably made, often implicitly rather than explicitly, about the values that will be affected by the decision, whether those be ecological, social, economic, or monetary. Often the changes in these values are not made explicit, leading to decisions that have unwanted and avoidable side effects. Since most development decisions are based on (market-) economic considerations, it is especially important to make a proper assessment of all the monetary consequences of these decisions. However, monetary valuation should always be seen in addition to, and not as a replacement for, ecological, social and cultural values under consideration in the decision-making process. The Ramsar Convention has recognized the importance of applying wetland valuation in ensuring appropriate decision-making in relation to Environmental Impact Assessment, in particular in Resolution VIII.9 on *Guidelines for incorporating biodiversity-related issues into environmental impact assessment legislation and/or processes and in strategic environmental assessment' adopted by the Convention on Biological Diversity (CBD), and their relevance to the Ramsar Convention.*

Box 3. The importance of wetlands for recreation and tourism: coral reefs in the Philippines (from White et al. 2000)

The Philippines has an estimated 27,000 km^2 of coral reef, with only about 5 percent of this area considered still to be in excellent condition. Recent valuation studies indicate that reefs in the country are contributing a conservative US$ 1.35 billion to the national economy and that one km^2 of healthy Philippine reef with some tourism potential produces annual net revenues ranging from US$ 29,400 to US$ 113,000. A case study of Olango Island, Cebu, with 40 km^2 of poor quality coral reef was analyzed together with its wetland habitat and mangrove contribution. The current annual net revenue range from the Olango Island reef is US$ 38,300 to 63,400 per km^2 or US$ 1.53 to 2.54 million for the entire 40 km^2 reef area. Another US$ 389,000 is added when other associated wetlands are considered. This relatively high per km^2 and total amount of current revenue reflects the proximity of the Olango reef to Mactan Island, Cebu, a well-known tourist destination. The revenues accrue primarily from on- and off-site expenditures of diving tourists. Costs of managing Olango Island coral reefs and wetland habitats for improved net revenues (benefits) and conservation would amount to less than US$ 100,000 per year. Cost and benefit analyzes show that there is a very strong justification on the part of local and national government and private sector groups to invest in the management of reefs such as Olango Island. Improved reef quality and wetland stewardship on Olango could easily mean a 60 percent (US$ 1.4 million) increase in annual net revenues from reef and mangrove fisheries and tourism expenditures.

There are three situations in which it is particularly important to carry out valuation studies. These are:

1) **Assessment of Total Economic Value (TEV)**: i.e., to determine the total contribution of ecosystems to the local or national economy and human well-being. As most wetlands play a crucial role in maintaining local livelihoods and significantly contribute to the regional, national and even global economy, it is important that information about the Total Economic Value of wetlands (see Figure 7) is explained and communicated to all stakeholders and that the boundary conditions for policy making are created that stimulate conservation and sustainable use of this "natural capital" and prevent further degradation or (partial) destruction. Because of the increasing relevance or tourism and recreation in attracting financial resources for the conservation and sustainable utilization of wetlands, Box 3 gives an example of the importance of the valuation of their tourism/ recreation service. Case study 2 in Appendix 1 provides a further example of the importance of applying TEV.

2) **Trade-off Analysis**: i.e., to evaluate effects (costs and benefits) of alternative development options for a given wetland in order to make informed decisions about possibilities (and impossibilities) for sustainable, multi-functional use of wetland services (see SCBD 2005[2]). Proper inclusion of all values in trade-off analysis and decision-support systems is essential for achieving "wise use" of wetlands, i.e., outcomes that are ecologically sustainable, socially acceptable, and economically sound (see Box 4).

There are many examples of the local economic value of intact wetlands exceeding that of converted or otherwise altered wetlands. For example, services provided by intact mangroves in Thailand are worth about US$60,000 per hectare compared to about US$17,000 from shrimp farms, and in Canada intact freshwater marshes have a value of about US$ 8,800 per hectare compared to US$ 3,700 for drained marshes used for agriculture (Balmford *et al.* 2002).

Through years of uneconomical conversions, we have built up a large "natural capital debt" which we are now, partly, repaying at high cost by spending large amounts of money on wetland restoration and adaptation projects. Information on the economic value of wetlands, and the natural capital they represent, can help to achieve more intergenerational equity by highlighting the need for, and benefits of, limiting wetland use to the *interest* of the natural capital instead of diminishing the capital itself.

Ramsar's *Principles and guidelines for wetland restoration* (Resolution VIII.16) recognize that the costs of restoring wetlands and their ecosystem services are often far higher than the costs of maintaining the ecological character of the intact wetland, and Resolution VIII.9 recognizes the role of impact assessment in wetland restoration and rehabilitation, including in the identification of possibilities for mitigation of lost wetlands.

2 SCBD 2005, to be published in the CBD Technical Series, includes a closer look at the importance of valuation for including biodiversity losses or gains in national income accounts.

Box 4. Restoration costs of degraded wetlands: an example from the Netherlands

In many instances, wetland "development" projects have caused more harm than good and are now being restored at high cost. In the Netherlands, where there is a long and successful tradition of draining wetlands, dikes (banks) have long been the preferred choice for managing water and preventing flooding. With the protection offered by these dikes, large investments in infrastructure, agriculture, housing and industry are now concentrated in former wetlands; the cost of a flood in these areas is very high. However, climate change is posing new future risks through increases in sea level and extreme river discharges, and this has led to a shift in the trade-off costs of continuing indefinitely to raise all dikes. Thus in the less heavily developed areas, a costly multi-million Euro programme of river restoration has commenced which includes broadening floodplains, (re)creating water retention areas in natural depressions, and (re)opening secondary channels of rivers (Stuip *et al.* 2002).

3) **Impact Assessment:** i.e., to analyze the effects of (proposed) wetland drainage, or other destructive practices, on wetland services and their value (including ecological, socio-cultural, economic and monetary values). In many cases there will be good reasons for converting natural ecosystems into another type of land (or water) use. There are also many occasions in which the loss of ecosystems and their services is caused by accidents (e.g., oil spills) and unintended side effects (so-called "externalities") of economic activities (see Box 5).

Results from studies on the total value of ecosystems can help to compensate those people who suffered losses (loss of "value") due to a given activity, and they can provide information to include "externalities" in the economic production process (see also "How can wetland valuation studies be used?" below).

How can wetland valuation studies be used?

More and better information on the socio-cultural and economic benefits of ecosystem services is needed to:

i) demonstrate the contribution of wetlands to the local, national and global economy (and thus build local and political support for their conservation and sustainable use);

ii) convince decision-makers that the benefits of conservation and sustainable use of wetlands usually outweigh the costs and explain to them the need to better factor wetlands into development planning (through more balanced cost-benefit analysis);

iii) identify the users and beneficiaries of wetland services to attract investments and secure sustainable financial streams and incentives for the maintenance, or restoration, of these services (i.e., make users pay and ensure that local people receive a proper share of the benefits); and

iv) increase awareness about the many benefits of wetlands to human well-being and ensure that wetlands are better taken into account in economic welfare indicators (e.g., in Gross National Product (GNP) calculations) and pricing mechanisms (through internalization of externalities).

In addition to raising awareness about wetland benefits in decision-making, valuation studies can help to improve how local institutions manage resources; identify better markets and resource management options for wetlands and their products; and inves-

Box 5. The use of valuation in environmental impact assessment

In the case of oil spills, economic valuation has shown the direct and indirect damage inflicted upon coastal systems and has provided a basis for financially compensating local people for lost ecosystem services. Often these indirect, and in the past neglected, damages are much higher than the direct clean-up and damage costs. For example, the Prestige Oil spill off the coast of France and Spain in 2002 led to clean-up costs of over 2 billion Euro, but the indirect damage to the fishermen, tourism industry, local people's livelihoods, and lost natural values was calculated at over 5 billion Euro (Garcia 2003). As the insurance coverage of the oil company only amounted to 175 million Euro, the case for compensation is still being debated in court. Calculations such as this can help to determine more realistic insurance premiums and thus "internalize" the so-called external effects of, in this case, the oil industry, and hopefully contribute to quicker implementation of preventive measures (e.g., making oil ships safer and, by raising oil prices, stimulating development of alternative energy sources).

tigate people's livelihood strategies and how these determine the constraints and options for making wise use of wetlands (Guijt & Hinchcliffe 1998).

Wetland valuation can also help in sizing the amount of damage done by an accident, natural disaster or illegal use, thereby helping in legal proceedings and decisions on suitable restoration options (see SCBD 2005 for further discussion).

How to implement this guidance

The main part of the guidance which follows outlines a framework which should be followed in order to conduct an integrated assessment of wetland ecosystem services, and it sets out five key steps in undertaking a wetland valuation assessment. Subsequent sections provide more detailed guidance on undertaking each of these steps and the available methods for their application.

Additional support and information is being developed and provided through the Internet on www.naturevaluation.org. This supplies access to existing databases, literature and case studies and is being regularly updated. This Web site also gives access to a discussion platform for exchange of information and experiences on valuation of wetland services.

A framework for wetland valuation

A Framework for the integrated assessment and valuation of wetland services

Based on literature review (see References and Further Reading), the authors' original work, and information and advice from the STRP, a framework for wetland valuation has been designed and is provided in Figure 2.

The four main steps described in this guidance are: 1. Policy Analysis; 2. Stakeholder Analysis; 3. Function Analysis (inventory: identification and quantification of services); and 4. Valuation of services. A key fifth step, the need to communicate the value of wetlands to all stakeholders and decision-makers, is also briefly discussed.

Some additional activities are needed for a complete integrated assessment of the role of wetland

Figure 2. A Framework for integrated assessment and valuation of wetland services

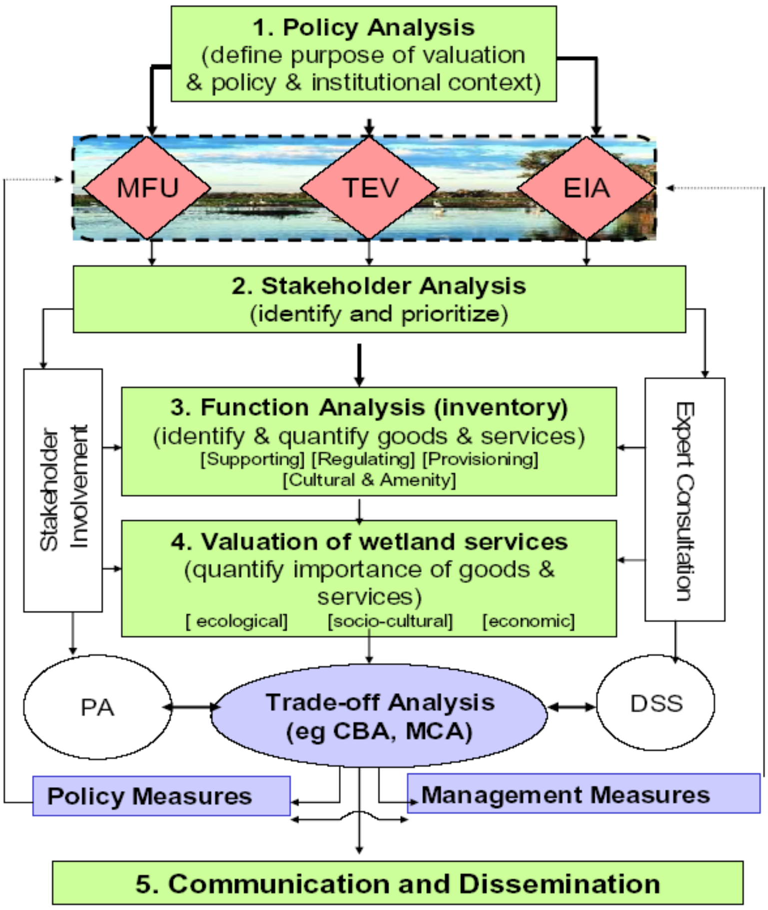
Explanation of symbols, colours and abbreviations:

Green: the five steps described in this guidance;

White: additional tools and activities which are needed for a full Integrated Assessment, but which are not covered in this guidance;

Mauve: areas of application (i.e., in trade-off analysis to determine policy and management measures); *Red:* the three situations in which Valuation is used: MFU - assessment of options and trade-offs for multi-functional use of wetlands, TEV - assessment of the total contribution (value) of wetlands to the economy at different scales (local, national, or even global), EIA - assessments of the effects/impacts (ecological and socio-economic) of wetland conversion or proposed conversion.

Other abbreviations: PA – Participatory Approach; DSS - Decision Support System; CBA - Cost Benefit Analysis; MCA – Multi-Criteria Analysis.



ecosystems in development planning. These include analysis of pressures, trade-offs, and management implications. These are included in Figure 2, but are not further discussed in this report (see, for example, Emerton & Bos 2004 and Appendix 3 for further information sources).

A brief description of the steps for undertaking wetland valuation

A short description is given below of the main steps distinguished in this guidance; a more detailed description (including methods for applying these steps) is given in the following sections.

Step 1: Analysis of policy processes and management objectives *(why undertake the valuation?)*

Insight into the policy processes and management objectives is essential to set the stage for a discussion of what kind of valuation is needed (e.g., to assess the impact of past or ongoing interventions, to analyze trade-offs of planned wetland uses (= partial valuation), or to determine the Total Value of the intact wetland). During this stage of the valuation process, it should also be determined how values that are relevant to policy and management decisions can be generated.

Step 2: Stakeholder analysis and involvement *(who should do the valuation, and for whom?)*

Early in the process, the main stakeholders should be identified, because the involvement of stakeholders is essential in almost all steps of the valuation procedure: i.e., to determine the main policy and management objectives, to identify the main relevant services and assess their value, and to discuss trade-offs involved in wetland use.

Step 3: Function analysis (identification & quantification of services) *(what should be valued?)*

In this step, through inventory methods wetland characteristics (ecological processes and components) are translated into functions which provide specific ecosystem services. These services should be quantified in appropriate units (biophysical or otherwise), based on actual or potential sustainable use levels.

Step 4 Valuation of services *(how to undertake the valuation?)*

In this step, the benefits of wetland services identified in step 3 are analyzed. These benefits should be quantified in both the appropriate value units (ecological, socio-cultural and economic indicators) as well as monetary values.

Step 5 Communicating wetland values *(to whom to provide the assessment results?)*

To make the results of the valuation fully accessible to all stakeholders and relevant decision-makers, communication and dissemination activities are essential. On-line support to this guidance will be provided through www.naturevaluation.org.

Although this report stops with this last step, it is crucial that the information generated by the valuation be structurally integrated in decision-making instruments such as multi-criteria analysis and cost-benefit analysis (see Figure 2). Advice on doing this is, however, beyond the scope of this paper.

In the following sections key issues, approaches and relevant methods and data needs are described for each if the five main steps of the wetland valuation framework.

Step 1: Policy analysis - analysis of policy processes and management objectives

Analysis of policy processes and management objectives is essential to set the stage for a discussion of why the valuation is necessary and what kind of valuation is needed (e.g., to assess the impact of past or ongoing interventions, to analyze trade-offs of planned wetland uses (= partial valuation), or to determine the Total Value of the intact wetland).

During this stage of the valuation process, it should also be determined how values can be generated that are relevant to policy and management decisions.

Why is policy analysis necessary?

Policies, institutions and governance aspects influence the kind of values that will be taken into account in decision-making and management measures.

The aim of policy analysis is to:

i) identify the types of information (and kinds of values) required and by whom;

ii) understand the policy process and stakeholder interests, both in current practice and the desirable state, and how they influence the kind of information that is required;

iii) enable key stakeholders to assign their own values and incorporate them into decision-making, and be able to compare different kinds of values;

iv) describe the objective of the valuation within the policy and stakeholder context;

v) identify the main valuation questions in relation to the current and 'desired' policies; and

vi) ensure that valuation reflects policy goals and aspirations for wetlands and those who use them.

Elements of policy analysis

The following five main elements should be included in policy analysis. These are based on the DFID Sustainable Livelihoods Web site (see the guidance sheets for extra information, http://www.livelihoods.org) and the IFAD Sustainable Livelihoods workshop on Methods for Institutional and Policy Analysis (http://www.ifad.org/sla/background/english/institution.ppt).

These five elements are:

i) *Social capital and actors*: to involve the appropriate stakeholder groups in the valuation process, the main actors and 'social capital'[3] need to be identified (see also Step 2 (*Stakeholder analysis*)). Questions to be asked include: What is the available knowledge on the current situation? What force is available to harness the problems? Who are the players? Who is affected? What techniques are available to elicit values from under-represented groups?

ii) *Policy context, statements and measure:* the current policy context needs to be analyzed to see how policies interrelate, how they work together or against each other, in order to be aware of opportunities and constraints.

iii) *Policy process and priorities*: through analyzing existing policies and policy gaps, policy priorities can be identified.

iv) *Institutions and organizations*: institutions (rules, procedures, and norms of society) and organizations (government, private sector, and civil society) form the interface between policy and people. Questions to keep in mind while mapping the relevant institutions for a particular analysis or valuation: "Why do policy statements often say one thing, when quite another thing is observed in the field?", "How do the realities of the micro-level situation get fed into the policy-making process?"

v) *Livelihood strategies*: An analysis of policies for sustainable livelihoods (and ecosystems) requires an understanding of the livelihood priorities, the policy sectors that are relevant, and whether or not appropriate policies exist in those sectors.

Methods for policy analysis

There are a number of different methods for policy analysis that can be applied to one or more of the five main elements of analysis. Table 1 gives an overview of the main policy analysis methods and the different elements of policy to which they can be applied. Appendix 2 provides additional information on each of these methods and how to apply them, with reference sources for finding further information.

There are some methodological issues that must be kept in mind when conducting policy analysis. Policy is highly political; policy can shift when local, regional or national governing bodies change their political stance after elections. This means policy has the potential of being only temporary. Policy and policy making are also macro-, meso- and micro-processes, meaning that regional policy makers can have a defining influence concerning local policy. The institutions and organizations involved in policy and policy making are not uniform. Each organization has its own culture and language, which may not always bring the message across clearly to stakeholders or to other organizations and institutions. One must also keep in mind that policy affects different stakeholder groups in different ways.

In situations where a policy analysis shows that a valuation cannot be conducted in the best way possible due to constraints in institutional or human capacity or social capital, measures of capacity-building and training could be considered as well as support for related research and cooperation with partners (SCBD 2005).

Step 2: Stakeholder analysis and involvement

Early in the process, the main stakeholders should be identified. This is particularly important because in almost all steps of the valuation procedure, stakeholder involvement is essential in order to determine the main policy and management objectives, to identify the main relevant services and assess their value, and to discuss trade-offs involved in wetland use.

A stakeholder is a person, organization or group with interests in an issue or particular natural resource. Stakeholders are both the people with power to con-

3 *Social capital* is the 'raw material' of civil society which is created from the myriad of everyday interactions between people. It is not located within the individual person or within the social structure, but in the space between people. It is not the property of the organization, the market or the state, though all can engage in its production (http://www.mapl.com.au/socialcapital/soccap1.htm).

Table 1. Methods for analyzing different elements of policy and policy process
(adapted from: http://www.livelihoods.org)

Methods	Policy elements to which each method can be applied				
	Social capital & actors	Policy context, statements & measures	Policy process and priorities	Institutions and organizations	Livelihood Strategies
Document analysis	•	•	•	•	•
Interviews	•	•	•	•	•
Policy mapping		•	•		
Policy ranking			•		
Visioning			•		
Power analysis	•			•	
Social maps	•			•	
Strategy flow diagrams	•				•
Institutional analysis	•			•	
Stakeholder analysis	•		•		
Actor network analysis	•		•		
Livelihood analysis					•
Preference ranking					•
Time lines		•	•		•

trol the use of resources, and those with no influence but whose livelihoods are affected by changing the use of resources. According to Brown *et al.* (2001), stakeholder analysis is a system for collecting information about groups or individuals who are affected by decisions, categorizing that information, and explaining the possible conflicts that may exist between important groups and areas where trade-offs may be possible. It can be undertaken simply to identify stakeholders or to explore opportunities for getting groups or individuals to work together.

There are three main steps involved in stakeholder analysis: identification, prioritization, and involvement of stakeholders.

Methods used in stakeholder analysis

Methods which can and should be used, as appropriate, in stakeholder analyses of wetland valuation are listed in Table 2. A particularly important tool is the use of questionnaires, which can be used in all stages of the stakeholder analysis. It is important to have expert advice and input in the design of such questionnaires, lest there be a heightened risk that ambiguous, confusing, or uninterpretable answers will be collected.

Questionnaire design

Questionnaires are an inexpensive way to gather data from a potentially large number of respondents. Often they are the only feasible way to reach sufficiently large numbers of people to allow statistical analysis of the results. A well-designed questionnaire that is used effectively can gather information on both the overall topic at hand and on specific components of the issue. Although questionnaires may be 'cheap' to administer compared to other data collection methods, they are every bit as 'expensive' in terms of design time and interpretation.

The steps required to design and administer a questionnaire include: 1) defining the objectives of the survey, 2) determining the sampling group, 3) preparing the questionnaire, 4) administering the questionnaire, and 5) interpretation of the results. Further advice on preparing a questionnaire is provided below.

Six principles for drafting a questionnaire

A stakeholder questionnaire should be designed with the following principles in mind:

i) Content: the minimum number of topics should be included to meet the objectives: What does the survey want to find out? why is the information needed? from whom and where can it

Table 2. Methods used in stakeholder analysis

Can be used for: Method	Selecting Stake-holders	Prioritizing Stake-holders	Involving Stake-holders
Data review	•	•	
Observation	•	•	
Interviews, questionnaires	•	•	•
Resource tenure & ownership maps	•	•	•
Diagrams, maps	•		•
Ranking		•	
Stories, portraits		•	•
Workshops		•	•

be obtained? and how are the topics are to be questioned?

ii) Time: the time needed to complete it should be kept reasonable (not more than 60 minutes). If necessary, the number of questions should be limited.

iii) Easy to use: the questionnaire should be easy to use both as an interview guide for the researcher and as an instrument for recording answers.

iv) Self-contained: appropriate detail/identification for the researcher, respondent, and date of interview should be included, as well as any other reference information such as field details.

v) Coding: coding for analysis should be done directly on the form, preferably alongside the verbal response for each question.

vi) Smart presentation: thought should be given to quality of paper, size of sheets used, clarity of printing and presentation, and spaces provided for recording answers.

Steps to follow when designing a questionnaire form

(from Poate & Daplyn 1993; see also: http://www.cc.gatech.edu/classes/cs6751_97_winter/Topics/quest-design/)

i) Draw up a list of question topics from a mixture of theoretical models, empirical information, research evidence and terms of reference for study.

ii) For each topic, phrase the specific information required as a question.

Question phrasing: Information required should be well and clearly defined at each stage. Each question should have: a) the same meaning to every person asked, b) an answer which the respondent knows, c) an answer which can be given clearly and unambiguously by the respondent.

iii) List the questions in logical order, following either a chronological or a sequential pattern.

iv) Decide for each question how to record the interview response.

v) Make a first draft layout on the style of paper to be used.

vi) Test the design on model respondents.

vii) Prepare a pilot draft for a pilot or test survey.

viii) Modify the form from the results of the test.

ix) Finalize the design and layout.

x) Continually review the number of questions listed – avoid well-worn topics, 'shopping lists' or 'just in case' questions….if in doubt, leave it out.

Identification and selection of stakeholders

The first step in stakeholder analysis is to identify people, groups and organizations who are important to involve in a valuation or who might be affected by the outcome (see Table 3). Several identification criteria can be used, such as *type of influence*: people who are affected by the policy that results from the valuation, as well as those who affect the policy and *spatial distribution*: stakeholders identified from a macro- to a micro- level (e.g., global and international wider society, national, regional, local off-site and local on-site) (Brown *et al.* 2001).

There are different ways to identify stakeholders, and it is up to the selector to use his or her common sense and prudence in selection. Methods for selection

Table 3. Main methods used in the identification and selection of stakeholders

Methods	Description	Sources/References
Data Review	Review of existing data on potential stakeholders, and/or the issue at hand that the stakeholder analysis is needed for.	City Hall, local NGO's, involved organisations and institutions
Observation	Observation of potential stakeholders, interaction of stakeholders	Rhoads (1999). *Interactions between scientists and non-scientists in community bases watershed management: Emergence of the concept of stream naturalization.*
Interviews, Questionnaires	For accurate determination for the selection of stakeholders. Method to gauge level of involvement, power structure, level of influence, etc.	Purdue University Writing Lab. *Field research: conducting an interview* MacNamara (1999). *General guidelines for conducting interviews.*
Resource tenure & ownership maps	Case studies and actual step-by-step mapping is shown for a clear concept on how to go about it.	Guijt & Hinchcliffe (1998). *Participatory Valuation of Wild Resources: an overview of the Hidden harvest methodology.*
Diagrams, Maps	Actual mobility maps with clear explanations on how to accurately translate stakeholders mobility into maps	Guijt & Hinchcliffe (1998), as above.

include a top-down approach (macro- to micro- level) and questionnaires to large groups for mutual identification. Stakeholders can also identify each other by asking already involved stakeholders to name others whom they think are relevant and need to be considered. This identification process will unearth a range of individuals, groups, NGOs, other organizations and government departments.

A distinction should be made between stakeholders who identify themselves as a cohesive group (e.g., companies and NGOs) and unorganized 'groups' such as small businesses and households.

There is no 'standard set' of stakeholders relevant to wetland valuations. Stakeholders identified for one valuation project are not necessarily important for another. In addition, stakeholders change over time, so previously identified stakeholders must be reconsidered rather than immediately assumed still to be relevant to the process (Brown *et al.* 2001).

Prioritizing stakeholders

Since not all stakeholders will prove to be directly relevant to the particular wetland valuation exercise, stakeholders need to be categorized according to their level of influence and their importance to the valuation. Besides categorizing the stakeholders into different levels of importance, it is also necessary to look at the level of involvement of the stakeholders. Certain stakeholders may need only to be notified of the outcome of the valuation, whilst others should be fully and directly involved in the process.

Stakeholders can be categorized according to their level of influence and their importance (Figure 3), so that the relative levels of influence and importance determine whether a stakeholder is a primary, secondary, or external stakeholder. *Importance* refers to the degree to which the stakeholder is considered a focus of a decision to be made. *Influence* refers to the level of power a stakeholder has to control the outcome of a decision. Influence is dictated by stakeholders' control of, or access to, power and resources. Influential stakeholders (lobbying groups, wealthy landowners, etc.) are often already engaged in the process or have access to it.

Based on this categorization, three types of stakeholders can be distinguished:

1) *Primary stakeholders* (Figure 3, cells A & B) – those who have high importance to the process. Note that such stakeholders may frequently perceive

Figure 3. Prioritizing stakeholders based on their influence and importance (to a project) (Source: http://www.cphp.uk.com/downloads)

Degree of Importance / Degree of Influence	High Influence	Low Influence
High Importance	A **Stakeholders who stand to lose or gain significantly from the project AND whose actions can affect the project's ability to meet its objectives.** The project needs to ensure that their interests are fully represented in the coalition. Overall impact of the project will require good relationships to be developed with these stakeholders.	B **Stakeholders who stand to lose or gain significantly from the project BUT whose actions cannot affect the project's ability to meet its objectives.** The project needs to ensure that their interests and values are fully represented in the coalition.
Low Importance	C **Stakeholders whose actions can affect the project's ability to meet its objectives BUT who do not stand to lose or gain much from the project.** They may be a source of risk; and you will need to explore means of monitoring and managing that risk.	D **Stakeholders who do not stand to lose or gain much from the project AND whose actions cannot affect the project's ability to meet its objectives.** They may require limited monitoring or informing of progress but are of low priority. They are unlikely to be the subject of project activities or involved in project management.

themselves as having low influence, despite being important.

2) *Secondary stakeholders* (cells A & C) – those who can be both important and influential, may be directly involved in the process, and are integral to success. They can in some circumstances be highly influential (for example, governmental implementing agencies).

3) *External stakeholders* (cells C & D) – those who can also be influential but who tend to have low importance for particular activities. External stakeholders can, however, be influential to outcomes.

Involving stakeholders

As a final stage in stakeholder analysis, it is essential to identify what form of participation is both desirable and feasible for the different actors in each stage and activity of the valuation process (see Table 4). This will depend largely on the objectives of the valuation. These objectives, in turn, will have many implications for the research design. If it is to be a data gathering exercise, then rapidity will probably win over pursuit of local analytical processes. If it is to be an exercise leading to local action, then building local analysis and competence will need to be prioritized over quick research outcomes.

Participatory methods imply certain obligations, and it is important to be aware of the following issues (IIED 1997):

i) Active involvement of people in research and analysis means that all participants should have ownership of the results. This implies a requirement for effective and timely feedback, the sharing of reports, and the recognition of contributions.

ii) The use of interactive, participatory methods may generate enthusiasm and excitement and raise expectations. This implies that plans for follow-up must always be part of these activities. Rooting research work within local structures, seeking alliances with development actors on the ground, and finding a means to pursue findings all require prior planning and a commitment that stretches both before and beyond the research study.

iii) Open and frank discussions about research use can raise latent resource-related conflicts that

Table 4. Methods for involving stakeholders (For additional guidance on the levels of participation, see ESCARP Virtual Conference (www.unescap.org/drapd/vc/orientation/M6_-intro.htm; and Brown et al. 2001))

Approach	Method of involvement	Application (level of participation)
Top-down	Public awareness campaigns, government monitoring and enforcement.	Policies and programs are issued and implemented. Participants must behave in a prescribed way.
Consultation	Consultation meetings and consideration of some or all recommendations. Involvement of other groups in implementation and monitoring may or may not be sought.	Plans and policies are formulated and presented to stakeholders for comments and reactions.
Participation	Public awareness campaigns, affiliation with NGOs and community groups. Joint government and community monitoring and enforcement.	Stakeholder groups are encouraged to get involved (voluntary or with market incentives) in the valuation activities.
Collaboration	Public awareness, consultations at the initial stage and community assistance with monitoring and enforcement	Stakeholder groups are involved in the design and operation of programs and projects but still under overall direction and leadership.
Partnership	Stakeholders share in formulating, raising public commitment, funding, monitoring and enforcement.	Together, stakeholder groups design, implement and monitor plans, policies, programs and projects on equal footing.
Autonomous	Stakeholder groups may or may not coordinate and share information.	Stakeholder groups individually design and implement programs and projects.

then need to be addressed. Do researchers have the skills to deal with some of these conflicts?

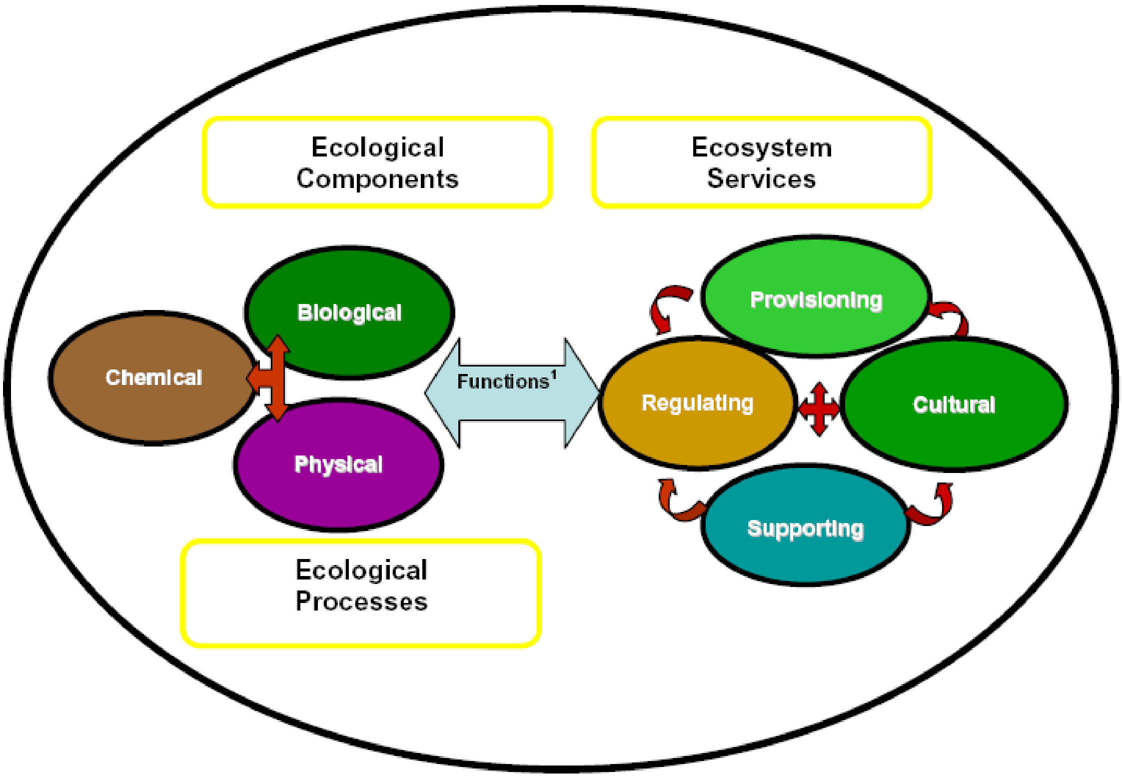
iv) Finally, active local involvement in research has costs as well as well-recognized benefits. These costs include the real costs of time out of busy lives and material costs in terms of accommodation and food provided, as well as the potential costs of political and social disputes generated by the intervention. These costs must be recognized and compensated in locally appropriate ways.

Further information and guidance on stakeholder analysis methods can be found in McCracken *et al.* (1988), Guijt & Hinchclife (1998), Brown *et al.* (2001), and Grieg-Gan *et al.* (2002).

Step 3: Function analysis: inventory of wetland services

Wetlands are composed of a number of physical, biological and chemical components such as soils, water, plant and animal species, and nutrients. Interactions among and within these components allow the wetland to perform certain *functions*. Ecosystem functions have been defined as "the capacity of ecosystem process and components to provide goods and services that satisfy human needs, directly or indirectly" (see de Groot 1992; de Groot *et al.* 2002). The Millennium Ecosystem Assessment (2003) defined ecosystem services as "the benefits people obtain from ecosystems" (whereby services are defined broadly and include both goods (i.e., resources) and services in the more narrow sense (i.e., benefits from ecosystem processes and non-material uses).

Figure 4. Relationships among ecological components and processes that comprise a wetland and the ecosystem services they deliver



[1] The degree to which Ecological Components and Processes provide Ecosystem Services depends on the functional properties of the ecosystem (*e.g.* biomass production, nutrient cycling, food-chain dynamics and other properties of species and abiotic components)

The first part of the function analysis in this step of valuation should translate wetland characteristics (ecological processes and components) into a comprehensive list of services which can then be quantified in appropriate units (biophysical or otherwise) to determine their value (importance) to human society (Figure 4).

Identification and selection of wetland services

Depending on the purpose of the valuation (see Step 1), the stakeholders and their interests (Step 2), and the ecological and socio-economic setting, different services will be relevant in the valuation process.

The first step in this part of the valuation assessment is the development of a checklist of the main services of the wetland being assessed. Table 5 provides a list of the main services provided by different types of wetland (both inland and coastal) and their general relative magnitude. Depending on the complexity of the wetland being valued, the services should be described for each of the main ecosystem components (e.g., constituent river, lake, marsh etc.) and if possible be supported by maps to show the spatial distribution of each service.

The selection of services to be included in the valuation process should be done in close consultation with the main stakeholders (see Step 2 above). It is beyond the scope of this report to describe each of these services in any detail.

Quantification of the capacity of wetlands to provide ecosystem services on a sustainable basis

Once the main services delivered by the wetland have been selected, the magnitude of the actual and potential availability of these main services should be determined, based on sustainable use levels. Table 6 provides a list of example indicators

Table 5. Services provided by a) inland and b) coastal wetlands.
Source: Millennium Ecosystem Assessment (Finlayson et al. 2005).

Scale is low •, medium ●, to high: ⬤; not known = ?; blank cells indicate that the service is not considered applicable to the wetland type. The information in the table represents expert opinion for a global average pattern for wetlands; there will be local and regional differences in relative magnitudes.

Services	Comments and Examples	Permanent and Temporary Rivers and Streams	Permanent Lakes, Reservoirs	Seasonal Lakes, Marshes, and Swamps, Including Floodplains	Forested Wetlands, Marshes, and Swamps, Including Floodplains	Alpine and Tundra Wetlands	Springs and Oases	Geothermal Wetlands	Underground Wetlands, Including Caves and Groundwater Systems
Inland Wetlands									
Provisioning									
Food	production of fish, wild game, fruits, grains, and so on	⬤	⬤	⬤	⬤	•	•		
Fresh water	storage and retention of water; provision of water for irrigation and for drinking	⬤	⬤	●	•	•	•		⬤
Fiber and fuel	production of timber, fuelwood, peat, fodder, aggregates	●	●	•	⬤	●	•		
Biochemical products	extraction of materials from biota	•	•	?	?	?	?	?	?
Genetic materials	medicine; genes for resistance to plant pathogens, ornamental species, and so on	•	•	?	•	?	?	?	?
Regulating									
Climate regulation	regulation of greenhouse gases, temperature, precipitation, and other climatic processes; chemical composition of the atmosphere	•	⬤	•	⬤	•		•	•
Hydrological regimes	groundwater recharge and discharge; storage of water for agriculture or industry	⬤	⬤	●	●	•	•		•
Pollution control and detoxification	retention, recovery, and removal of excess nutrients and pollutants	⬤	●	•	●	•	•		●
Erosion protection	retention of soils and prevention of structural change (such as coastal erosion, bank slumping, and so on)	●	•	•	●	?	•		•
Natural hazards	flood control; storm protection	●	⬤	⬤	●	●	•		•
Cultural									
Spiritual and inspirational	personal feelings and well-being; religious significance	⬤	⬤	●	●	•	●	•	•
Recreational	opportunities for tourism and recreational activities	⬤	⬤	●	•	•	•	•	•
Aesthetic	appreciation of natural features	⬤	●	•	●	•	•	•	•
Educational	opportunities for formal and informal education and training	⬤	⬤	●	●	•	•	•	•
Supporting									
Biodiversity	habitats for resident or transient species	⬤	⬤	●	●	•	•	•	•
Soil formation	sediment retention and accumulation of organic matter	⬤	•	●	⬤	•	?	?	
Nutrient cycling	storage, recycling, processing, and acquisition of nutrients	⬤	⬤	⬤	⬤	•	•	?	•
Pollination	support for pollinators	•	•	•	●	•	•		

Services	Comments and Examples	Estuaries and Marshes	Mangroves	Lagoons, Including Salt Ponds	Intertidal Flats, Beaches, and Dunes	Kelp	Rock and Shell Reefs	Seagrass Beds	Coral Reefs
Coastal Wetlands									
Provisioning									
Food	production of fish, algae, and invertebrates	⬤	⬤	•	●	•	●	•	●
Fresh water	storage and retention of water; provision of water for irrigation and for drinking	•		•					
Fiber, timber, fuel	production of timber, fuelwood, peat, fodder, aggregates	⬤	⬤	●					
Biochemical products	extraction of materials from biota	•	•			•			•
Genetic materials	medicine; genes for resistance to plant pathogens, ornamental species, and so on	•	•	•		●			•
Regulating									
Climate regulation	regulation of greenhouse gases, temperature, precipitation, and other climatic processes; chemical composition of the atmosphere	●	●	●	•		•	•	●
Biological regulation (C11.3)	resistance of species invasions; regulating interactions between different trophic levels; preserving functional diversity and interactions	●	⬤	●	•		•		•
Hydrological regimes	groundwater recharge/discharge; storage of water for agriculture or industry	•		•					
Pollution control and detoxification	retention, recovery, and removal of excess nutrients and pollutants	⬤	⬤	●		?	•	•	•
Erosion protection	retention of soils	●	⬤	•				•	•
Natural hazards	flood control; storm protection	⬤	⬤	•	•	•	●	●	⬤
Cultural									
Spiritual and inspirational	personal feelings and well-being	⬤	•	●	⬤	•	•	•	⬤
Recreational	opportunities for tourism and recreational activities	⬤	•	•	⬤	•			⬤
Aesthetic	appreciation of natural features	●	•	●	●				⬤
Educational	opportunities for formal and informal education and training	•	•	•	•		•		•
Supporting									
Biodiversity	habitats for resident or transient species	●	●	•	⬤	•	⬤	•	⬤
Soil formation	sediment retention and accumulation of organic matter	●	●	•	•				
Nutrient cycling	storage, recycling, processing, and acquisition of nutrients	●	●	●	•	•	•		●

suitable for determining the sustainable use of wetland services.

The capacity of ecosystems to provide services in a sustainable manner depends on the biotic and abiotic characteristics which should be quantified with ecological, biophysical or other appropriate indicators. For example, the capacity of wetlands to provide fish can be measured by maximum sustainable harvest levels (in terms of biomass or some other unit), the capacity to store water by hydrological parameters (e.g., water volume, flow velocity, etc.), and the capacity for recreational use by aesthetic quality indicators and carrying capacity for visitor numbers (see Table 6).

As most functions and related ecosystem processes are inter-linked, sustainable use levels should be determined under complex system conditions, taking due account of the dynamic interactions between functions, values, and processes (Limburg *et al.* 2002).

Further references and data sources on the application of methods to assess each of the wetland services and indicators listed in Table 6 can be obtained from existing information sources, such as those available through www.naturevaluation.org.

Step 4: Valuation of wetland services

Total Value and types of value

Following the various perceptions and definitions of value and valuation (see Box 1), three main types of values can be defined which together determine the Total Value (or importance) of wetlands. These are: ecological, socio-cultural, and economic values (see Figure 5). Each type of value has its own set of criteria and value units, and these are briefly described in the following sections.

As each wetland area and each decision-making situation is, strictly speaking, unique in space and time, data on these values should as much as possible be obtained through original research on the ecological, socio-cultural and economic indicators, such as those mentioned in Table 6 and Figure 5, for each decision-making situation. This is a time-consuming task, but fortunately an increasing body of information is available in the literature and through the Internet. As the literature keeps growing, and databases become more complete and sophisticated, a good start can be made through a thorough desk study and then the application of benefit transfer techniques (see below).

Regardless of the methods used (field research, desk studies, Internet searches, benefit transfer), the involvement of stakeholders is important in the collection and/or the verification of the data (see Step 2). An overview of the main criteria and measurement units (indicators) needed to quantify the ecological, socio-cultural, economic and monetary importance of wetland services is provided in the following sections.

Ecological value (importance) of wetland services

The ecological importance (value) of ecosystems has been articulated by natural scientists in reference to causal relationships between parts of a system, for example, the value of a particular tree species to control erosion or the value of one species to the survival of another species or of an entire ecosystem (Farber *et al.* 2002)

At a global scale, different ecosystems and their species play different roles in the maintenance of essential life support processes such as energy conversion, biogeochemical cycling, and evolution (Millennium Ecosystem Assessment 2003). The magnitude of this ecological value is expressed through indicators such as species diversity, rarity, ecosystem integrity

Figure 5. The components of the Total Value of a wetland

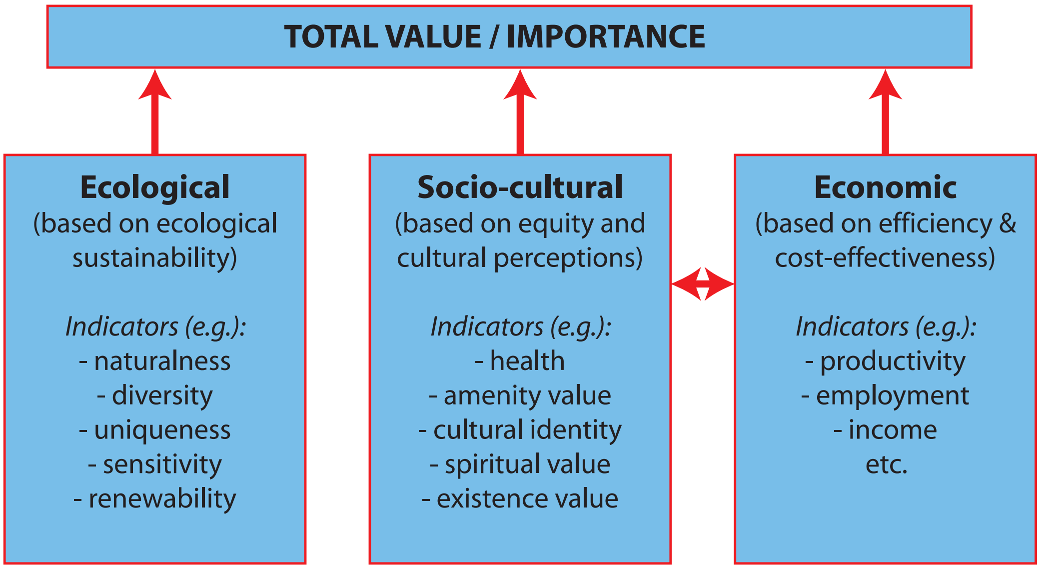


Table 6. Indicators for determining (sustainable) use of wetland services

Services	Ecological process and/or component providing the service (or influencing its availability) = Functions	State indicator (how much of the service is present)	Performance indicator (how much can be used/ provided in sustainable way)
Provisioning			
Food: production of fish, algae and invertebrates	Presence of edible plants and animals	Total or average stock in kg	Net productivity (in Kcal/ year or other unit)
Fresh water: storage and retention of water; provision of water for irrigation and for drinking.	1) Precipitation or surface water inflow 2) biotic and abiotic processes that influence water quality (see water purification)	-Water quantity (in m3) -Water quality related to the use (conc. of nutrients, metals, etc.)	Net water inflow (m3/year) (i.e., water inflow minus water used by the ecosystem and other water needs)
Fiber & fuel & other raw materials: production of timber, fuel wood, peat, fodder, aggregates	Presence of species or abiotic components with potential use for fuel or raw material	Total biomass (kg/ha)	Net productivity (kg/year)
Biochemical products and medicinal resources	Presence of species or abiotic components with potentially useful chemicals and/or medicinal use	Total amount of useful substances that can be extracted (kg/ha)	Maximum sustainable harvest
Genetic materials: genes for resistance to plant pathogens	Presence of species with (potential) useful genetic material	Total "gene bank" value (e.g., number of species & subspecies)	Maximum sustainable harvest
Ornamental species: e.g., aquarium fish and plants	Presence of species or abiotic resources with ornamental use	Total biomass (kg/ha)	Maximum sustainable harvest
Regulating			
Air quality regulation: e.g., capturing dust particles	Capacity of ecosystems to extract aerosols & chemicals from the atmosphere	Leaf area index, NOx-fixation, etc.	Amount of aerosols or chemicals "extracted" - effect on air quality
Climate regulation: regulation of greenhouse gases, temperature, precipitation, and other climatic processes	Influence of ecosystems on local and global climate through land-cover and biologically- mediated processes	Greenhouse gas-balance (esp. C-fix), DMS production, Land cover characteristics, etc	Quantity of greenhouse gases, etc., fixed and/or emitted - effect on climate parameters
Hydrological regimes: groundwater recharge/ discharge; storage of water for agriculture or industry	Role of ecosystems (especially forests and wetlands) in capturing and gradual release of water	Water storage capacity in vegetation, soil, etc., or at the surface	Quantity of water stored and influence of hydrological regime (e.g., irrigation)
Pollution control & detoxification: retention, recovery and removal of excess nutrients / pollutants	Role of biota and abiotic processes in removal or breakdown of organic matter, xenic nutrients and compounds	Denitrification (kg N/ha/y), Accumulation in plants, - Kg –BOD /ha/y, chelation (metal-binding)	Maximum amount of waste that can be recycled or immobilized on a sustainable basis; influence on water or soil quality
Erosion protection: retention of soils	Role of vegetation and biota in soil retention	Vegetation cover, root-matrix, etc	Amount of soil retained or sediment captured
Natural hazard mitigation: flood control, storm & coastal protection	Role of ecosystems in dampening extreme events (e.g., protection by mangroves and coral reefs against damage from hurricanes)	Water storage (buffer) capacity in m3; ecosystem structure characteristics	Reduction of flood danger and prevented damage to infrastructure
Biological Regulation: e.g., control of pest species and pollination	Population control through trophic relation; role of biota in distribution, abundance and effectiveness of pollinators	Number & impact of pest control species; number & impact of pollinating species	Reduction of human diseases, livestock pests, etc.; dependence of crops on natural pollination

Cultural & amenity			
Cultural heritage and identity: sense of place and belonging	Culturally important landscape features or species	Presence of culturally important landscape features or species (e.g., No. of WHS)	Number of people "using" ecosystems for cultural heritage and identity
Spiritual & artistic inspiration: nature as a source of inspiration for art and religion	Landscape features or species with inspirational value to human arts and religious expressions	Presence of landscape features or species with inspirational value	Number of people who attach religious significance to ecosystems; number of books, paintings, etc., using ecosystems as inspiration
Recreational: opportunities for tourism and recreational activities	Landscape features; attractive wildlife	Presence of landscape & wildlife features with stated recreational value	Maximum sustainable number of people & facilities; actual use
Aesthetic: appreciation of natural scenery (other than through deliberate recreational activities)	Aesthetic quality of the landscape, based on e.g. structural diversity, "greenness", tranquility	Presence of landscape features with stated appreciation	Expressed aesthetic value, e.g., number of houses bordering natural areas; number of users of "scenic routes"
Educational: opportunities for formal and informal education & training	Features with special educational and scientific value/ interest	Presence of features with special educational and scientific value/ interest	Number of classes visiting; number of scientific studies, etc
Supporting			
Biodiversity & nursery: Habitats for resident or transient species	Importance of ecosystems to provide breeding, feeding or resting habitat to resident or migratory species (and thus maintain a certain ecological balance and evolutionary processes)	Number of resident, endemic species, habitat integrity, minimum critical surface area, etc.	"Ecological Value" (i.e., difference between actual and potential biodiversity value); dependence of species or other ecosystems on the study area
Soil formation: sediment retention and accumulation of organic matter	Role of species or ecosystem in soil formation	Amount of topsoil formed (e.g., per ha per year)	These services cannot be used directly but provide the basis for most other services, especially erosion protection and waste treatment
Nutrient cycling: storage, recycling, processing and acquisition of nutrients	Role of species, ecosystem or landscape in biogeochemical cycles	Amount of nutrients (re-) cycled (e.g., per ha/year)	

(health), and resilience, which mainly relate to the supporting and regulating services. Table 7 lists the main ecological valuation criteria and their associated indicators.

Socio-cultural value (importance) of wetland services

For many people, natural systems, including wetlands, are a crucial source of non-material well-being through their influence on physical and mental health and historical, national, ethical, religious, and spiritual values. A particular mountain, forest, or watershed may, for example, have been the site of an important event in their past, the home or shrine of a deity, the place of a moment of moral transformation, or the embodiment of national ideals. These are some of the values that the Millennium Assessment recognizes as the cultural services of ecosystems (Millennium Ecosystem Assessment 2003). The main types of socio-cultural values described in the literature are therapeutic value, amenity value, heritage value, spiritual value, and existence value.

Table 8 lists the main criteria that determine the socio-cultural importance of ecosystems (wetlands), which are mainly related to the cultural and amenity services listed in Table 5.

To some extent, these values can be captured by economic valuation methods (see further below), but to the extent that some ecosystem services are essential to a people's very identity and existence, they are not fully captured by such techniques. To obtain a certain measure of importance, this may be approximated by using participatory assessment techniques (Campbell & Luckert 2002) or group valuation (Jacobs 1997; Wilson & Howarth 2002). Table 9 gives an overview of approaches for socio-cultural valuation.

Table 7. Ecological valuation criteria and measurement indicators (after de Groot *et al.* 2003)

Criteria	Short description	Measurement units/indicators
Naturalness/integrity (representativeness)	Degree of human presence in terms of physical, chemical or biological disturbance	- Quality of air, water, and soil - % key species present - % of min. critical ecosystem size
Diversity	Variety of life in all its forms, including ecosystems, species & genetic diversity	- number of ecosystems/ geographical unit - number of species/surface area
Uniqueness/rarity	Local, national or global rarity of ecosystems and species	- number of endemic species & subspecies
Fragility/vulnerability (resilience/resistance)	Sensitivity of ecosystems to human disturbance	- energy budget (GPP/NPP[1]) - carrying capacity
Renewability/recreatability	The possibility for spontaneous renewability or human-aided restoration of ecosystems	- complexity & diversity - succession stage/-time/NPP - (restoration costs)

[1] GPP – Gross Primary Production; NPP = Net Primary Production

Table 8. Socio-cultural valuation criteria and measurement indicators (after De Groot *et al*. 2003).

Socio-cultural criteria	Short description	Measurement units/indicators
Therapeutic value	The provision of medicines, clean air, water & soil, space for recreation and outdoor sports, and general therapeutic effects of nature on peoples' *mental and physical well-being*	- Suitability and capacity of natural systems to provide "health services" - Restorative and regenerative effects on people's performance - Socio-economic benefits from reduced health costs & conditions
Amenity value	Importance of nature for *cognitive development*, mental relaxation artistic inspiration, aesthetic enjoyment and recreational benefits.	- Aesthetic quality of landscapes - Recreational features and use - Artistic features and use - Preference studies
Heritage value	Importance of nature as reference to personal or collective *history and cultural identity*	- Historic sites, features and artefacts - Designated cultural landscapes - Cultural traditions and knowledge
Spiritual value	Importance of nature in symbols and elements with *sacred, religious and spiritual significance*	- Presence of sacred sites or features - Role of ecosystems and/or species in religious ceremonies & sacred texts
Existence value	Importance people attach to nature for *ethical* reasons (*intrinsic* value) and inter-generational equity (*bequest* value). Also referred to as "warm glow-value"	- Expressed (through, e.g., donations and voluntary work) or stated preference for nature protection for ethical reasons

Table 9. Methods for quantification of the importance people attach to the socio-cultural values of ecosystems (compiled from information in Brown *et al.* 2001, Guijt & Hinchcliffe 1998)

	Measuring the importance people attach to therapeutic value, amenity value, heritage value, spiritual value and/or existence value provided by wetlands, based on:			
Assessment Method	**Judgment**	**Attitude**	**Well-being**	**Perception**
Checklist (of issues & stakeholders)	•	•	•	•
Questionnaires (& Interviews)	•	•	•	•
Visual media (preferences)	•	•	•	•
(Expert) jurors/referees	•			
Animation technologies for group interaction		•		
Judgment (personal & groups)			•	
Measurement of environmental variables			•	
Behavioural observations			•	
Interviews with key persons				•
Desk research (e.g., of media attention)				•

Economic value (importance) of wetland services

Some authors consider cultural values and their social welfare indicators as a subset of economic values – others state that in practice economic valuation is limited to efficiency and cost-effectiveness analysis, usually measured in monetary units, disregarding the importance of, for example, spiritual values and cultural identity which are in many cases closely related to ecosystem services. In this report, economic and monetary valuation are therefore treated separately from socio-cultural valuation, whereby it is emphasized that ecological, socio-cultural, and economic values all have their separate role in decision-making and should be seen as essentially complementary pieces of information in the decision-making process.

Numerous studies have assessed the economic value of ecosystems (e.g., Hartwick 1994; Barbier *et al.* 1997; Asheim 1997; Costanza *et al.* 1997; Daily 1997; Pimentel & Wilson 1997; Hamilton & Clemens 1999), and the concept of Total Economic Value (TEV) (Figure 6) has become a widely used framework for assessing the utilitarian value of ecosystems. This framework typically disaggregates TEV into two categories: *use values* and *non-use values*.

Use values are composed of three elements: direct use, indirect use, and option values. *Direct use value* is also known as extractive, consumptive or structural use value and mainly derives from *goods* which can be extracted, consumed or enjoyed directly (Dixon & Pagiola 1998). *Indirect use value* is also known as non-extractive use value, or functional value, and mainly derives from the *services* the environment provides. *Option value* is the value attached to maintaining the option to take advantage of something's use value at a later date. Some authors also distinguish 'quasi-option value', which derives from the possibility that even though something appears unimportant now, information received later might lead us to re-evaluate it.

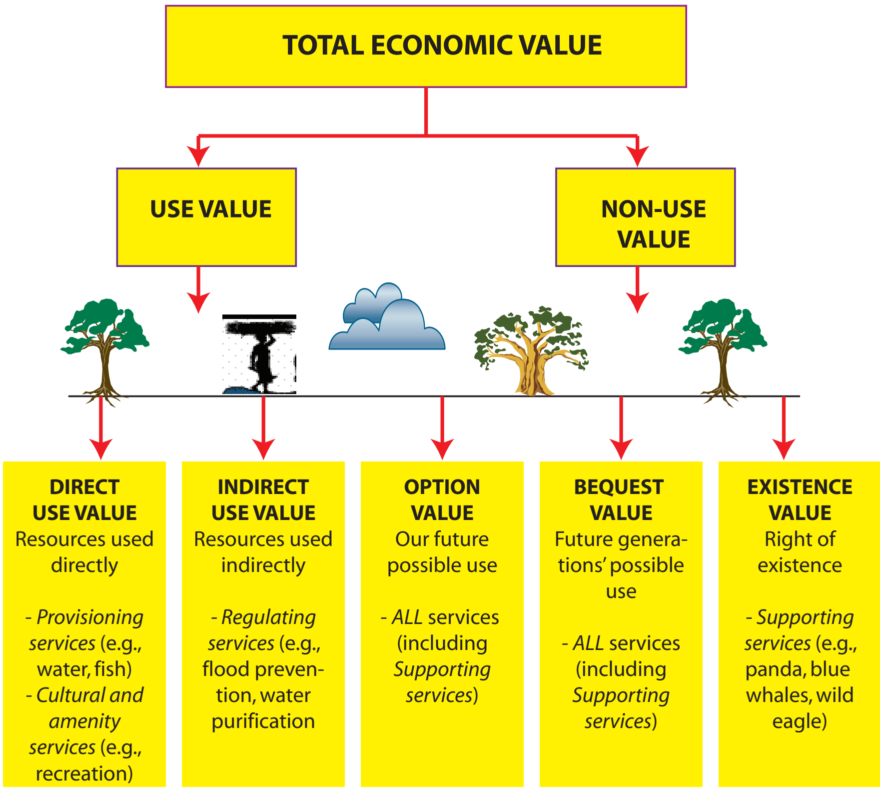
Non-use values derive from the benefits the environment may provide which do not involve using it in any way, whether directly or indirectly. In many cases, the most important such benefit is *existence value*: the value that people derive from the knowledge that something exists, even if they never plan to use it. Thus people place value on the existence of blue whales or the panda, even if they have never seen one and probably never will. However, if blue whales became extinct, many people would feel a definite sense of loss (Dixon & Pagiola 1998). *Bequest value*, finally, is the value derived from the desire to pass on values to future generations, that is, our children and grandchildren.

The economic importance of ecosystem services can be measured not only in monetary units, but also by their contribution to employment and productivity, e.g., in terms of number of people whose jobs are related to the use or conservation of wetland services, or the number of production units which depend on wetland services. Since both employment and pro-

Figure 6. The Total Economic Value Framework

Adapted from Millennium Ecosystem Assessment (2003), based on Pearce & Warford (1993) and Dixon & Pagiola (1998).

Note that "bequest value" is often also shown as another kind of (future) use (option) value.



ductivity can be relatively easily measured through the market, this is usually part of the monetary valuation method.

Monetary valuation of wetland services

The relative importance people attach to many of the values listed in the sections above, and their associated wetland services, can be measured using money as a common denominator. Monetary or financial valuation methods fall into three basic types, each with its own repertoire of associated measurement issues (Table 10):

1) direct market valuation;
2) indirect market valuation; and
3) survey-based valuation (i.e., contingent valuation and group valuation).

If no site-specific data can be obtained, due to lack of data, resources or time, *benefit transfer* can be applied (i.e., using results from other, similar areas to approximate the value of a given service in the study site). This method is rather problematic because, strictly speaking, each decision-making situation is unique, but the more data that becomes available from new case studies, the more reliable benefit transfer becomes.

Although Table 10 is based on various literature sources and seeks to reflect a broad consensus on monetary valuation methods, other views and terminologies do exist. For example, Dixon & Pagiola (1998) use the term "Change in output of marketable goods" as a combined term for market price and factor income; and they combine avoided (damage) cost, replacement cost and mitigation cost into so-called "Cost based approaches".

A more detailed description of the monetary valuation methods in Table 10 is provided below, followed by an overview of which methods are most often used to determine the monetary value for different services (Table 11).

1. Direct market valuation

Market price: This is the exchange value that ecosystem services have in trade, mainly applicable to production functions, but also to some information functions (e.g., recreation) and regulation functions (e.g., water regulation services).

Factor income (FI): Many ecosystem services enhance incomes; an example is natural water quality improvements which increase commercial fisheries catch and thereby the incomes of fishermen.

Public investments: New York City, for example, decided to use natural water regulation services of largely undeveloped watersheds, through purchase or easements (worth ca. 100 million US$/year), to deliver safe water and avoided the construction of a $6 billion water filtration plant. This implies that

Table 10. Monetary valuation methods, constraints, and examples. Compiled after Barbier *et al.* (1997), King & Mazotta (2001), Wilson & Carpenter (1999), Stuip *et al.* (2002). For further information and examples, see Appendix 3.

<table>
<tr><th colspan="2">METHOD</th><th>DESCRIPTION</th><th>CONSTRAINTS</th><th>EXAMPLES</th></tr>
<tr><td rowspan="3">1. Direct market valuation</td><td>Market price</td><td>The exchange value (based on marginal productivity cost) that ecosystem services have in trade</td><td>Market imperfections and policy failures distort market prices.</td><td>Mainly applicable to the “goods” (e.g., fish) but also some cultural (e.g., recreation) and regulating services (e.g., pollination)</td></tr>
<tr><td>Factor income or prod. factor method</td><td>Measures effect of ecosystem services on loss (or gains) in earnings and/or productivity</td><td>Care needs to be taken not to double count values</td><td>Natural water quality improvements which increase commercial fisheries catch and thereby incomes of fishermen</td></tr>
<tr><td>Public pricing *</td><td>Public investments, e.g., land purchase, or monetary incentives (taxes/subsidies) for ecosystem service use or conservation</td><td>Property rights sometimes difficult to establish; care must be taken to avoid perverse incentives.</td><td>Investments in watershed-protection to provide drinking water, or conservation measures</td></tr>
<tr><td rowspan="5">2. Indirect market valuation</td><td>Avoided (damage) cost method</td><td>Services that allow society to avoid costs that would have been incurred in the absence of those services</td><td rowspan="3">It is assumed that the costs of avoided damage or substitutes match the original benefit. However, this match may not be accurate, which can lead to underestimates as well as overestimates.</td><td>The value of the flood control service can be derived from the estimated damage if flooding would occur.</td></tr>
<tr><td>Replacement cost & substitution cost</td><td>Some services could be replaced with human-made systems</td><td>The value of groundwater recharge can be estimated from the costs of obtaining water from another source (substitute costs).</td></tr>
<tr><td>Mitigation or restoration cost</td><td>Cost of moderating effects of lost functions (or of their restoration)</td><td>Cost of preventive expenditures in absence of wetland service (e.g., flood barriers) or relocation</td></tr>
<tr><td>Travel cost method</td><td>Use of ecosystem services may require travel and the associated costs can be seen as a reflection of the implied value.</td><td>Over-estimates are easily made. The technique is data intensive.</td><td>Part of the recreational value of a site is reflected in the amount of time and money that people spend while traveling to the site.</td></tr>
<tr><td>Hedonic pricing method</td><td>Reflection of service demand in the prices people pay for associated marketed goods</td><td>The method only captures people’s willingness to pay for perceived benefits. Very data intensive.</td><td>Clean air, presence of water, and aesthetic views will increase the price of surrounding real estate.</td></tr>
</table>

3. Surveys	Contingent valuation method (CVM)	This method asks people how much they would be willing to pay (or accept as compensation) for specific services through questionnaires or interviews	There are various sources of bias in the interview techniques. Also there is controversy over whether people would actually pay the amounts they state in the interviews.	It is often the only way to estimate non-use values. For example, a survey questionnaire might ask respondents to express their willingness to increase the level of water quality in a stream, lake or river so that they might enjoy activities like swimming, boating, or fishing.
	Group valuation	Same as Contingent valuation (CV) but as an interactive group process	The bias in a group CV is supposed to be less than in individual CV.	
4. Benefit transfer		Uses results from other, similar area to estimate the value of a given service in the study site	Values are site and context dependent and therefore in principle not transferable.	When time to carry out original research is scarce and/or data is unavailable, Benefit transfers can be used (but with caution)

* strictly speaking, public pricing is not "market based" but is real money involved in transactions related to ecosystem services reflecting the public WTP for their use or conservation.

those watersheds saved New York City an investment of US$ 6 billion and represent a willingness to pay-value of at least 100 million US$/year. Wetlands trading programs allow property owners to capitalize on the demand for wetlands banks, with wetlands being sold in banks for $74,100 to $493,800 per ha (Powicki 1998).

2. Indirect market valuation

When there are no explicit markets for services, it is necessary to resort to more indirect means of assessing values. A variety of valuation techniques can be used to establish the (revealed) willingness to pay (WTP) or willingness to accept compensation (WTA) for the availability or loss of these services:

Avoided cost (AC): Services allow society to avoid costs that would have been incurred in the absence of those services. Examples are flood control (which avoids property damages) and waste treatment (which avoids health costs) by wetlands.

Replacement cost (RC): Services could be replaced with man-made systems; an example is natural waste treatment by marshes which can be (partly) replaced with costly artificial treatment systems.

Mitigation or restoration cost: the cost of moderating effects of lost functions or of their restoration can be seen as an expression of the economic importance of the original service. For example, the cost of preventive expenditures in the absence of wetland service (e.g., flood barriers) or relocation.

Travel cost (TC): Use of ecosystem services may require travel. The travel costs can be seen as a reflection of the implied value of the service. An example is the amount of money that visitors are willing to pay to travel to a place or an area that they want to visit.

Hedonic pricing (HP): Service demand may be reflected in the prices people will pay for associated goods; an example is that housing prices at beaches usually exceed prices of identical inland homes near less attractive scenery.

3. Survey-based valuation

Contingent valuation (CV): Service demand may be elicited by posing hypothetical scenarios that involves the description of alternatives in a social survey questionnaire. For example, a survey questionnaire might ask respondents to express their willingness to pay (i.e., their stated preference as opposed to revealed preference, see above) to increase the level of water quality in a stream, lake or river so that they might enjoy activities like swimming, boating, or fishing (Wilson & Carpenter 2000). Lately the related method of contingent choice – asking respondents whether or not they would pay a predetermined amount – has gained popularity, since it eliminates some of the weaknesses of CV.

Group valuation: Another approach to ecosystem service valuation that has gained increasing attention recently involves group deliberation (James & Blamey 1999; Coote & Lenaghan 1997; Jacobs 1997; Sagoff 1998; Wilson & Howarth 2002). This evolving set of techniques is founded on the assumption that the valuation of ecosystem services should result from a process of open public deliberation, not from the aggregation of separately measured individual preferences. Using this approach, small groups of citizens are brought together in a moderated forum

Table 11. The relationship between ecosystem functions and services and monetary valuation technique (source: de Groot *et al.* 2002).

In the columns, the most used method on which the calculation was based is indicated with +++, the second most with ++, etc.; open circles indicate that that method was not used in the Costanza *et al.* (1997) study but could potentially also be applied to that service.

ECOSYSTEM FUNCTIONS (and associated services - see Table 6)	Maximum monetary values (US$/ha Year)[1]	Direct Market Pricing[2]	Indirect Market Pricing					Contingent Valuation	Group Valuation
			Avoided Cost	Replacement cost	Factor Income	Travel cost	Hedonic pricing		
Regulating services									
1. Gas regulation	265		+++	o	o			o	o
2. Climate regulation	223		+++	o	o		o	o	o
3. Disturbance regulation	7,240		+++	++	o		o	+	o
4. Water regulation	5,445	+	++	o	+++		o	o	o
5. Water supply	7,600	+++	o	++	o	o	o	o	o
6. Soil retention	245		+++	++	o		o	o	o
9. Waste treatment	6,696		o	+++	o		o	++	o
10. Pollination	25	o	+	+++	++			o	o
11. Biological control	78	+	o	+++	++			o	o
Supporting services									
12. Refugium function	1,523	+++		o	o		o	++	o
13. Nursery function	195	+++	o	o	o		o	o	o
7. Soil formation	10		+++	o	o			o	o
8. Nutrient cycling	21,100		o	+++	o			o	o
Provisioning services									
14. Food	2,761	+++		o	++			+	o
15. Raw materials	1,014	+++		o	++			+	o
16. Genetic resources	112	+++		o	++			o	o
17. Medicinal resources		+++	o	o	++			o	o
18. Ornamental resources	145	+++		o	++		o	o	o
Cultural services									
19 Aesthetic information	1,760			o		o	+++	o	o
20 Recreation & tourism	6,000	+++		o	++	++	+	+++	
21 Cultural & artistic	25	o			o	o	o	+++	o
22 Spiritual & historic						o	o	+++	o
23 Science & education		+++			o	o		o	o

[1] Dollar values are based on Costanza *et al.* (1997) and apply to different ecosystems (e.g., waste treatment is mainly provided by coastal wetlands and recreational benefits are, on a per hectare basis, highest in coral reefs). These monetary values are examples for illustrative purposes only: actual values will vary from location to location, depending on ecological, biogeographic and socio-economic conditions.

[2] Based on added value only (i.e., market price minus capital and labour costs, typically about 80%).

to deliberate about the economic value of ecosystem services. The end result is a deliberative "group" contingent valuation (CV) process. With a group CV, the explicit goal is to derive a monetary value for the ecosystem service in question, through group discussions and consensus building (after Millennium Ecosystem Assessment 2003).

4. Benefit Transfer

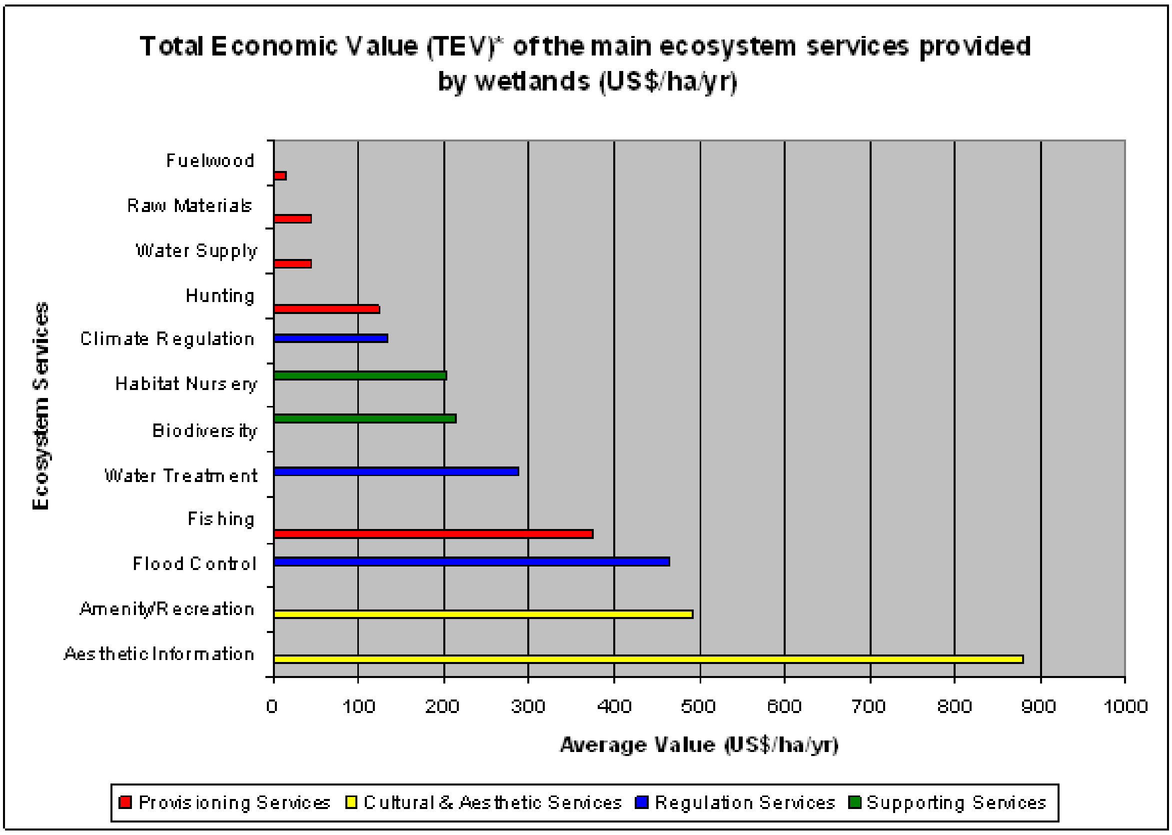
In case of human or financial resource constraints, values can sometimes be taken out of previous studies focusing on a different region or time period. This practice of transferring monetary values is called 'benefit transfer'. An example is a case study done on Olango Island in the Philippines (White *et al*. 2000 – see Box 5 above), where the values for fishery, both for the local market and for live fish export, have been obtained from coral reef studies elsewhere in the Philippines. This data was combined with local data on seaweed farming and tourism (Stuip *et al.* 2002).

As the extensive literature on monetary valuation of ecosystem services has shown, each of these methods has its strengths and weaknesses (see Farber *et al*. 2002; Wilson & Howarth 2002; SCBD 2005). Based on a synthesis by Costanza *et al.* (1997) of over 100 literature studies, Table 12 gives an overview of the link between these valuation methods and the main ecosystem services.

Table 11 shows that for each ecosystem service usually several monetary valuation methods can be used. The table also shows that in the Costanza-study (Costanza *et al.* 1997) usually only one or two methods were used for each service (+++ & ++).

To avoid double counting, and to make monetary valuation studies more comparable, a type of 'rank ordering' should ideally be developed to determine the most preferred monetary valuation method(s) for each ecosystem service, supported by a "choice-tree" to guide the evaluator through the valuation process (see for an example, Dixon & Pagiola 1998).

Figure 7. The Total Economic Value (TEV) of the main ecosystem services provided by wetlands (US$/ha/year)



All figures are average global values based on sustainable use levels and taken from two synthesis studies: Schuijt & Brander 2004 (calibrated for 2000) and Costanza et al. 1997 (calibrated for 1994), together covering over 200 case studies. Most figures are from Schuijt & Brander 2004, except the aesthetic information service and climate regulation. The overall total for the services assessed is 3,274 US$/ha/year, but this total does not include services such as ornamental and medicinal resources, historic and spiritual values, sediment control and several others, and so it is certainly an underestimation.

Based on a large number of case studies, Figure 7 [preceding page] gives an overview of the monetary value of the main services provided by wetlands.

On a global scale, using the overall total of ca. 3,300 US$/ha/year from Figure 7, the total economic value of the remaining 63 million hectares of wetland around the world would amount to about US$ 200 billion/year – a conservative estimate since no values were found for many services. The Costanza *et al.* (1997) study arrived at a figure of 940 billion, mainly due to much higher estimates for several services (notably flood control (4,539 US$/ha/year), water treatment (4,177 US$/ha/year), and water supply (3,800 US$/ha/year).

Thus, for our own benefit and that of future generations, it would be more economical to maintain this natural capital and to live off the interest (through sustainable use) instead of reducing the capital itself – as we are still presently doing in many cases by converting and degrading the remaining wetland ecosystems and their services.

Step 5: Communicating wetland values

Ecosystems form part of the total wealth of nations, but because many ecosystem services are not traded in the market, their values are not captured in conventional systems of national accounts. As a result, conventional measures of wealth give incorrect indications of the state of well-being, leading to misinformed policy actions, poorly informed decision-making, and ill-advised strategic social choices. To make the results of a valuation study fully accessible to all the stakeholders and relevant decision-makers, communication and dissemination activities are essential.

The Millennium Ecosystem Assessment (Finlayson *et al.* 2005) concluded that one of the major continuing drivers of loss and degradation of wetlands was that decision-makers either do not have available to them, or choose to ignore, full information on the total value of wetland ecosystem services when considering whether to approve destruction or conversion of wetlands. This leads to decisions to convert despite valuation studies repeatedly demonstrating that the value of naturally-functioning wetlands is frequently much greater than the value of their services when converted, particularly where such a conversion benefits a single stakeholder group rather than formerly multiple use systems benefiting a range of stakeholders.

These guidelines have stressed the importance of fully involving the various different types of stakeholders throughout wetland valuations (section 2 above). It is just as important to ensure that the results of the valuation, whether it be undertaken for trade-off analysis, assessment of Total Economic Value, or as part of an environmental impact assessment, are explained and made fully available in appropriate forms to the stakeholders concerned – not least since some types of stakeholders can be highly influential in decisions that are made concerning maintenance or conversion of wetlands, and equally since many stakeholders may be unaware of, and surprised by, the major values of many types of ecosystem service such as water purification, flood control, and recreational and aesthetic services in the wetland they use (see, e.g., Figure 7).

The most appropriate form and approach to the dissemination of valuation findings to stakeholders will of course vary depending on the purpose of the valuation work, the type of stakeholder involved, and the role they can play in making appropriate decisions on maintaining wetland ecosystem services. One or more of workshops and presentations, leaflets and other publications, videos, interactive CD/DVDs, educational materials for formal and informal education, etc., may be considered. There is a wealth of information on choosing appropriate communication, education and public awareness (CEPA) tools (see for example the Ramsar Convention's CEPA Web site, in particular http://www.ramsar.org/outreach_methodologies.htm).

Valuation forms an important component of the assessment of the impacts of specific development proposals (EIA) and in policy-relevant Strategic Environmental Assessment (SEA), and also in the 'post-event' assessment of the impacts of change including natural and human-made disasters (see, e.g., Box 4). The Ramsar Convention has adopted joint guidance with the Convention on Biological Diversity (CBD) and the Convention on Migratory Species (CMS) on impact assessment (COP8 Resolution VIII.9 at http://ramsar.org/res/key_res_viii_09_e.htm, also available in the forthcoming Ramsar Wise Use Handbook 13, 3rd Edition, 2006), and expects that Parties to the Convention will ensure that a full impact assessment is undertaken where a development proposal will, or is likely to, affect a designated Wetland of International Importance (Ramsar site). It is therefore likely that a significant volume of wetland valuation information is contained within the 'grey literature' of Environmental Impact Statements, information which is currently not readily available for use in, for example, valuations using benefit transfer methods. It is important that those undertaking and presenting such valuations make this information more widely available for other valuation practitioners.

Ecosystem valuation is a relatively new and emerging science, and it is important that those undertaking such valuations should make widely available and share their results and experiences, as methodologies continue to develop and evolve. On-line support to implementing these guidelines is being provided through www.naturevaluation.org, which gives access to existing databases, literature and case studies, and provides discussion platforms for the exchange of information and experiences on valuation of wetland services.

References and further reading

References marked with an asterisk (*) are key publications that provide particularly important information and further reading on wetland valuation. A list of Web sites that provide further information on wetland services, valuation and stakeholder and policy analysis is provided in Appendix 3.

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Appendix 1. Case studies of wetland valuation

To illustrate the valuation methods described in this guidance, this Appendix provides five case studies of different types of wetland valuation study. This is followed by a listing of other available case studies on wetland valuation.

Case study 1. Trade-off analysis

Economic value and management strategies of El Tamarindo mangroves, El Salvador

Source: Sarah Gammage, Environmental Economics Programme, Discussion Paper DP 97-02, June 1997. IIED

Site Description

The mangroves in El Tamarindo cover an area of approximately 487 hectares and lie in the Gulf of Fonseca, in the southeast of El Salvador.

Issues

To date the mangroves of El Tamarindo have experienced encroachment and degradation from agricultural conversion; the relocation and settlement of communities displaced by civil war; clearance and excavation for commercial aquaculture and salt production; and commercial and individual extraction for timber and fuel wood. Unsustainable logging practices have led to deforestation rates in the region of 24 hectares per year over the period of 1974 to 1989. This has resulted in significant trade-offs between other use values offered by the mangrove ecosystem, such as shoreline stabilization, barrier services and groundwater recharge, that rely on the forest stand remaining intact.

Reasons for this valuation study

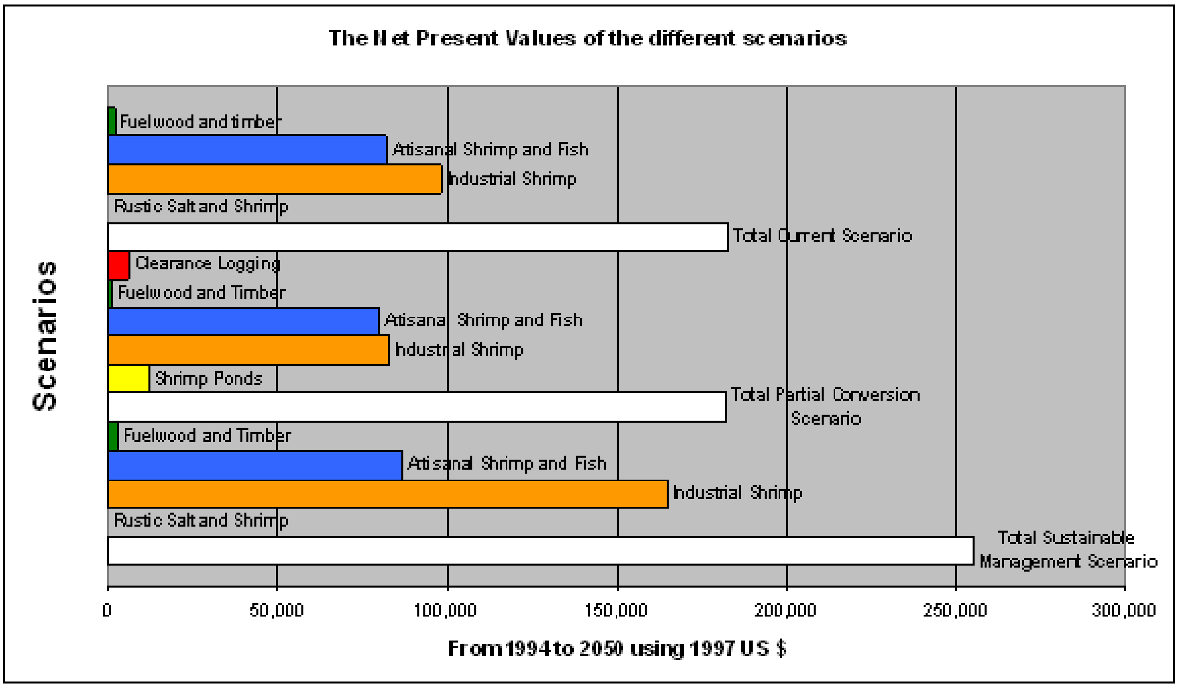
The purpose of this project was to estimate the 'total economic value' of the mangrove system in part of the Gulf of Fonseca, El Salvador, and to develop a cost-benefit framework to compare the sustainable management of the forest with alternative use scenarios. The current management strategy was compared both to its sustainable counterpart and to the partial conversion of the mangrove ecosystem to semi-intensive aquaculture and salt ponds.

Although the researchers chose to compare three separate management options (Figure A1), the actual choices are only between the current management strategy and partial conversion. For the sustainable management option to be implemented, a variety of policy and institutional changes would also need to be set in place.

Why is it that the market fails to arrive at the sustainable management option unaided?

a) *The existence of externalities:* The profitability of shrimp farming continues to be overestimated and incorrectly calculated because the costs of mangrove depletion are not perceived as a 'cost' of shrimp farming. Those preservation benefits lost through forest conversion must be considered in addition to the net revenues generated from the sale of shrimp abroad. All calculations for salt flats and rustic shrimp production should be similarly adjusted.

Figure A1. The net present value of the different scenarios for the management of El Tamarindo mangroves (El Salvador), from 1994 to 2050, using 1997 market prices in US$.



b) Market failure and collapse. The inability to smooth consumption over time and borrow against future earnings, in order to mitigate temporary shortfalls in income, increases both individual and household resource dependency. Environmental goods and services are often substituted for marketed goods and services in order to overcome liquidity constraints. This is most apparent in the case of fuelwood and propane gas use, but it is also visible in the use of mangroves for timber, boat building and fodder for cattle.

c) Institutional failure. Where markets fail, governments face the choice of intervention. Changes in the institutional context that shapes consumption and investment decisions can correct for divergences between private and social costs.

Case study 2. Total economic value (TEV)

The importance of integrating wetland values into land and development decisions for the Nakivubo Urban Wetland, Uganda

Source: Stuip et al. 2002, Wetlands International Wageningen; Original Paper: Emerton, L., L. Lang, P. Luwum & A. Malinga (1998), The present economic value of Nakivubo urban wetland, Uganda. IUCN, Kampala.

Site description

Nakivubo is located on the outskirts of the city of Kampala in the southeast of Uganda, adjacent to Lake Victoria. It is a swamp with an area of 5.3 km² and is fed by the Nakivubo River, which is the main drainage canal for Kampala. The wetland extends from the central industrial district of Kampala to Lake Victoria at Murchison Bay and is bordered by dense residential settlements and commercial areas.

Issues

The Nakivubo wetland is threatened by urban and industrial encroachment. Ultimately this may result in the total loss of wetland resources and services and their associated economic benefits. Urban planners, decision-makers and developers are aware of the immediate gains in income and employment arising from wetland conversion, but do not take account of possible economic costs associated with the loss of wetland resources and services.

Reason for the valuation study

This valuation study was done to determine the total economic value of the wetland resources to get an idea of the possible economic costs associated with the loss of these wetland resources and services.

Values quantified

Direct use - wetland products: Nakivubo supports subsistence and income generating activities for residents bordering the wetland. The most significant are small-scale cultivation, papyrus harvesting, brick making, and fish farming. These values have been quantified with the market price method.

Indirect use - water purification: Nakivubo is a recipient of much of Kampala's domestic and industrial wastewater. Via the Nakivubo River the wetland receives raw sewage from approximately 100,000 households, as well as from industries that are not connected to the main sewage system. In addition it receives the effluent of the main wastewater treatment plant of Kampala. The wetland protects Murchison Bay and Lake Victoria from the effects that would arise if the wastewater were to be discharged directly into this bay. This protection is critical for the city's water supply, as the main intake for the piped water supply of Kampala is located 3 km from the outflow of the wetland to Murchison Bay.

Estimating the water purification value

The economic value of Nakivubo's capacity for water purification has been quantified with the replacement cost method, by estimating the necessary investments in the case that the wetland is "removed" (See Table A1). Two estimates were made:

Table A1. The present economic value of Nakivubo Wetland (US$ in 1998)

	Total yearly flow* (thousand US$/ year)
Direct use	
Crop cultivation	156
Papyrus harvesting	14
Brick making	25
Fish farming	5
Indirect use	
Water purification	980 – 1810
Non-use	Not estimated
TOTAL	1,180 – 2,010

* Total yearly flow/ha (US$/ha./yr) is 2,225-3,800

1) The construction of sewerage and sanitation facilities in the settlements around the wetland, the connection of Nakivubo River to a wastewater treatment plant, and the expansion of this plant in order to cope with the additional wastewater load.

2) The transfer of the intake of Kampala's water supply to an alternative location.

In order to benefit from the full capacity of the wetland for water purification, there is a need to reconstruct the inlet of Nakivubo River into the wetland. This investment has been taken as a cost in the present value of the wetland.

At present, a large part of the water purification value of Nakivubo is received free of charge by the beneficiaries; some of these beneficiaries - industries and wealthier households - are in a situation where they can well afford to contribute. The management of the Nakivubo wetland requires a financing strategy that attempts to capture some of this value.

Discussion

The Nakivubo case is of special interest because its main value is one of indirect-use: the purification of a considerable amount of urban wastewater. The case is open to a number of interesting discussion points:

The merit of the case study is that it points at a fundamental requirement in plans for converting the Nakivubo wetland: an alternative method of wastewater treatment. If the search for this alternative were taken as the focus of a separate study, the costs involved may well turn out to be lower than the costs presented here, but it is unlikely that these costs are low.

The unit value of Nakivubo (2,220-3,800 US$/ha/year) is much higher than results of other African case studies, which typically range from 45-90 US$/ha/year. This in itself does not discredit the case, as it is the only urban wetland, and it is quite plausible that the value of a wetland increases with proximity to cities. Nakivubo presents an example of an extreme case – a relatively small wetland that is intensively used, including as a buffer for almost all of the wastes of a large city.

The authors point out that the food crops cultivated in the wetland may be – or may become - a health hazard. Thus, the value of crop cultivation may be incompatible with wastewater treatment and could be lost in some near future.

The non-use values for Nakivubo are not described in the case study, but are likely to be suppressed by the input of urban wastewater. This cost may be considerable if the wetland in its natural form performs ecological functions for the Victoria Lake as a whole.

An important issue raised is that wetland ecosystems such as Nakivubo often help to fill the gap between the level of basic services that a government is able to provide and that which rapidly increasing urban populations require. Omitting environmental concerns from urban planning and development can give rise to untenable economic losses for some of the poorest sectors of the population, decrease social and economic welfare throughout cities' residents, and impose high economic costs on the public sector agencies who have the responsibility for providing basic services and assuring an acceptable standard of urban living. These groups are rarely in a position to bear such costs or expenditures.

Case Study 3: Rapid participatory assessment

Wetland valuation in Veun Sean village, Stoeng Treng Ramsar site, Cambodia

Source: Case studies in wetland valuation # 11, Feb. 2005. IUCN Water and Nature Initiative (WANI), Integrating Wetland Economic Values into River Basin Management

Site Description

The Ramsar site in Stoeng Treng Province, Cambodia, covers about 14,600 hecatares and extends 37 kilometers in length along the Mekong River, from 5 km north of Stoeng Treng town to the border with the Lao PDR. The Ramsar site is characterized by rocky streams, small islands, sandy inlets, deep pools, and seasonally inundated riverine forests.

Veun Sean village, the smallest village in the Ramsar site, has a population of about 150 people. The village is situated on Khorn Hang Island, although the land use practices such as cultivation, non-timber forest products (NTFP), collection, and wildlife hunting extend beyond the island to the mainland. Veun Sean is relatively poor in built and human capital – there is only one well, no electricity, no latrines and poor access to health services. Almost 75% of people from Veun Sean cannot read or write.

Valuation Methods Used

This case study describes an application of participatory approaches to assess the importance of wetland resources to people from Veun Sean. The study goes beyond quantative assessment to understand the context in which resource-use decisions are made – and the linkages between poverty and the importance of wetland resources.

Resource Mapping. This is an effective tool for gaining an understanding of the spatial distribution of wetland resources. It is also an interactive activity, which can be a good 'ice-breaker' between community and researchers. The resource map of Veun Sean identified deep pools as important fishing grounds, as well as areas of cultivation and hunting some distance from the village.

Web diagrams of social networks. In this activity, groups were invited to identify institutions, which were illustrated on paper circles. Institutions from within the village were placed inside a large circle, and external institutions were placed outside the circle. Lines were drawn between different institutions to describe the strength of influence between these organizations.

Flow diagram of wetland values. The wetland was represented by drawing the Mekong River with flooded forests in the centre of a sheet. An arrow was drawn from the wetland to a fish to illustrate a wetland use. The group then identified and described various benefit flows and market linkages, including: fishing, fish spawning, waterbird hunting, water for cooking and drinking, irrigating cash crops, and transport. The group agreed that fish, a valuable resource of nutrition and income, were the 'most important' wetland resource.

Seasonal calendar of activities. Each group was invited to identify the main activities that they conducted. These were then rated across seasons, wet, dry cold, and dry hot. It was evident that the key factor that influences the timing of activities across the seasons is rice growing, which is driven by seasonal differences in weather. The wet season, when most rice cultivation occurs, is the busiest time of year for both men and women.

Wealth ranking. A measure of wealth consistently identified by all members of the group was a household's ability to grow rice sufficient to meet the needs of the family throughout the year. Rich families were identified as growing sufficient or excess rice, medium families as facing 'rice shortage' for six months, and poor and very poor families for nine or ten months. During this activity, the group noted that in response to rice shortages, poorer households generated income to purchase rice by selling fish and wildlife.

Relative ratings. This approach reflected the experiences drawn from the previous activities. Ratings were conducted using piles of 1 to 5 beans. A variety of wetland values from the flow diagram of wetland values were identified. The group unanimously rated fish as '5' representing the highest level of relative importance. Problem ratings were undertaken to identify some of the key problems faced by the households. Lack of access to hospital services was described as a major factor contributing to health problems. The impact of recent droughts and the lack of buffalo to prepare land were described as major underlying causes of rice shortage. Declining fish stocks were also identified as a significant problem. Ratings of sources of income revealed that

Table A2. Wetland Values: Riel per household per year (4,000 Riel = 1 US$)

Rating	Value	Wetland Uses
● ● ● ● ●	1,700,000	Fishing, washing, cooking/drinking
● ● ● ●	1,360,000	Transportation
● ● ●	1,020,000	Construction material, firewood
● ●	680,000	Aquatic animals, waterbirds, reptiles, irrigation, traditional medicines
●	340,000	Floodplain rice, recreation, dolphins
Total	12,900,000	

poorer households have fewer options for generating income – although it appears that they may be more dependent on generating income to purchase the staple food, rice. Fish (mostly sold to middlemen) and cash crops are relatively important income sources for all households.

Household surveys. Targeted household surveys were also conducted to complement and verify the participatory activities. A key aim of the household survey was to provide additional quantitative information about the wetland values described in the participatory activities. The quantitative assessment confirmed the fisheries resource is more valuable to poorer households, because of its importance as a source of income.

Results

The value of other wetland uses was estimated using the relative ratings of different wetland uses. Using this method, the average value of the wetland to a household in Veun Sean was calculated as approximately US$ 3,200 per year (see Table A2).

On average, the value of fisheries resource is $425 per household per year. However, for a poorer household, fisheries are worth about $650 per year. Much of this value is derived from income earned from selling fish, which is mainly used to purchase the food staple, rice.

Discussion

It is critical to consider access to these fisheries and other wetland resources. The poorest households have limited access to land, labor, transport to markets, health care or alternative sources of income. They are particularly dependent on fisheries resources on an 'as-needs' basis to generate income to purchase rice.

In the Stoeng Treng Ramsar site, strategies to conserve and protect the fisheries resource must consider the biological importance of the habitats in the region as spawning and dry season refuges. However, it is critical that this information be considered in light of local-level dependencies on access to the resources.

In this context, participatory research methods for economic assessment could be a key tool used in the planning process – to gain an understanding in the importance of wetland resources to local communities.

Case Study 4: A property-pricing approach

Valuing urban wetlands in the Portland metropolitan region, USA

Source: Mahan, B.L., 1997, Valuing urban wetlands: a property pricing approach, US Army Corps of Engineers, Institute for Water Resources, Evaluation of Environmental IWR Report 97-R-1, Washington DC.

Site Description

The study area is the part of Multnomah County that lies within the Portland, Oregon, urban growth boundary. The area enjoys significant water resources, including two major rivers, several lakes, numerous streams and many wetlands.

Valuation method used

This study aimed to value wetland environmental amenities in the Portland metropolitan region. It used hedonic pricing techniques to calculate urban residents' willingness to pay to live close to wetlands. The study used a data set of almost 15,000 observations, with each observation representing a residential home sale. For each sale, information was obtained about the property price and a variety of structural, neighborhood and environmental characteristics associated with the property, as well as socio-economic characteristics associated with the buyer. Wetlands were classified into four types – open water, emergent vegetation, forested, and scrub-shrub – and their area and distance from the property were recorded.

The first stage analysis used ordinary least squares regression to estimate a hedonic price function relating property sales prices to the structural characteristics of the property, neighborhood attributes, and amenity value of nearby wetlands and other environmental resources. Results showed that wetland proximity and size exerted a significant influence on property values, especially for open water and larger wetlands.

Results

The size of the nearest wetland and distance to the nearest wetland provide information on how wetlands affect property prices in general, without regard to specific types and geographical measures. Results from these variables indicate that 'larger' is more valuable: a one acre increase in size is worth 35$.

For both the log-log model and linear models, open water areal was the only type that shared a consistent positive value for proximity. For example: a house that is one percent closer to an open water areal wetland would have a .04 percent greater value, all other things being equal. Using mean distance and home value, moving 49 feet closer to an open water areal wetland results in a $50 increase in home value.

Proximity to streams has a greater influence on price ($13.81 per foot) than does proximity to lakes ($7.51 per foot). Somewhat surprisingly, proximity to rivers and parks had the opposite effect on market price. Concern over flooding and heavy commercial and industrial development along much of Portland's river front may explain why being closer reduces property value.

Discussion

In general, there are few examples of the application of hedonic pricing techniques to water-related ecosystem goods and services. One reason for this, and a weakness in this technique, is the very large data sets and detailed information that must be collected, covering all of the principal features affecting prices. It is often difficult to isolate specific ecosystem effects from other determinants of wages and property prices.

Another potential problem arises from the fact that this technique relies on the underlying assumption that wages and property prices are sensitive to the quality and supply of ecosystem goods and services. In many cases markets for property and employment are not perfectly competitive, and ecosystem quality is not a defining characteristic of where people buy property or engage in employment.

Case Study 5: Using mitigative or avertive expenditure techniques

Valuing wetland nitrogen abatement in Sweden

Source: Gren, I., Folke, C., Turner, K. and I. Bateman 1994, Primary and secondary values of wetland ecosystems, Environmental and Resource Economics 4: 55-74.

Site Description

The Martebo mire, on the island of Gotland, has been subject to extensive draining, and most of its ecosystem-derived goods and services have been lost.

Valuation Method

A study was carried out to assess the value of these lost life-support services by calculating the value of replacing them with human-made technologies.

The study recorded each of the main life support services associated with the Martebo mire and assessed the technologies that would be required to replicate them. The wetland produced functions, services and

Table A3. Life-support functions, environmental goods and services of the Martebo Mire: Exploitation Effects and Replacement Technologies.

Societal Support	Exploitation Effects	Replacement Technologies
Peat accumulation	Peat layer reduction and disappearance through decomposition, intensive farming, and wind erosion, degraded soil quality, reduced water storage	Artificial fertilizers re-draining of ditches
Maintaining drinking water quality	Lost source for urban area	Water transports
Maintaining groundwater level	Dried wells	Pipeline to distance source
Maintaining drinking water quality	Saltwater intrusion, nitrate in drinking water, pesticides in drinking water	Well drilling saltwater filtering water quality controls water purification plant silos for manure from domestic animals

Maintaining surface water level	Decreased evaporation and precipitation, reduced amounts of water	Nitrogen filtering water transports dams for irrigation pumping water to dam
Moderation of water flows		Irrigation pipes and machines
	Pulsed run-offs	Water transport for domestic animals
		Regulating wire
	Decreased average water flow in associated stream	Pumping water to stream
	Reduced capacity	
Processing sewage, cleansing chemi-cals	Eutrophication of ditches and streams	Mechanical sewage nutrient and removal
		sewage transports
		sewage treatment plant
		clear-cutting of ditches and stream nitrogen reduction in sewage treat-ment plants
Filter to coastal waters	Adding to eutrophication	
Providing		
- food for humans	Loss of food sources	Agriculture production
- food for domestic animals	Loss of food sources	Imports of food
- roof cover	Loss of construction materials	
Sustaining		Roof materials
- andromous trout population	Degraded habitat, commercial and sport fishery losses	Releases of hatchery raised trout
	Loss of habitat	Farmed salmon
	Loss of habitat	
- Other fish species	Endangered species	
- wetland dependent flora and fauna	Lost	
Species diversity	Lost	
Storehouse for genetic materials		
Birdwatching, sport fishing, boating and other recreational values	Lost	
Aesthethic and spiritual values	Lost	

goods, and the man-made replacement technologies are summarized in Table A3.

Results

Replacement costs were calculated at market prices. The results of the study indicated that the annual cost of replacing the wetland's services was between $350,000 and $1 million.

An interesting aspect of this study was that it also used energy analysis to provide complementary estimates of life support capacity. This was done by comparing industrial energy used throughout the economy to produce and maintain the replacement technologies with the solar energy required by the wetland to produce and maintain similar ecological services. Analysis indicated that the biophysical cost of producing a technical replacement in the economy (15-50TJ of fossil fuel equivalents a year) was almost as high as the loss of life-support services measured as solar energy fixing ability by plants (55-75 TJ of fossil fuel equivalents a year).

Discussion

Many of the wetland functions and services discussed do not have a direct market value. This is one fundamental reason why the wetland's often unperceived but real and long-lasting societal support value has been destroyed or degraded via conversion to land use activities that generate a short-term, direct and immediate income.

Other available case studies on wetland valuation

(see also: www.naturevaluation.org)

Wetland Type(s)	Country	Functions	Valuation Method	Source
Peat bog swamp complex	New Zealand	Recreation, fishing, flood control	Total economic value	W. T. Kirkland, 1988. *Economic value of Whangamarino wetland, New Zealand.* Masters Thesis, Massey University, New Zealand.
Freshwater marsh & wooded swamp	USA	Flood prevention, water purification, recreation	Total economic value	F.R. Thibodeau, B.D. Ostro, 1981. Economic value of the Charles River Basin wetlands. *Journal of Environmental Management* 12: 19-30.
Floodplain	Central/ Eastern Europe	Recreational value/ nutrient sink	Benefit transfer	M. Andréassen-Gren & K.H. Groth, 1995. *Economic evaluation of Danube Floodplain.* WWF International, Gland, Switzerland.
Freshwater floodplain wetland	South Africa	Wetland products, biodiversity, ecotourism, floodprevention	Market pricing benefit transfer	K. Schuijt, 2002. *Land and water use of wetlands in Africa: economic values of African wetlands*. Interim Report IR-02-063, IIASA, Laxenburg, Austria.
Riverine, floodplain, lakes & swamps	Nile Basin coun-tries, Africa	Econ. Val. Products	Need for finance mechanisms	L. Emerton & F. Vorhies, 1998. Why Nile Basin wetlands need financing. In: *Wetlands services – getting customers to pay*. Paper for the Workshop on Mechanisms for Financing Wise Use of Wetlands. 2nd International Conference on Wetlands and Development. Dakar, Senegal.
Freshwater wetland, lake and river	Brazil	Wetland products, biodiversity	(total) Economic valuation	A.F. Seidl and A.S. Moraes, 2000. Global valuation of ecosystem services: application to the Pantanal da Nhecolandia, Brazil. *Ecol. Econ*. 33:1-6
Freshwater lakes	Kenya	Wetland products, transport, tourism	Replacement cost, conversion cost	R. Abila, 1998. *Utilization and economic valuation of the Yala Swamp wetland.* University College, Kenya.
Mangroves	El Salvador	Wetland products, biodiversity, flood & storm protection	Cost benefit analysis	Gammage, S., 1997. *Estimating the returns to mangrove conversion: sustainable management or short term gain?* IIED Environmental Economics Discussion Paper, DP97-02
Mangroves	El Salvador	Products	Economic valuation of products & 3 different management strategies.	Gammage, S., 1997. *Estimating the returns to mangrove conversion: sustainable management or short term gain?* IIED Environmental Economics Discussion Paper, DP97-02
Estuary	Netherlands	Flood prevention, habitat, nursery, tourism, fisheries	Total economic valuation	R.S. de Groot, 1992. Economic values of the Dutch Wadden Sea, the Netherlands.In: *Functions of nature*. Wolters-Noordhoff,Groningen.
Coral, seagrass beds, mangroves & mudflats	Philippines	Wetland products, coastal protection, aesthetic/ biodiversity value	Economic valuation (sustainable & current scenario), cost & benefit of management.	A.T. White, M. Ross & M. Flores, 2000. Benefits and costs of coral reef and wetland management, Olango island, Philipines. In: *Collected essays on the economics of coral reefs*. H.S.J. Cesar (ed), CORDIO, Sweden

Estuary/ coastal lagoon	Morocco	Use & non-use values (products)	Economic valuation, direct use values (products) & willingness to pay, community involvement.	Benessaiah, N., 1998. Merja Zerga In: *Mediterranean Wetlands, Socio-economic aspects*. Ramsar Convention Bureau, Gland, Switzerland.
Coastal wetland and lagoon	Sri Lanka	Biodiversity, recreation, sewage, carbon sequestra-tion	Total economic value	Emerton, L., Kekulandala, 2003. *Assessment of the economic value of Muthurajawela Wetland, Sri Lanka.*Occasional Papers of IUCN Sri Lanka, No.4.
Coral reefs	Indonesia	Fishery	Economic valuation of cost & benefits of blast fishing of individual fishing households and Indonesian society as a whole.	Pet-Soede,L., H.S.J. Cesar & J.S. Pet (IVM). Blasting away: the economics of blast fishing on Indonesian coral reefs. In: *Collected essays on the economics of coral reefs*, H.S.J. Cesar (ed) 2000. Cordio Sweden.
Coral reefs	Overview study	Fishery (& biodiversity)	Bioeconomic study of fishery & marine reserves	L. Rodwell & C.M. Roberts. *Economic implications of fully-protected marine reserves for coral reef fisheries.* In: *Collected essays on the economics of coral reefs*, H.S.J. Cesar (ed) 2000. Cordio Sweden.
Coral Reefs	Bonaire	Recreation	Economic valuation of protection & management & discounting of future benefits & costs.	Pendleton, L. 1995. Valuing coral reef protection. *Ocean and Coastal Management.* 26: 119-131.

Appendix 2. Overview of the main methods for policy analysis

Overview of the main methods for policy analysis

See References & Further Reading for full reference citations and Web URLs.

Method	Description	Application	Reference(s)
Data Collection Methods			
Document analysis	Analysis of all types of documents drafted that could affect the valuation	Search out relevant documents, e.g., through Google or library and read these. How to note sources, make abstracts, use key words	Flanders, J., 2003. National Archives and Records Administration (NARA)
Interviews	Interviews with stakeholders relevant to the policies (e.g., policy makers, policy executors, those affected by policy)	-Select stakeholders, prepare interview questions -Select stakeholders, prepare interview questions, set date and location, ensure plenty of time, come prepared on background/ history/ running issues.	Purdue University Writing Lab, weblink. MacNamara, C., 1999.
Data Interpretation Methods			
Visioning	"Imagining" the necessary policy priorities	With the aid of a facilitator who talks you through the visioning process	Dobson, C., 2006.
Preference ranking	Identification and listing in order of importance of preferred livelihood strategies.	*Preference ranking*. Also called direct matrix ranking, an exercise in which people identify what they do and do not value about a class of objects (for example, tree species or cooking fuel types).	The World Bank Participation Sourcebook, 1996.
Timelines	Using a timeline for the policy context can give an idea of the historical creation of policy to current use. The motivation for a policy becomes clear.		Greller's Tips for Teachers, 2006.
Strategy flow diagrams	To map out strategies and their direction for sustainable livelihood and increasing social capital		IFAD Sustainable Livelihoods online Workshop.
Social maps	Mapping of the social structure of all relevant stakeholders (listing them and inserting connection lines; who is communicating with who)	Social mapping can be used to present information on layout, infrastructure, demography, ethno-linguistic groups, wealth, power, interrelations and other issues.	Iapad.
Resource Tenure Maps	Indicating rights to, and ownership of land or resources	Case studies and step-by-step mapping is shown for a clear concept on how to go about it.	Guijt, I. And F. Hinchcliffe (eds),1998.
Mobility Maps	Showing seasonal movement, migration trends, etc;	Actual mobility maps with clear explanations on how to accurately translate stakeholders mobility into maps	Guijt, I. And F. Hinchcliffe (eds),1998.
Actor network analysis	Analysis of all possible influencing factors that affect the actions of the valuation and the influence of the valuation on possible factors that could be affected.	Analysis and comparison of the language used by the different actors. E.g., scientists and farmers. Farmers see weeds and reeds in a ditch while a scientist sees aquatic habitats containing a rich assemblage of habitats (Burgess, 2000)	J. Burgess, J. Clark & C.M. Harrison, 2000. Ryder, M., 2006.
Policy mapping	Mapping out (listing of) all relevant policies, and inserting connection lines to clarify which policies affect each other.	Policy analysis	A. de Boer & M. van der Wegen.
Policy ranking	Rating policies in level of importance to the valuation	Policy analysis	A. de Boer & M. van der Wegen.

Comprehensive Assessment Methods			
Livelihood analysis	Analysis of livelihoods, concerning community structure, employment, gender relations, etc.		Institute of Development Studies, 2006.
Stakeholder analysis	Analysis of stakeholders who potentially could be involved, affected by, or affect the valuation		Overseas Development Administration, 1995. Bob Dick, 2000. J. Rietbergen-McCracken & D. Narayan, 1996.
Institutional analysis	Listing of all relevant institutions and their level of involvement, connectedness	Institutional analysis	IFAD Sust. Livelihoods Workshop. Environment and Natural Resource Management.
Participatory Rural Appraisal (PRA)	Emphasizes local knowledge and enables local people to make their own appraisal, analysis, and plans.	PRA techniques are used for gathering information on community resources. The techniques include the use of transect walks, maps, calendars, matrices, and diagrams using locally available materials.	The World Bank Participation Sourcebook, 1996. International Institute for Sustainable Development (IISD). J.N. Pretty & S.D. Vodouhê, 1997. Summer Institute of Linguistics (SIL), 1999.
Power analysis	Analysis of the power structure (e.g., policy makers, powerful stakeholders who can affect policy, who is affected?)	Analysis of the stakeholders and assessing their power and potential	S. Kumar, 2003.

Appendix 3. Web sites providing further information

Web sites providing further information on wetland services, valuation and stakeholder & policy analysis

Organization	URL	Policy	Stakeholders	Function Analysis	Function Valuation
Association of Environmental and Resource Economists	http://www.aere.org				•
Commonwealth Scientific & Industrial Organization	http://www.csiro.au	•			•
Conservation Finance Guide	http://guide.conservationfinance.org	•			•
Convention on Biological Diversity	http://www.biodiv.org			•	•
Ecological Society of America	http://esa.org/ecoservices		•	•	
Economic and Social Commission for Asia and the Pacific	http://www.unescap.org	•	•		
Ecosystem Services Project	http://www.ecosystemservicesproject.org			•	•
Environment Canada EVRI	http://www.evri.ca				•
Environmental Protection Agency New South Wales	http://www.epa.nsw.gov.au/envalue/			•	•
Environmental Economics, World Bank	http://www.worldbank.org/environmentaleconomics	•	•	•	•
EVE Concerted Action Site	http://www.landecon.cam.ac.uk/eve/			•	•
Forest Trends	http://www.forest-trends.org	•			•
Foundation for Sustainable Development	http://www.fsd.nl			•	•
Guiana Shield Initiative	http://www.guianashield.org	•	•		•
International Institute of Ecological Economics	http://www.ecoeco.org				•
IUCN Biodiversity Economics	http://www.biodiversityeconomics.org				•
IUCN Economics and Environment	http://www.iucn.org/themes/economics	•	•		
IUCN Water and Nature Initiative	http://www.waterandnature.org	•	•		•
International Water Management Institute	http://www.iwmi.cgiar.org/	•	•		
Livelihoods	http://www.livelihoods.org	•	•		
Millennium Ecosystem Assessment	http://www.maweb.org	•	•	•	•
Nature Valuation & Cost Benefit Analysis	http://www.damagevaluation.com/			•	•
National Centre for Tropical Wetland Research	http://www.nctwr.org.au/	•		•	•

Netherlands Committee IUCN	http://www.nciucn.nl	•		•	•
Network for Nature Valuation & Financing	http://www.naturevaluation.org			•	•
Overseas Development Institute	http://www.odi.org.uk	•	•		
Ramsar Convention	http://www.ramsar.org	•	•	•	•
UK Department of Environment	http://www.defra.gov.uk		•	•	
University of Maryland Ecosystem Valuation	http://www.ecosystemvaluation.org				•
University of Vermont, Ecological Economics	http://www.uvm.edu/giee/			•	•
Wetlands International	http://www.wetlands.org	•		•	•

Ramsar Technical Reports

Ramsar Technical Reports are designed to publish, chiefly through electronic media, technical notes, reviews and reports on wetland ecology, conservation, wise use and management, as an enhanced information support service to Contracting Parties and the wider wetland community in support of implementation of the Ramsar Convention.

In particular, the series includes the detailed technical background reviews and reports prepared by the Convention's Scientific and Technical Review Panel (STRP) at the request of Contracting Parties, and which would previously have been made available in most instances only as "Information Papers" for a Conference of the Parties (COP). This is designed to ensure increased and longer-term accessibility of such documents. Other reports not originating from COP requests to the STRP, but which are considered by the STRP to provide information relevant to supporting implementation of the Convention, may be proposed for inclusion in the series. All Ramsar Technical Reports are peer-reviewed by the members, observers and invited experts appointed to the STRP.

Ramsar Technical Reports

No. 1.	2006	Guidelines for the rapid assessment of inland, coastal and marine wetland biodiversity (published jointly as CBD Technical Series No. 22).
No. 2.	2006	Low-cost GIS software and data for wetland inventory, assessment and monitoring.
No. 3.	2006	Valuing wetlands: guidelines for valuing the benefits derived from wetland ecosystem services (published jointly as CBD Technical Series No. 27). (Valoración de humedales, 2007)

In preparation

- A review of Ramsar sites and fisheries management
- The Convention's development of Criteria and guidelines for Ramsar site designation 1971-2005
- Methodologies for assessing the vulnerability of wetlands to change in their ecological character
- Reviews of environmental flow methodologies:
    - i. rivers;
    - ii. estuaries and near-shore environments;
    - iii. non-riverine inland wetlands
- A framework for a wetland inventory meta-database
- Implementation Plan for Global Action on Peatlands 2006-2008
- Review of wetland classification systems

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