# An Integrated Wetland Assessment Toolkit

## A guide to good practice

Edited by Oliver Springate-Baginski, David Allen and William Darwall

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Rue Mauverney 28
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Fax +41 22 999 0020
books@iucn.org
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# About the Authors

**Mr David Allen** is a Programme Officer with the IUCN Species Programme's Freshwater Biodiversity Unit (Cambridge, UK). He coordinates projects to assess the conservation status of freshwater species for inclusion in the IUCN Red List, and undertakes GIS mapping of species distributions. He has worked as a freshwater ecologist and as a Ramsar wetland site manager. E-mail: david.allen@iucn.org

**Dr Eddie Allison** is Director of the Policy, Economics and Social Science programme at the WorldFish Center, one of the institutes of the Consultative Group on International Agricultural Research. With headquarters in Penang, Malaysia, WorldFish works with its partners in government and civil society to reduce poverty and hunger by improving fisheries and aquaculture in Africa, Asia and the Pacific. Eddie was formerly a Senior Lecturer in Natural Resources at the School of Development Studies, University of East Anglia, UK. His research is focused on the governance of small-scale fisheries in a development context. Email: E.Allison@cgiar.org

**Dr William Darwall** is a Senior Programme Officer in the IUCN Species Programme and is head of the Freshwater Biodiversity Unit. He is the Project Coordinator for the Darwin Initiative Project of which this toolkit is a key component. His other work includes coordination of the IUCN/CI ongoing Global Freshwater Biodiversity Assessment and development of approaches for identification of important sites of freshwater biodiversity. He has more than 20 years' experience of working in aquatic ecosystems in both tropical and temperate zones. Email: william.darwall@iucn.org

**Ms Lucy Emerton** is Chief Economist of the Environment Management Group. At the time of co-authoring this publication, she was Head of IUCN's Global Economics & the Environment Programme. Lucy also established and led IUCN's environmental economics programmes in East Africa and Asia. Email: lucy@environment-group.org

**Dr Anna McIvor** is a freshwater ecologist currently working as a post-doctoral researcher in the Department of Zoology, University of Cambridge, UK. Her interests include river ecology, freshwater mussels, ecosystem services and freshwater conservation. E-mail: anna.mcivor@gmail.com

**Dr Oliver Springate-Baginski** is a Lecturer at the School of International Development, University of East Anglia, UK and Senior Research Fellow in the associated Overseas Development Group (ODG). His research interests include community-based natural resource management, political economy, political ecology, collective action and local government. Email: oliver.springate@uea.ac.uk

Refer to the reports for details of the case study technical report authors.
Mtanza-Msona case study, Tanzania (Chapter 7) http://intranet.iucn.org/webfiles/doc/SpeciesProg/FBU/MtanzaMsona_IWA_TechnicalReport_lowres.pdf
Stung Treng case study, Cambodia (Chapter 8): http://intranet.iucn.org/webfiles/doc/SpeciesProg/FBU/StungTreng_IWA_TechnicalReport_lowrest.pdf

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*Stung Treng integrated wetland assessment case study, Cambodia*

The study of the Stung Treng Ramsar Site was coordinated by Kong Kim Sreng, the project officer of the IUCN Cambodia Country Office. The project consultants were Alvin Lopez, Mark Dubois and Thuon Try.

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*Mtanza-Msona integrated wetland assessment case study, Tanzania*

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*The authors*

# Foreword

For billions of people throughout the world, especially the rural poor, wetlands are critical for livelihoods, providing vital supplies of water, food and materials as well as ecological services. Wetlands are, however, suffering from extreme levels of degradation with estimates putting wetland loss and drainage in some parts of the world at more than 50%. Such a high level of wetland degradation not only results in a tragic loss of the wetland species but is also impacting heavily on those people whose livelihoods depend upon wetlands. There are also significant losses to national and regional economies resulting from the loss of hydrological services, such as flood control and water purification, and of material goods such as those provided through fisheries.

The Ramsar Convention on Wetlands covers all aspects of wetland conservation and wise use, recognising wetlands as ecosystems that are extremely important for biodiversity conservation and for the well-being of human communities. However, it also recognises that no single approach is currently available to enable people to determine the full value of a wetland in terms of its biodiversity, economic value, and importance to people's livelihoods. An integrated assessment methodology is required to determine the full importance of a wetland. This toolkit provides a process for conducting such a fully integrated assessment of wetlands and thus aims to fill this gap in available methodology and assist those concerned with the Ramsar Convention to identify new Ramsar sites and help ensure the future wise use of wetlands in general.

I therefore commend this toolkit to you and urge all those concerned with the management and conservation of wetland resources, and in securing the wise use of wetlands, to read it and use it in their future work.

Anada Tiéga
Secretary General
The Convention on Wetlands
Ramsar Secretariat
Switzerland

# Terms Used

***Assessment***
*"Evaluation, estimation (of the quality, value, or extent of), to gauge or judge"*

Oxford English Dictionary 2008

***Biodiversity***
*"the variability among living organisms from all sources including,* inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."*

Millennium Ecosystem Assessment (MEA) 2005

The importance of this definition is that it draws attention to the many dimensions of biodiversity. It explicitly recognises that every biota can be characterized by its taxonomic, ecological, and genetic diversity and that the way these dimensions of diversity vary over space and time is a key feature of biodiversity. Thus only a multidimensional assessment of biodiversity can provide insights into the relationship between changes in biodiversity and changes in ecosystem functioning and ecosystem services

***Ecosystem services***
*"the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious, and other nonmaterial benefits."*

MEA 2005

This term corresponds with the usage by the Ramsar Convention of the terms "*products, functions and attributes*".

***Governance***
The patterns of exercise of public power. In terms of watersheds it can relate to allocation exercise and enforcement of rights to ownership, use of and access to resources. It can also involve management practices, policing and adjudication between claims.

***Livelihood***
*"Means of living, maintenance, sustenance; esp. to earn, gain, get, make, seek a livelihood"*

Oxford English Dictionary 2008

***Public goods***
Products and services which benefit society at large. Public goods are 'non-rival' in the sense that one person's consumption does not affect what is left for others, and 'non-excludable' in the sense that no one can be prevented from enjoying the good. Many wetland services are public goods, such as hydrological regulation services.

***Ramsar Convention on Wetlands of International Importance***
The Convention on Wetlands, signed in Ramsar, Iran in 1971, is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are presently 158 Contracting Parties to the Convention, with 1,759 wetland sites, totalling 161 million hectares, designated for inclusion in the Ramsar List of Wetlands of International Importance.
*"The Convention's mission is the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world"*

Ramsar COP8 2002

***Values and Valuation***
*"the relative status of a thing, or the estimate in which it is held, according to its real or supposed worth, usefulness, or importance"*

Oxford English Dictionary 2008

Value is the subjective estimation of worth. Different people value things differently for a range of personal reasons. However, in order to compare values — which becomes important when decisions over resource management must be made — value may be estimated in terms of some standard, medium of exchange or monetary value, and valuation methods are used to do this. Note that *value* and *price* are different as price involves a market bargaining and exchange situation.

***Wetlands***
*"areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres"*

Article 1.1 of the Ramsar Convention on Wetlands

Wetlands may be further categorised into freshwater and coastal zones.

***Wise use of wetlands***
*"[Wetlands'] sustainable utilisation for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem"*

Ramsar COP3 1987

The Ramsar Scientific and Technical Review Panel (STRP) has proposed updating the definition to: "the maintenance of their ecological character within the context of sustainable development, and achieved through the implementation of ecosystem approaches."

# Overview

## The *need* for an integrated wetland assessment toolkit:

Wetlands contain biodiversity of exceptional conservation significance, comprising many unique ecosystems and a wide array of globally-threatened species. At the same time they typically form essential components of local, national and even regional economies, as well as underpinning the livelihoods of adjacent human communities. Wetland goods and services are often particularly important for poorer and more vulnerable groups, which have limited alternative sources of income and subsistence, and have weak access to basic services.

Despite their importance, wetlands are under increasing pressure. According to the Millennium Ecosystem Assessment (MEA) 2005, the biodiversity of inland waters is in a worse condition than that of any other ecosystem; it is estimated that 50% of inland water area (excluding large lakes) has been lost globally. Wetland degradation and loss poses a severe threat to both development and conservation goals, and impacts disproportionately on some of the world's poorest communities.

Poor consideration of wetlands in decision-making remains one of the major factors leading to their degradation. Management decisions affecting wetlands (for example relating to investment, infrastructure or management of land and water resources) rarely consider the wider biological, ecological, developmental or economic values of wetlands as they are. Therefore the costs of wetland loss and benefits of wetland conservation are underestimated. While development planners commonly neglect the wider impacts of wetland degradation on economic, livelihood and poverty indicators, wetland-managing authorities have rarely been able to demonstrate or act on these links, or to factor poverty and livelihood concerns into on-the-ground conservation activities. Furthermore governance of wetlands has typically not effectively represented the interests of those constituencies depending on the wetlands for the provision of 'public goods', and has typically favoured those motivated to convert wetlands in order to increase private gain.

Methodological and information gaps partly explain the omission of wetland values from investment, land, and resource use decision-making. Although techniques exist, and have long been used, to assess wetland biological, economic and livelihood values and trends separately, there has been a lack of available *integrated* methods to assess the interlinkages and connectivity between wetland condition and economic/livelihood status, or to express this information in a form and with a focus that can inform and influence real-world conservation and development planning.

**_What_ this toolkit is:**
This toolkit sets out a process for integrated assessment and provides a set of methods that can be used to investigate the links between biodiversity, economics and livelihoods in wetlands, and to identify and address potential conflicts of interest between conservation and development objectives. The integrated approach presented in the toolkit also enables practitioners to assess a wetland in terms of its combined biodiversity, economic and livelihood values. It has a particular focus on strengthening pro-poor approaches to wetland management. It is intended to help overcome the current methodological and information gaps in wetland assessment, thereby facilitating the factoring of wetland values into conservation and development decision-making and management planning. It can be applied to all sorts of wetlands and at all scales. Note that the toolkit is not primarily intended as a village development planning methodology. However it may be adapted to contribute information needed for such a planning process.

**_Who_ this toolkit is for:**
The toolkit provides a set of practical and policy-relevant methods for information collection which can be used by those involved in wetland conservation and development planning. It is expected to be of use to wetland site managers, environmental impact assessors, conservation and development planners, and researchers from both natural and social science disciplines.

**The _contents_ of the toolkit:**
There are three main sections:

Section I presents the ***integrated assessment process***;
Section II presents the ***tools*** themselves; and
Section III illustrates the application of the toolkit with two ***case studies***.

In more detail, the toolkit provides:

- A **conceptual and methodological framework** for addressing wetland management issues, especially conservation and development trade-offs, through integrating biodiversity, economic valuation and livelihood assessment (Chapter 1).
- **Guidance on conducting an integrated assessment** and **methods** for planning and carrying out an integrated wetland assessment (Chapter 2).

- Tools, methods and techniques for **biodiversity assessment** (Chapter 3), **livelihoods assessment** (Chapter 4), and **economic valuation** (Chapter 5) of wetlands.
- Tools, methods and techniques for presenting integrated wetland assessment data through electronic **mapping** (Chapter 6).
- **Case studies** of the application of integrated wetland assessment in a management context in Stung Treng Ramsar Site, Cambodia and Mtanza-Msona Village, Tanzania (Chapters 7 and 8).
- **References:** key readings are provided at the end of each section and additional references at the end of the toolkit.

**Ongoing toolkit development process:**
The development of this toolkit should be viewed as an evolving process which will benefit greatly through feedback from practitioners' experiences in its application. Please send any comments or suggestions to iwa_toolkit@iucn.org. We anticipate updating and improving the document in the future as we receive new ideas and as we learn from our own experience in its application. We also hope to improve functionality of the toolkit through developing discrete sections on individual methodologies that will be available for download from the project website www.iucn.org/species/IWAToolkit .

### *WHAT INTEGRATED ASSESSMENT INVOLVES: A QUICKSTART GUIDE TO USING THE TOOLKIT*

Chapter 2 presents the practical details of the process. To summarise, the eleven recommended key steps are:

***Preparation and orientation:***

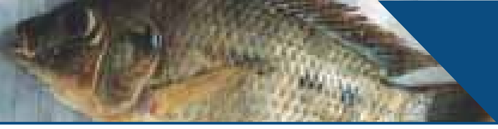
1. Identify the wetland and clarify the particular management concerns, objectives or issues to be addressed through the assessment. This process should involve multiple national, regional and local stakeholders as far as possible
2. Form the multi-disciplinary assessment field team and allocate roles and responsibilities
3. Review the current state of knowledge regarding the wetland and the focal issues
4. Identify the information needed, define the specific study questions and take sampling frame decisions
5. Plan integrated data collection according to opportunities and resource constraints

***Fieldwork:***

6. Pilot the field method to trial and adapt to the tools, and gain familiarity with the objectives and concerns of the other disciplines. Orient the team to integrated working practices and methods. Review plans in the light of experience
7. Conduct the full data collection fieldwork
8. Check and collate the data collected. Ensure that relevant links between data are maintained (such as species names and harvesting locations)

***Analysis, presentation and engagement:***

9. Conduct a joint analysis of data involving representatives from all parts of the team
10. Use Geographic Information System (GIS)-based mapping tools to present results in spatial form
11. Provide feedback and present findings according to an ongoing policy engagement process





# Chapter 1

## Introduction and conceptual framework

*Oliver Springate-Baginski, Eddie Allison, Lucy Emerton and William Darwall*

This chapter introduces the integrated approach to wetland assessment. It argues for integration as an essential principle for understanding wetlands and their management and use. It discusses different approaches for integration, and advocates a conceptual and methodological framework for assessing wetlands in a fully integrated manner.



*William Darwall/Darwin Integrated Wetland Assessment project*

## Introduction and conceptual framework

*This section introduces the concept of integrated wetland assessment. It involves discussion of:-*

- ✔ *Wetlands and their management*
- ✔ *The conventional practice of separate 'non-integrated' wetland assessment*
- ✔ *The need for an integrated assessment approach*
- ✔ *The principles of an integrated assessment (i.e. integrating biodiversity, valuation and livelihood approaches)*

## F1 Purpose of the toolkit

This toolkit presents integrated biodiversity, economic and livelihood assessment methodologies to strengthen pro-poor approaches to wetland conservation. It outlines the steps in designing, preparing for and carrying out an integrated assessment. The toolkit also describes methods for analysing and presenting the information collected, using GIS maps and electronic databases in order to identify overlaps between threatened species and high human dependence, and to develop site-level action plans for pro-poor wetland conservation and sustainable use. Two case studies are documented to demonstrate how the toolkit can be applied in practice: Stung Treng Ramsar Site on the Lower Mekong in Cambodia, and Mtanza-Msona village on the Rufiji floodplain in Tanzania.

The toolkit is founded on the premise that an integrated approach to assessment is necessary in order to generate information that is practically useful, and policy relevant, for wetland planning and management. As both wetland values and threats encompass biological, ecological, economic and livelihood aspects, and wetland management responses must simultaneously address and react to each of these factors, a thorough understanding of all — and of the interlinkages and interconnectivity between them — is required.

The main components of integrated wetland assessment are seen as species- and habitat-based biodiversity assessment, economic valuation, and livelihoods analysis. Maps and databases provide useful tools to represent, analyse and share the information that integrated assessments yield, as it can inform both local and global conservation planning and action, and point to management and policy recommendations which support biodiversity conservation, sustain local livelihoods, and reduce poverty.

The toolkit describes a framework for assessment which consists of the following stages:

**Stage 1:** **Preparation and orientation, including clarifying stakeholders' management objectives:** recognising and balancing both conservation and development goals, and promoting a pro-poor approach to wetland management, is a process that requires broad consultation and awareness of a wide range of issues. Developing a shared vision across stakeholder groups based on mutual respect and understanding, and rooting the assessment in real-world management goals and objectives, are both essential to give purpose to the assessment process, and to identify relevant management and policy-related questions for the assessment to tackle

**Stage 2:** **Assessment:** documenting the state of wetland biodiversity, identifying development and conservation pressures and threats, and understanding past, current, and future management and policy responses. This requires the co-ordination of data collection, survey, and review, across all the relevant disciplines and methods

**Stage 3:** **Analysis, presentation and evidence-based engagement:** analysing the data generated to address needs for management and policy information; emphasising the interlinkages and connectivity between biodiversity, economic and livelihood factors, and to ensure that information is presented in a practical and policy-relevant form which is both appropriate and useful for planners and decision-makers in conservation and development sectors

The guiding principles supporting this toolkit are that wetland assessments should:

- Be **integrated** across disciplines and themes
- Be geared to address a particular **management** issue or question
- Generate information that can be used to improve support and improve **planning** of on-the-ground wetland management, and provide information to make better **decisions** about how to use and allocate investment funds, land, and resources in and around wetlands
- Work to **strengthen** existing wetland management process
- Serve to **sustain** wetland values, with a particular focus on ensuring the continued generation and equitable access to wetland goods and services, particularly for poorer and more vulnerable human groups

## F2 Wetland ecosystems and their governance – supporting inclusive and informed decision-making

Wetlands are defined by the Ramsar Convention on Wetlands as: *"…areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres."*

(Ramsar 2009)

Wetlands' distinctive ecological characteristics are central to their management challenges:

*"Hydrological regime and topography are generally the most important determinants of the establishment and maintenance of specific types of wetland and wetland processes, creating the unique physicochemical conditions that make wetlands different from both deepwater aquatic systems and well-drained terrestrial systems. Hydrological conditions affect numerous abiotic factors, including nutrient availability, soil anerobiosis, and salinity in both coastal and inland wetlands, which in turn determine the biota that establish in a wetland. These biotic components can alter the hydrology and other physicochemical features of the wetland… [M]aintaining the hydrological regime of a wetland and its natural variability is necessary to maintain the ecological characteristics of the wetland, including its biodiversity."*

(MEA 2005)

### F2.1 Understanding and managing wetland landscapes

A wide range of wetland types can be distinguished:

*a. Inland wetlands:*

- Permanent and temporary rivers and streams
- Permanent lakes and 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

*b. Coastal wetlands*

- Estuaries and marshes
- Mangroves
- Lagoons, including salt ponds
- Intertidal flats, beaches and dunes
- Kelp
- Rock and shell reefs
- Seagrass beds
- Coral reefs

(MEA 2005)

Wetlands are connected with the broader landscapes in hydrological and ecological terms, and also exist within a human context. There are links between wetland goods and services, the ecological and biological processes which support them, and socio-economic processes both on- and off-site. Additionally, socio-economic processes and forces both on- and off-site influence their status, use, and management.

The complexity of wetland landscapes thus involves interplay of several key factors (Figure 1):

- Hydrology and topography of the physical wetland
- Biodiverse wetland ecosystems
- Ecosystem services to human communities both local and more distant
- Local livelihood systems
- Policies, governance, institutions, and markets

Each of these elements needs to be understood in order to understand the overall management challenge.

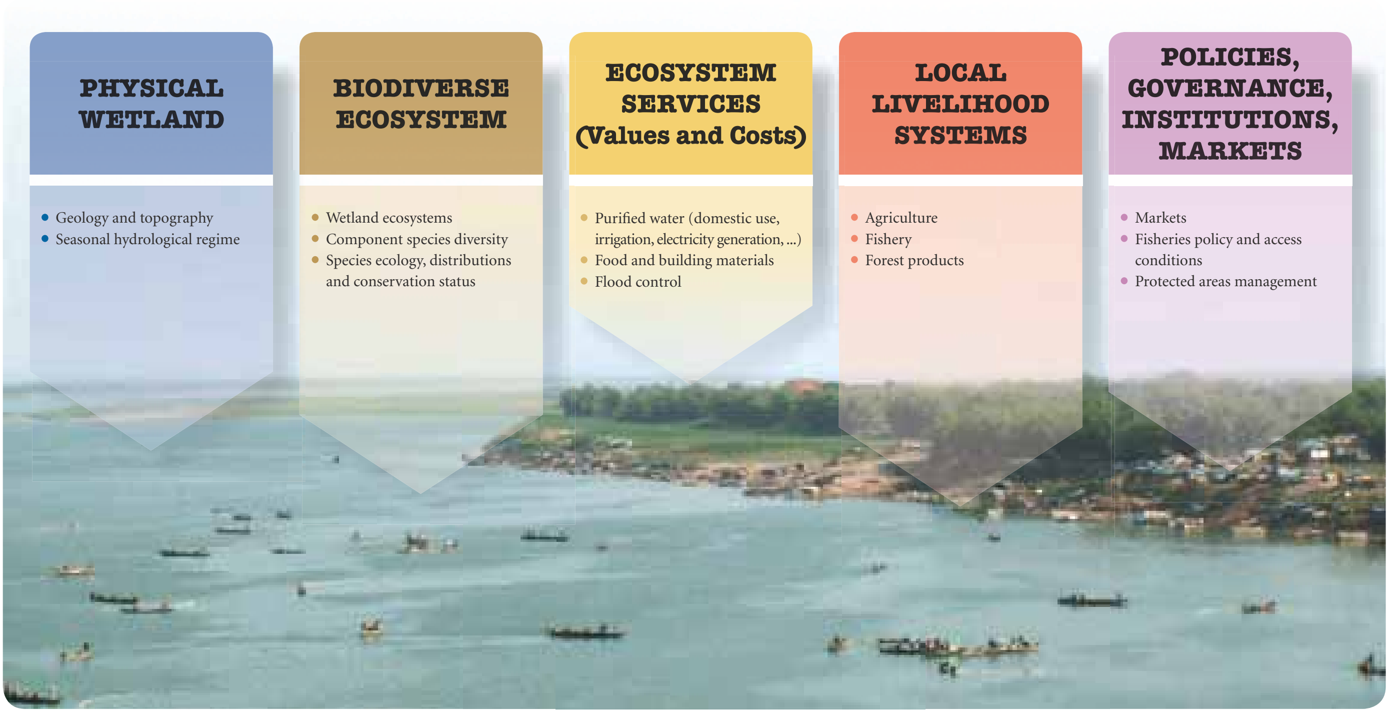



**Figure 1: Interlinked aspects of a wetland landscape**

**BOX 1: THE ECOSYSTEM APPROACH TO WETLANDS**

The ecosystem approach, as established and defined in the Convention on Biological Diversity, recognises the need for a holistic approach to wetland assessment and management. The ecosystem approach involves "*a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way*". It supports participatory planning guided by adaptive management to respond to the dynamic nature of ecosystems, in doing so involving all stakeholders and balancing local interests with the wider public interest. It advocates the decentralization of management to the lowest appropriate level, to achieve greater efficiency, effectiveness and equity.

These interlinkages and interconnectivity mean that the relationships and drivers that affect wetland status are extremely complex, concern both biophysical and socio-economic elements, and involve a series of interactions between them. Without simultaneously dealing with all of these elements it is neither possible to understand the conditions and status of a wetland within the broader physical and human landscape, nor to assess the likely outcomes and implications of different policy and management scenarios. Such integration reflects an ecosystem approach to wetland management (Box 1).

There are a number of wetland management scales relating both to the physical wetland hydrology, and also to national governance structures at different levels:

- The river basin level is the largest scale, and is likely to be regional, national or even international
- Site level may be defined by specific physical features, and/or convenience for management
- Local level refers to the settlement level and is the scale at which local people access and use the resource on a frequent basis

Wetlands provide a range of ecosystem services at these different scales, as detailed in Table 1.

### F2.2 Threats to wetlands – addressing conservation and development trade-offs

Wetlands are one of the most threatened ecosystems (MEA 2005), reflecting the fact that there are many competing demands on the land and natural resources that comprise and surround wetlands. Although there is in most cases some level of trade-off between managing wetlands for conservation and for human development needs, there is also a need to understand the nature and magnitude of this competition, and to be able to balance the competing demands to generate

**Table 1: Ecosystem services provided by or derived from wetlands**

| SERVICE CATEGORIES | SPECIFIC SERVICES | COMMENTS AND EXAMPLES |
|---|---|---|
| Provisioning | Food | production of fish, wild game, fruits, and grains |
| | Fresh water | storage and retention of water for domestic, industrial, and agricultural use |
| | Fibre and fuel | production of logs, fuelwood, peat, fodder |
| | Biochemical | extraction of medicines and other materials from biota |
| | Genetic materials | genes for resistance to plant pathogens, ornamental species, and so on |
| Regulating | Climate regulation | source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes |
| | Water regulation (hydrological flows) | groundwater recharge/discharge |
| | Water purification and waste treatment | retention, recovery, and removal of excess nutrients and other pollutants |
| | Erosion regulation | retention of soils and sediments |
| | Natural hazard regulation | flood control, storm protection |
| | Pollination | habitat for pollinators |
| Cultural | Spiritual and inspirational | source of inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems |
| | Recreational | opportunities for recreational activities |
| | Aesthetic | many people find beauty or aesthetic value in aspects of wetland ecosystems |
| | Educational | opportunities for formal and informal education and training |
| Supporting | Soil formation | sediment retention and accumulation of organic matter |
| | Nutrient cycling | storage, recycling, processing, and acquisition of nutrients |

**Table 2: Example of compatible and incompatible management approaches for reconciling conservation and development of wetlands**

| CONSERVATION OBJECTIVES | MANAGEMENT APPROACH | DEVELOPMENTAL OBJECTIVES |
|---|---|---|
| • Conservation of wetland biodiversity and wetland-based livelihood species | ✗ ***Incompatible approaches:***<br>✗ *Strict protected area management*<br>✗ *Regulation of rivers* | • Maintenance of natural-resource-based livelihoods in the same area<br>• Supply power and water for irrigation |
| | ✔ ***Compatible approaches:***<br>✔ *Maintaining river flows and flooding regimes*<br>✔ *Adaptive co-management working with local resource users*<br>✔ *Ecotourism* | |

maximum benefits for both conservation and development, as illustrated in Table 2.

It is widely accepted that successful wetland management requires that conservation interests and development pressures be reconciled. There are many ways of attempting this reconciliation. Sometimes, trade-offs have to be made between conservation goals and development objectives that are incompatible. In other cases, conservation and development are mutually reinforcing. Whatever the relationship between conservation and development in an individual case, the resolution of management actions and policy debates requires information about both, and an understanding of the linkages between them (see Box 2 overleaf).

## F3 Wetland assessment: improving upon conventional approaches

### F3.1 Contextualizing wetland assessment within management issues

Wetland assessment is the process of determining and describing the status, characteristics, or worth of a particular wetland. It involves measuring certain variables which are considered important in conservation and/or development terms, and can be taken as indicators of the health of the wetland itself, its attributes, functions, and workings, of the goods and services that it generates, and of the human and natural processes it supports.

Wetland assessment does not normally take place in isolation, but is normally prompted by a particular management or policy issue that needs to be addressed, or a particular decision that needs to be made about the use of funds, land or other resources. The information generated by the assessment therefore aims to assist in understanding or dealing with this issue, or in making this decision. However academically interesting it is to know the status, characteristics or worth of a particular site, wetland assessment is not an end in itself. It is a means to an end; better and more informed conservation and development decision-making. It is the management or policy issue which determines the scope, objective and parameters of wetland assessment.

### F3.2 The elements of wetland assessment

The different elements of wetland assessment have, traditionally, been seen as being distinct from each other, in jargon and approach, but also in their management focus and application:

*Conservation planning* is typically informed by data on biodiversity (for example on species distributions and abundance, habitat distribution and quality), and by information on threats to that biodiversity. In wetlands, these might include over-harvesting, conversion of floodplain and forest land for cultivation, or modification of rivers and floodplains through damming and drainage schemes.

In contrast, the overriding application and focus of *economic valuation* work has been in relation to assessing the costs and benefits of investment and development projects and programmes. Recently, economic valuation has however been added to the conservation toolkit. Although a large variety of methods are used and goals of valuation vary, in general valuation studies aim to derive an assessment of the value of the wetland site, per unit of wetland area, or for the species or biotic resources, or particular constituents of these. They are often used to highlight 'hidden' values – the contributions that biodiversity makes to livelihoods and the economy that are not accounted for in conventional economic analyses focussing on market-traded commodities and services. For example,

### BOX 2: KEY MESSAGES OF THE MILLENNIUM ECOSYSTEM ASSESSMENT WETLAND SYNTHESIS

*Wetland ecosystems (including lakes, rivers, marshes, and coastal regions to a depth of 6 meters at low tide) are estimated to cover more than 1,280 million hectares, an area 33% larger than the United States and 50% larger than Brazil. However, this estimate is known to under-represent many wetland types, and further data are required for some geographic regions. More than 50% of specific types of wetlands in parts of North America, Europe, Australia, and New Zealand were destroyed during the twentieth century, and many others in many parts of the world degraded.*

*Wetlands deliver a wide range of ecosystem services that contribute to human well-being, such as fish and fibre, water supply, water purification, climate regulation, flood regulation, coastal protection, recreational opportunities, and, increasingly, tourism.*

*When both the marketed and non-marketed economic benefits of wetlands are included, the total economic value of unconverted wetlands is often greater than that of converted wetlands.*

*A priority when making decisions that directly or indirectly influence wetlands is to ensure that information about the full range of benefits and values provided by different wetland ecosystem services is considered.*

*The degradation and loss of wetlands is more rapid than that of other ecosystems. Similarly, the status of both freshwater and coastal wetland species is deteriorating faster than those of other ecosystems.*

*The primary indirect drivers of degradation and loss of inland and coastal wetlands have been population growth and increasing economic development. The primary direct drivers of degradation and loss include infrastructure development, land conversion, water withdrawal, eutrophication and pollution, overharvesting and overexploitation, and the introduction of invasive alien species.*

*Global climate change is expected to exacerbate the loss and degradation of many wetlands and the loss or decline of their species and to increase the incidence of vector-borne and waterborne diseases in many regions. Excessive nutrient loading is expected to become a growing threat to rivers, lakes, marshes, coastal zones, and coral reefs. Growing pressures from multiple direct drivers increase the likelihood of potentially abrupt changes in wetland ecosystems, which can be large in magnitude and difficult, expensive, or impossible to reverse.*

*The projected continued loss and degradation of wetlands will reduce the capacity of wetlands to mitigate impacts and result in further reduction in human well-being (including an increase in the prevalence of disease), especially for poorer people in lower-income countries, where technological solutions are not as readily available. At the same time, demand for many of these services (such as denitrification and flood and storm protection) will increase.*

*Physical and economic water scarcity and limited or reduced access to water are major challenges facing society and are key factors limiting economic development in many countries. However, many water resource developments undertaken to increase access to water have not given adequate consideration to harmful trade-offs with other services provided by wetlands.*

*Major policy decisions in the next decades will have to address trade-offs among current uses of wetland resources and between current and future uses. Particularly important trade-offs involve those between agricultural production and water quality, land use and biodiversity, water use and aquatic biodiversity, and current water use for irrigation and future agricultural production.*

*Cross-sectoral and ecosystem-based approaches to wetland management — such as river (or lake or aquifer) basin-scale management, and integrated coastal zone management — that consider the trade-offs between different wetland ecosystem services are more likely to ensure sustainable development than many existing sectoral approaches and are critical in designing actions in support of the Millennium Development Goals.*

*Many of the responses designed with a primary focus on wetlands and water resources will not be sustainable or sufficient unless other indirect and direct drivers of change are addressed. These include actions to eliminate production subsidies, sustainably intensify agriculture, slow climate change, slow nutrient loading, correct market failures, encourage stakeholder participation, and increase transparency and accountability of government and private-sector decision-making.*

*The adverse effects of climate change, such as sea level rise, coral bleaching, and changes in hydrology and in the temperature of water bodies, will lead to a reduction in the services provided by wetlands. Removing the existing pressures on wetlands and improving their resiliency is the most effective method of coping with the adverse effects of climate change. Conserving, maintaining, or rehabilitating wetland ecosystems can be a viable element to an overall climate change mitigation strategy.*

*(MEA 2005)*

Kong Kim Sreng/Darwin Integrated Wetland Assessment Project

*Fisheries often play a key part of rural livelihoods, as shown here in Stung Treng Ramsar Site*

crops and timber are typically included in studies of rural production and consumption, while non-timber forest products and locally used but non-traded resources are not included. Often, ecosystem services provided by forests and floodplains (e.g. local climate regulation, prevention of soil erosion, flood regulation etc.) are not valued either.

*Livelihood analysis* has developed from rural development research, and is applied in relation to development projects and programmes focused on promoting sustainable resource use and on reducing poverty and related conditions such as social exclusion and vulnerability. Local-level livelihood assessments focus on people's assets and capabilities, their livelihood strategies and activities, and their incomes and consumption levels, the aim being to help enhance these. There is also a strong focus on understanding the social, cultural, legal, and political structures and processes that constrain peoples' opportunities to improve their lives. Livelihoods analysis is often used to inform and guide development programmes (e.g. Livelihoods Connect; www.livelihoods.org).

The inevitable outcome of using these different assessment methods separately for wetlands is that wetland planning has been pulled in divergent directions by the different assessments rather than reconciling these different objectives through considering how to best to trade-off different options and seeking 'win-win' opportunities where possible. The MEA recognised that ecosystem approaches which better reconcile the divergent management goals for wetlands are increasingly important.

### F3.3 'Non-integrated' approaches to wetland assessment

Although biodiversity assessment, economic valuation, and livelihood analysis techniques are each relatively well-developed, and have been extensively applied to wetlands, there have to date been few attempts to integrate them within the context of real-world management and policy issues. There remain very few, if any, examples of assessments which bring together biodiversity, economic, and livelihood elements under one framework. At best, a series of assessments are carried out separately and brought together only after data have been collected and a final analysis made. More commonly, a single aspect of wetland use or management is investigated in detail, and broad (and often uninformed) assumptions about other elements are made.

While there is widespread recognition that wetland planning and management should take account of both conservation and development objectives, often the approach to informing these activities is not integrated at all. A series of research questions are formulated, investigated and reported on separately by each discipline. It is only when the assessment, analysis and reporting have taken place that some effort is made to draw out combined conclusions and recommendations for management purposes (Figure 2). This section describes the way programme design, assessment of conservation and development issues and presentation of information is typically carried out in a non-integrated manner.

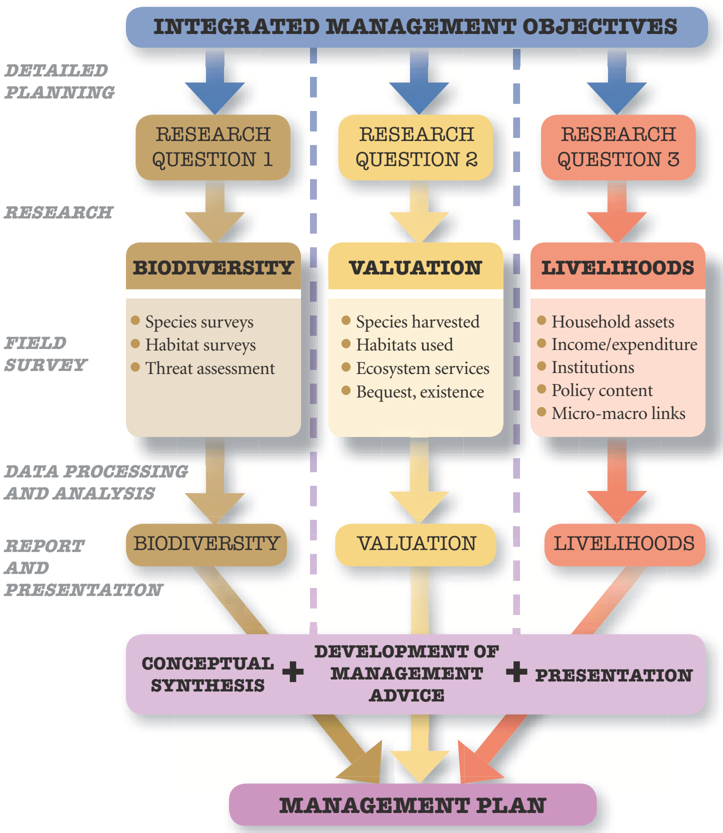



**Figure 2: A 'non-integrated' approach to wetland assessment**

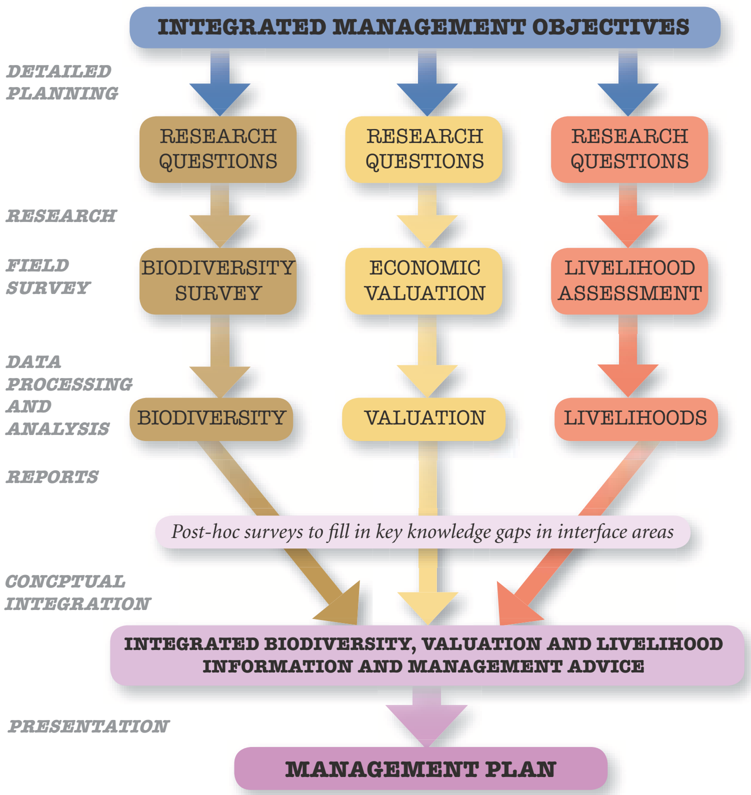



**Figure 3: Integrating wetland assessments which are already under way as separate studies**

Even though integrated conservation and development are often both incorporated into the overarching wetland management objective, and an assessment process is instigated in order to identify ways to achieve that goal, the different thematic elements of this assessment tend to remain separated. Individual specialists are commissioned to carry out studies on conservation and development issues, and the process may unfold as follows:

1. The specialists identify research questions pertinent to their particular expertise and terms of reference and then design assessment programmes to address these questions

2. For logistical reasons, the assessment processes do not often take place in parallel. They may take place at different times, perhaps in different localities, and with limited discussion between groups

3. Each group collects and analyses its own data and writes its own report, using its own specialist language and discipline-based standards and norms of good practice

4. Management advice is framed and presented in different ways; some reports make essential use of spatial mapping of some components of the biodiversity, livelihoods, and economic assessment. Other reports are largely text-based, while others use complex numerical analyses

5. The management group then has the task of drawing on these reports to assess different management options. At this point, gaps and discontinuities become apparent. Missed opportunities are belatedly spotted. Arguments over objectives ensue. Value judgments are made as to which report to give credence to in the case of disparities

6. It is discovered that no one has worked at the same spatial scale, and that the biodiversity survey team and livelihoods team disagree on the root causes of observed or perceived threats to diversity, and therefore on what management actions are needed to address them

7. Management then either decides it 'needs more research' to resolve the problems before any management action can be recommended, or it makes decisions based on subjective evaluation of the validity of different claims made in each separate report or by each disciplinary group

This lack of integration results in inefficient use of resources for assessment and analysis of information, erodes trust between conservation and development advocates, and puts the burden of conceptual integration and analysis on decision-makers. It also typically generates a series of confusing, unharmonized, and at the worst contradictory, sets of information and recommendations for decision-makers.

## F4 Integrating when, how and by whom the assessment is carried out

This toolkit is founded on the guiding principle that if assessment is to be useful to real-world wetland management planning and decision-making, it must adopt an integrated approach; one which brings together biodiversity, economics and livelihood elements. As explained in the paragraphs below, this involves documenting — through assessment — the biological, ecological and socio-economic aspects of wetlands, along with their status, trends, and threats. To be effective, equitable and sustainable in practice, wetland management responses must be informed by an understanding of all of these elements, including their mutual causality and interconnectivity.

### F4.1 Moving from thematic separation to integrated assessment

There are various degrees of integration. Although ideally a wetland assessment would be thematically integrated from its very conceptualization and design right through to the presentation of results to decision-makers, in many cases this

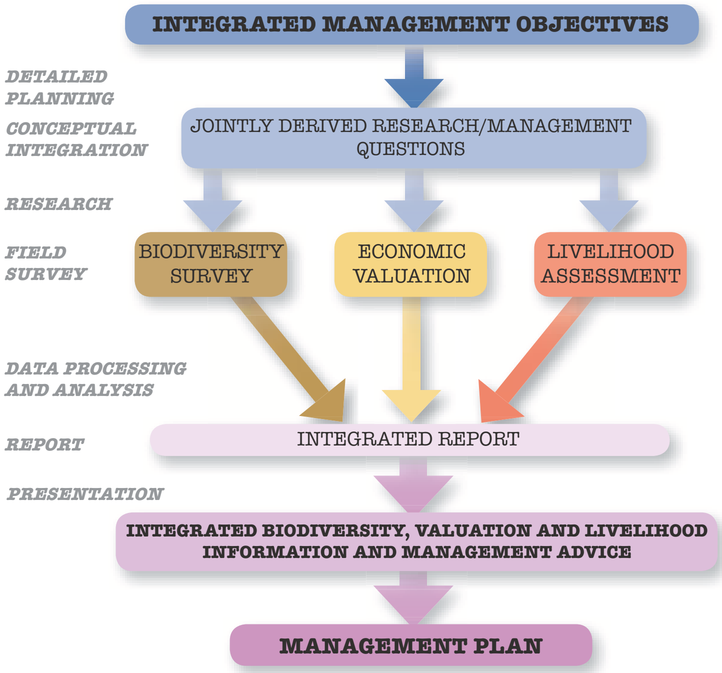



**Figure 4: Integrating the work of separate field survey teams within a single assessment**

is not possible. The assessment is taking place in a situation or context where prior work has been carried out, a programme or project is already under way, or a particular emphasis has already been placed on particular elements of wetland management and information needs. Below, we look at three levels of thematic integration in wetland assessment:

1. Integrating wetland assessments which are already under way as separate studies
2. Integrating the work of separate field survey teams within a single assessment
3. Carrying out an integrated assessment with an integrated survey team

Integration can take place by working with existing project teams to harmonize and synthesise the different components of their workplan (Figure 3). Here, even though separate studies of biodiversity, economic valuation, and livelihoods may have already been conducted — with separate objectives and methodological approaches — greater attention is placed on integrating the findings from these surveys prior to presenting them to management stakeholders. It may also be possible at this analytical stage to identify key gaps in knowledge, which may be found at areas of interface between disciplines, and develop targeted actions to fill these gaps. Although this leaves conceptual and analytical integration rather late in the programme planning cycle, at least it means that decision-makers and other interested parties are able to discuss results that have emerged from a process of consultation and cross-disciplinary testing.

Partial integration of biodiversity, economic, and livelihoods assessment (Figure 4) ideally takes place right from the start of integrated programmes – by asking questions that are not restricted simply to conservation concerns, or to development concerns, but relate to both. In cases where programmes are yet to begin, a fully integrated assessment can be designed as an integral part of the programme cycle. This may also be suitable as a method where a project or programme has completed an initial phase and is about to begin another. While this model has the advantage that disciplinary teams understand each others' aims and develop a joint strategy for assessment, there is the disadvantage of a lack of field-level co-ordination and exchange of expertise. This misses opportunities for insight (for example in joint focus groups conducted with biodiversity and livelihoods experts) as well as the chance to build trust and understanding among survey personnel from different disciplines and viewpoints. This model also misses the opportunity for time-saving and reduction of interviewer fatigue through collecting all the relevant information during a single visit to a site or community.

The fully integrated model which we recommend (Figure 5) has the advantage that exchange of ideas takes place at all stages – from defining objectives, through carrying out fieldwork, to data analysis and presentation. Its disadvantages may include the time and effort it takes to plan and conceptualize, and the intellectual and professional demands it places on participants. This model

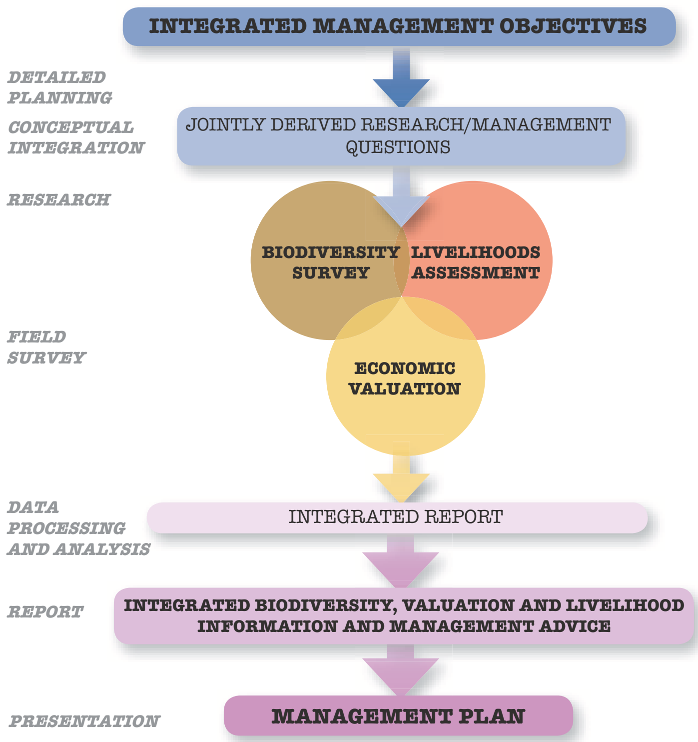



**Figure 5: Carrying out an integrated assessment with an integrated survey team**

helps wetland conservation and development stakeholders to move away from a situation where they are making decisions on the basis of a series of biodiversity assessments, economic valuations, and social development reports that have been carried out by different groups of people, who were commissioned separately by programme or project planners, did not consult one another, worked in different places and at different times to each other, using different methods, analytical tools and scales of working, and who were each able to provide only a part of the information required, leaving gaps which had to be filled by information derived from guesswork, inapplicable generalizations or vested interests.

### F4.2 Strengthening equitable, pro-poor approaches

The Millennium Ecosystem Assessment *Ecosystems and human well-being: Wetlands and water synthesis* (MEA 2005; www.millenniumassessment.org) recognised that wetland degradation and loss affects the poorest the worst. A pro-poor focus recognises that poor people not only lack the basic necessities of life, they also lack power and control over their lives and the decisions that affect them. It thus aims to take specific consideration of these needs, and to ensure that any activity carried out in wetlands should not negatively impact on the status of the poor – and wherever possible should attempt to improve it. In order to incorporate an understanding of the specific needs and status of the poor, and their links to wetland ecology and biology within broader livelihood and economic processes, information is needed about all of these factors and forces. An integrated approach to wetland assessment allows and supports pro-poor concerns to be integrated into on-the-ground management and planning, and ensures that the needs of poorer and more vulnerable groups are adequately represented and reflected.

## F5 Conceptual integration in what is being assessed

### F5.1 Integrated assessment: understanding and acting on the links between ecosystem services and human well-being

At the most basic conceptual level, an integrated assessment involves assessing the three main aspects of the wetlands interaction with human society:

- the ecosystem (and the physical conditions that support it), through biodiversity assessment (and background physical assessment)
- the value of the ecosystem services wetlands provide
- consideration of wetlands' role in local people's well-being through a livelihood assessment. Note that the human management and use of wetlands involves a policy and governance context, and this must also be assessed as a related aspect of the livelihood assessment

The integrated approach is illustrated in Figure 6.

This basic conceptual approach can be elaborated to provide a detailed 'map' for full integrated assessment, as shown in Figure 7. Section II of this toolkit provides data collection tools according to this structure: Chapter 3 provides Physical Wetland and Biodiverse Ecosystem assessment tools; Chapter 4 covers Local Livelihood Systems assessment and Institutions, Governance and Markets assessment; and chapter 5 provides tools for Economic Valuation of Ecosystem Services.

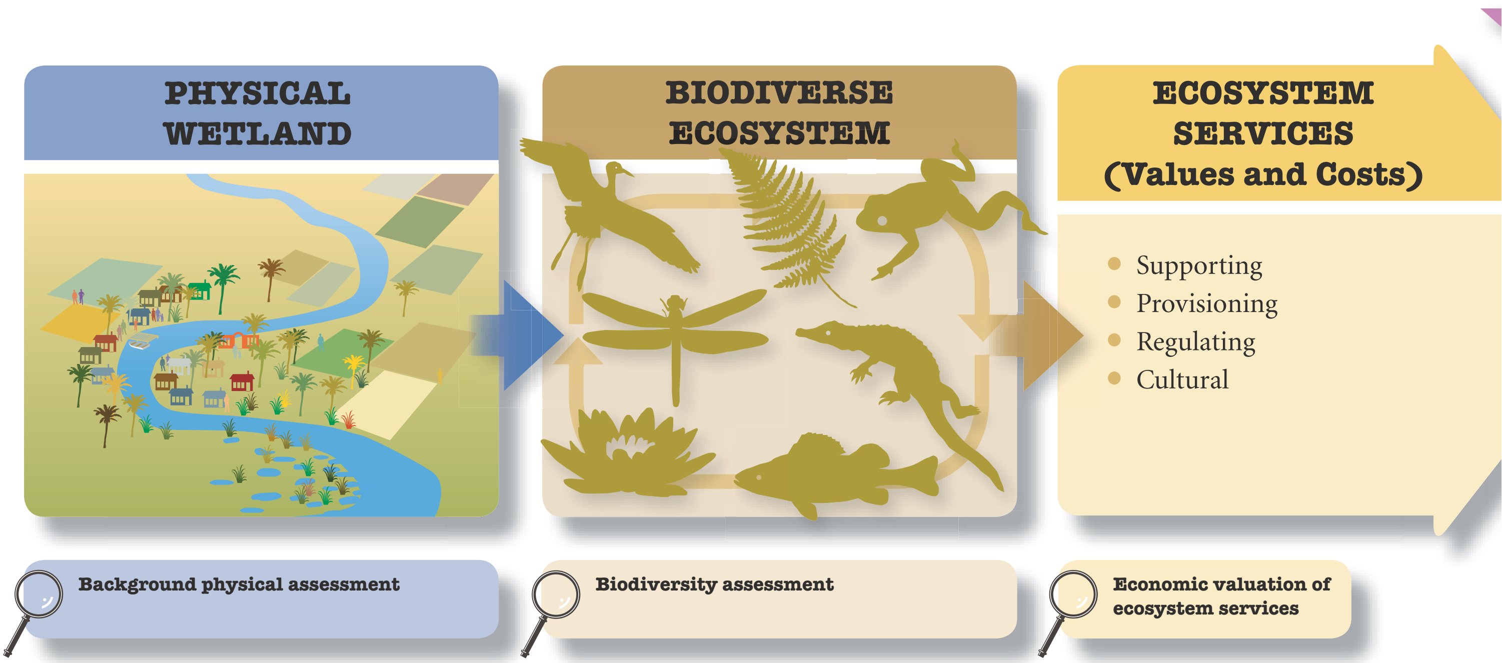



**Figure 6: Integrated assessment of the links between wetland ecosystems, their ecosystem services and human well-being**

*Kong Kim Sreng/Darwin Integrated Wetland Assessment Project*

*Following survey fieldwork in Stung Treng Ramsar Site, Cambodia, the combined assessment team jointly analysed the data that had been collected and presented their findings directly back to local stakeholders*

A variety of conceptual models can be used to describe the interconnectivity between biodiversity, economic values, and livelihoods. The MEA (2005) provides a useful framework with which to describe these linkages – between the supporting, provisioning, regulating, and cultural services that wetland ecosystems provide, and the various constituents of human well-being which ensure security, basic materials for a good life, health, good social relations, freedom of choice and action.

While biodiversity assessment provides the means to establish the links between ecosystem health and the provision of particular goods and services, economic valuation expresses

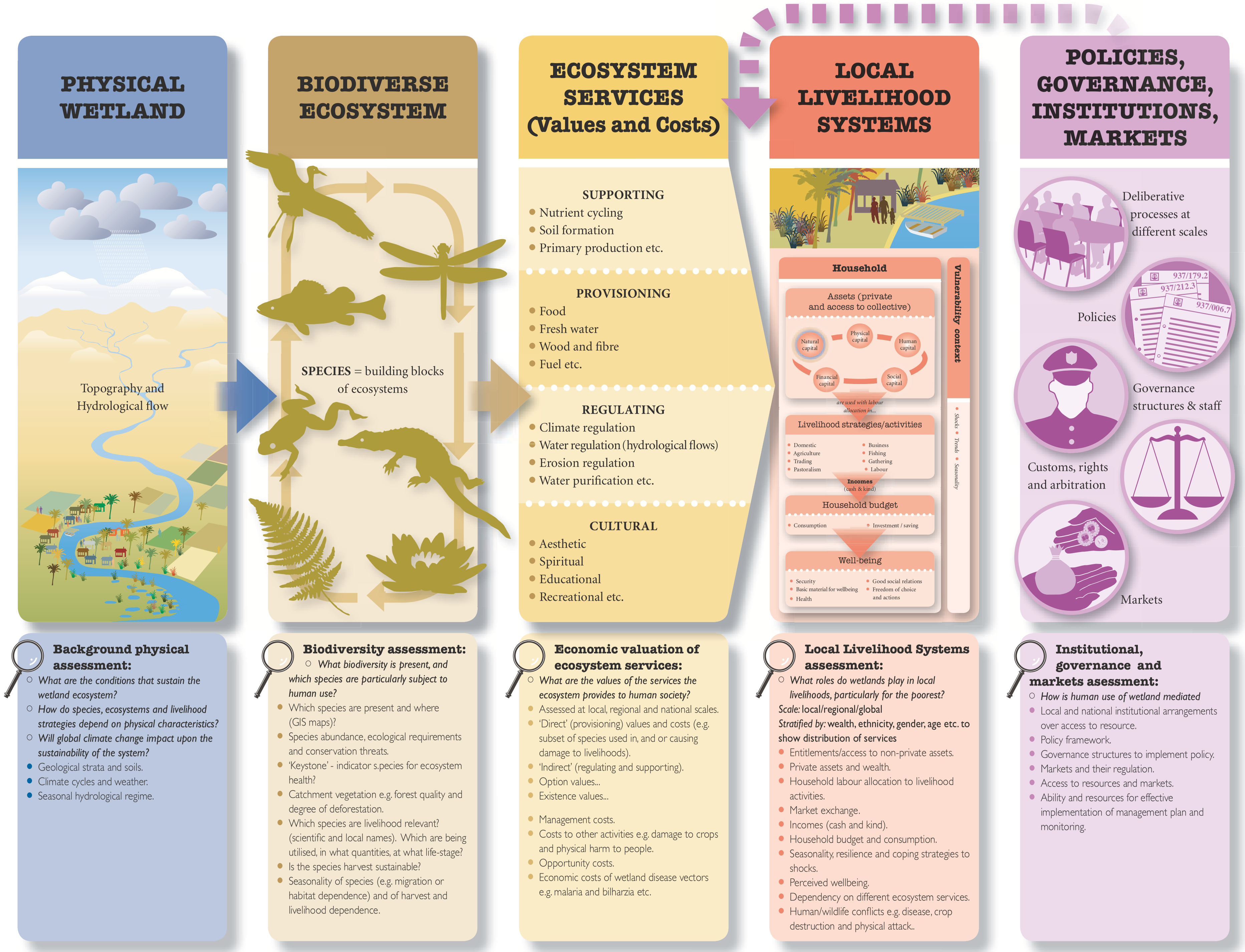



**Figure 7: Integrated Wetland Assessment – conceptual approach**

the economic significance of these services for human well-being, and livelihoods analysis describes the components of human well-being in relation to ecosystems and the economy. Together, an integrated approach to wetland assessment which incorporates all these elements enables the links between wetland ecosystems, livelihoods, economic productivity, and human well-being to be described, and the various institutions, policies, markets and other forces which moderate and shape these links to be understood.

### F5.2 The merits of integrated assessment from the biodiversity perspective

Wetlands are unique ecosystems that often sustain a high level of biodiversity including many rare, endemic or threatened species. The physical characteristics of wetlands, which are the basis of the wetland ecosystems, are determined by a range of factors including topography and hydrological flow. Wetland species cover all trophic levels and are often dependent on intact habitats, being highly sensitive to environmental changes such as changes in water flows, and declines in water quality caused, for example, by pollution or sedimentation.

The sustainable management of a wetland requires maintenance of the seasonal hydrological regime and water flows. Changes to the physical conditions within a wetland, for instance from diversion of water or damming, can have potentially very serious impacts on biodiversity, ecosystem services, and local livelihoods, and understanding current and potential threats to a wetland site is key to developing an understanding of the status and threats to its biodiversity (Figure 8).

Arguments for biodiversity conservation based solely on the intrinsic value of species — with the possible exception of highly endangered, highly charismatic species — are rarely successful in influencing decision-makers and protecting wetland habitats. Evidence from integrated assessments that show the value of species in terms of livelihoods and economics is likely to strengthen the case for wetland conservation.

Taking an integrated assessment approach can improve understanding of the biodiversity present within a wetland in many ways. Much of biodiversity has direct value to humans, supporting people's livelihoods in numerous ways. For instance, humans depend on animals and plants for food, clean water

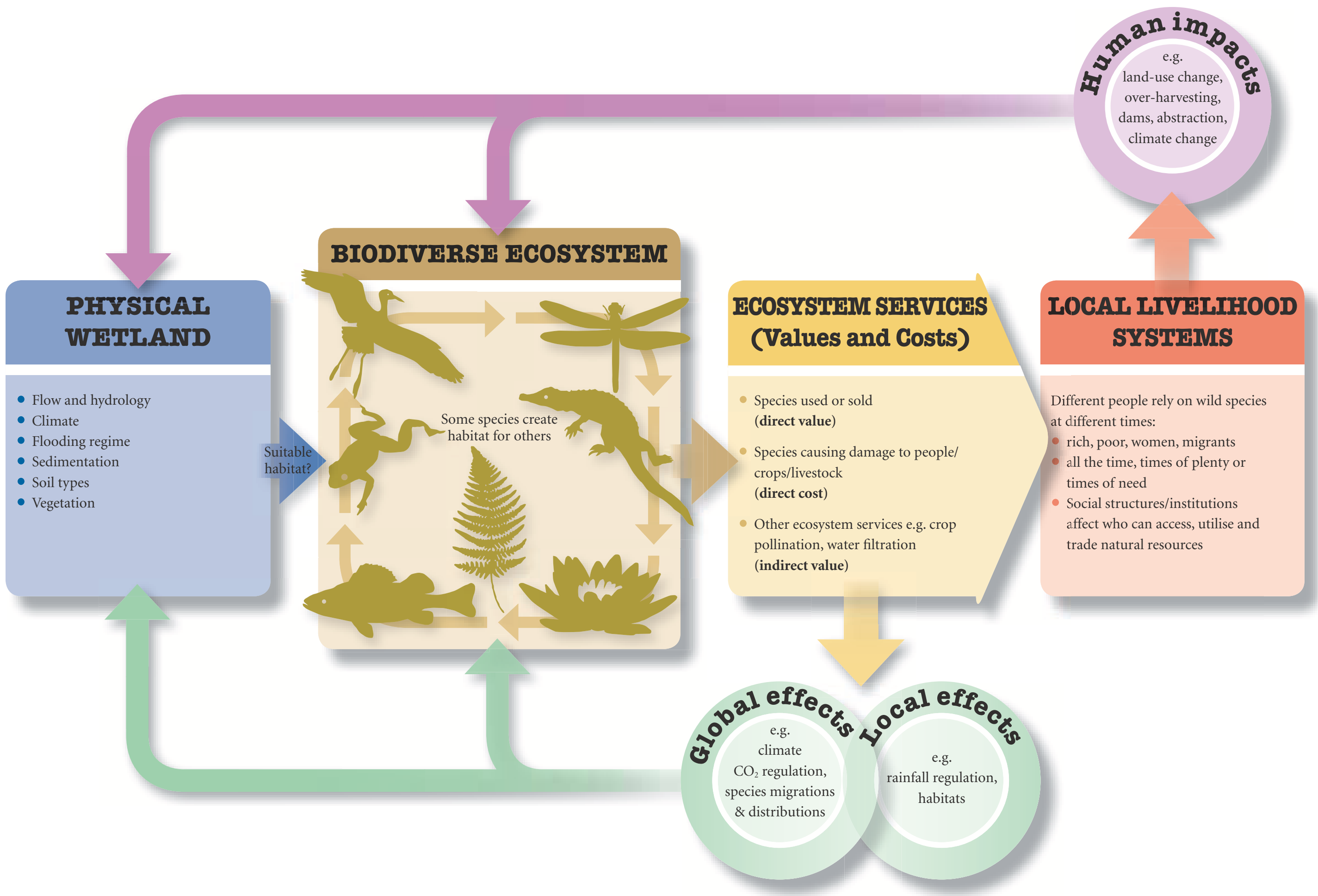



**Figure 8: Ecosystem and species contributions to livelihoods, and how human impacts can in turn affect species**

for drinking, wood or other plant-based fuels to cook and keep warm, and materials for building and making products such as clothes. The supply of most of these necessities is provided or influenced by biodiversity (both past and present), be it as insects pollinating crops, as forests providing wood, or as bacterial films purifying water.

Human activities and policies often result in the degradation and loss of biodiversity, for instance when dams are built for hydro-electric energy, or through unsustainable levels of utilization. Decisions over wetland resource use often neglect, or are uninformed by, the intrinsic value of the biodiversity lost, and the value that the biodiversity contributes and the people whose livelihoods were reduced or lost. Decision-makers therefore need to be better informed regarding the range of biodiversity present, its conservation importance, and its role in livelihoods and ecosystem service values. The aim of integrated biodiversity assessment is to strengthen arguments for the conservation of wetlands and their ecosystems, habitats, species and services, through the provision of fuller information on wetland biodiversity and values. This toolkit presents methods to provide this information to decision-makers. Wetland communities are often highly dependent on biodiversity; for example, fishing often provides essential food and income. Such communities are also particularly vulnerable to factors outside their control, as activities far upstream or downstream can affect fish populations and flooding regimes (e.g. Abell *et al.* 2007).

Biodiversity assessment involves assessing what biodiversity is present within a wetland, its distribution (location) and in some cases its threat status (especially for endemic or highly utilized species), as well as information such as the degree of utilization, which allows linkages to be made to livelihoods and economics analysis.

Deciding what biodiversity to assess within the assessment area will be a key decision in the planning stages of an integrated wetland assessment: it will usually be impractical — for reasons of time, skills, and resources — to attempt to survey all biodiversity within a site. Instead, biodiversity survey effort should be informed by the biodiversity, livelihoods and economics literature review and perhaps the pilot study within the survey site. Survey effort could, for example, be focused on endemic species (those found only within the survey area – probably relevant only for vary large wetlands or for very range-restricted species), and on those species of high economic or livelihood value. In practice, we suggest limiting survey effort to a small number of taxonomic groups such as fishes, birds, molluscs, dragonflies and damselflies, and aquatic plants (see section B1.2 for more information) which are generally easily surveyed, well known, utilized and indicative of ecosystem condition.

### F5.3 The merits of integrated assessment from the economic valuation perspective

Economic valuation demonstrates and quantifies the value of the natural environment to human society, in particular here the value that wetland ecosystem services provide (Figure 9). Ecosystem products and other services have an objective importance within the local, regional, or national economy in the same way that for instance agricultural products from intensively managed terrestrial landscapes have. And, like agricultural production, wetland ecosystem services may be valued in

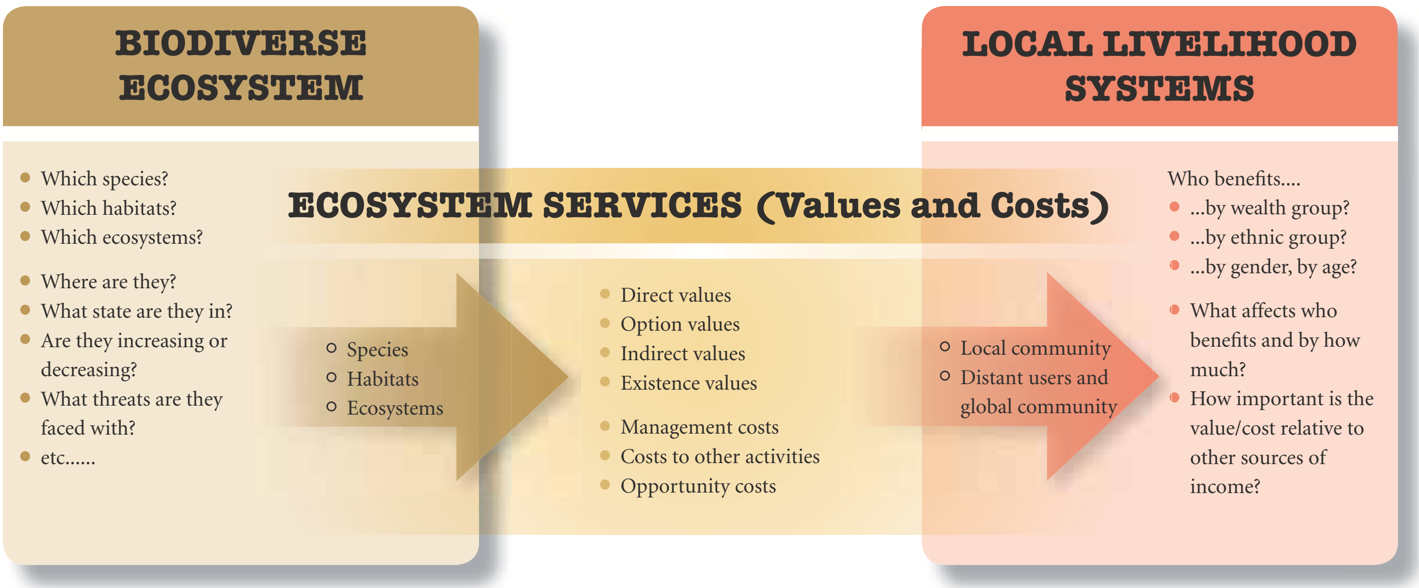



**Figure 9: Assessing the services ecosystems provide through economic valuations**

Gita Kasthala/Darwin Integrated Wetland Assessment Project

*Sampling for freshwater molluscs during the Mtanza-Msona assessment*

Kong Kim Sreng/Darwin Integrated Wetland Assessment Project

money terms. Yet, because many of the services are not traded, special methods are often needed to identify or estimate the values in money terms. Valuation has become increasingly important as it becomes recognised that not valuing the wide range of ecosystem services risks them being assumed to have no value.

A variety of methods can capture both the obvious values, such as the value of timber sold for export, and the hidden values, such as the water purification services provided by wetlands.

Integration is important because conventional valuation studies rarely tease out the *species composition* of the resources valued, nor do they often separate out *who* receives the value. Disaggregating biodiversity and livelihoods information can allow the incorporation of non-monetary values into a wetland assessment, such as the conservation value of particular species which may be locally or globally threatened, and the importance of natural resources to the poorest members of society, who often form the particular focus of development agendas.

### F5.4 The merits of integration from the livelihoods perspective

Wetland human communities are typically heavily dependent on the wetland resources present for their livelihoods, in terms of fisheries, irrigation water, and gathering of other wetland products. Changes in the quantity or quality of those wetland resources or in people's access to them may seriously affect people's livelihoods. The governance and institutional context of the wetland management is critical here for understanding the current status of the resource and any contests over its control, and for determining the possibility of influencing management and the capacity to implement improved management assessments.

Conventional livelihood analysis usually documents this natural resource use and the factors which affect access to resources, noting also local perceptions of change in resource availability and causes of those changes. This information can feed into development processes which may improve resources access and management, involving for instance facilitating institutions such as local fishing associations, which can report illegal harvesting activities or lobby against threats such as dams or prawn farms.

*Integrated assessment, involving gathering related biodiversity* information and *economic valuation* can add value to this process in a number of ways. Identifying the species which make up the resources may help to design more sustainable harvesting strategies, based on knowledge of life cycles and migration patterns. Species surveys will help to identify threatening processes, such as invasive species or diseases affecting harvested species, and identifying species' distributional ranges allows the management of individual species resources. Documenting the species present provides baseline data with which future changes in species can be compared; if local people notice that some species are disappearing, scientific evidence can be used to back this up. Additionally, threatened species can be used to enlist the support of conservation organisations, who may be able to offer advice, funding or political influence.

The main benefit of putting an economic value on resource use is that quantifying the value of resource use allows the financial benefits of proposed developments to be weighed up against the loss of income that may result.

Figure 10 shows the Sustainable Livelihoods Framework (adapted to take into account the need for more detailed information on biodiversity and its economic values.

This framework is described in more detail in section L2.

## Further reading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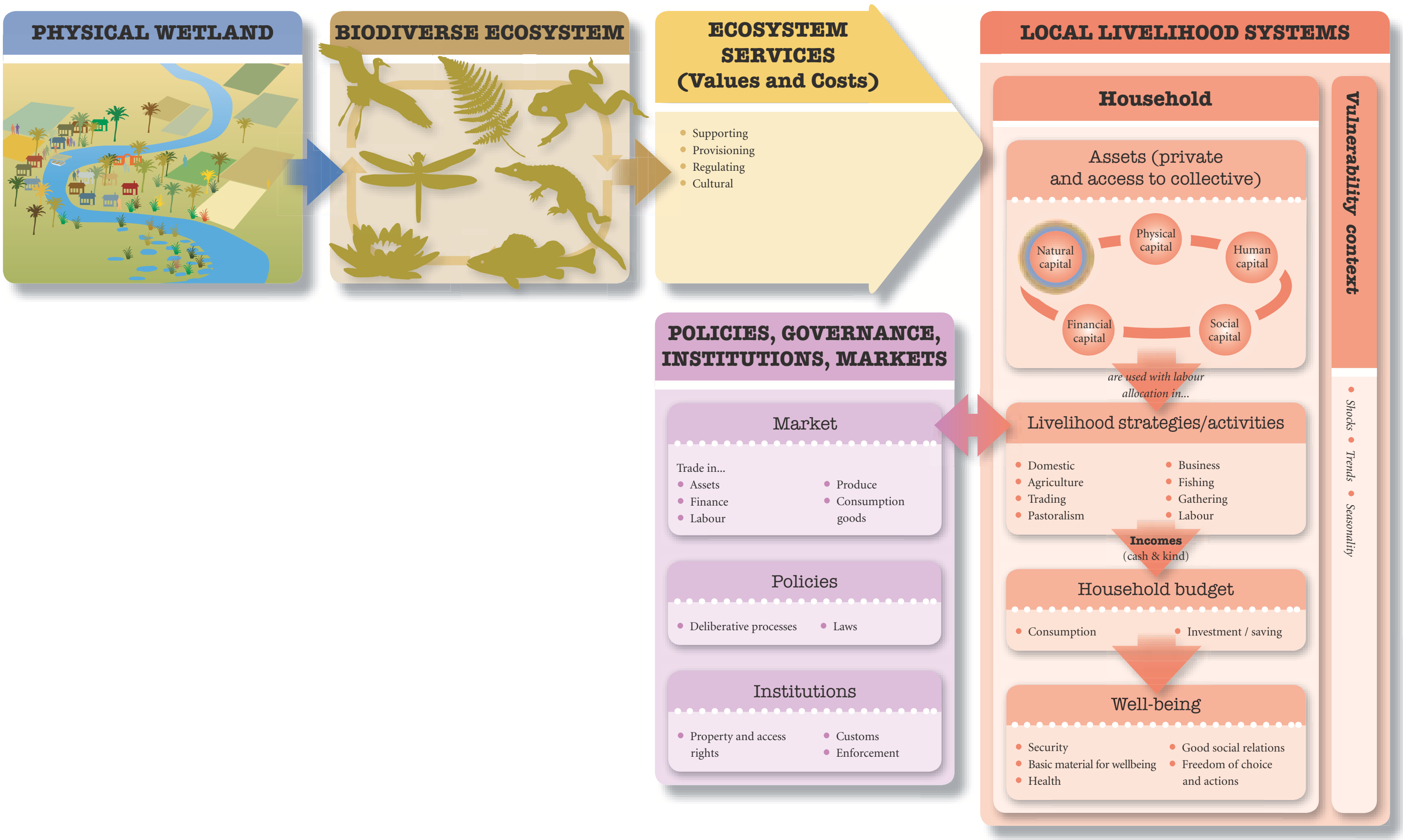


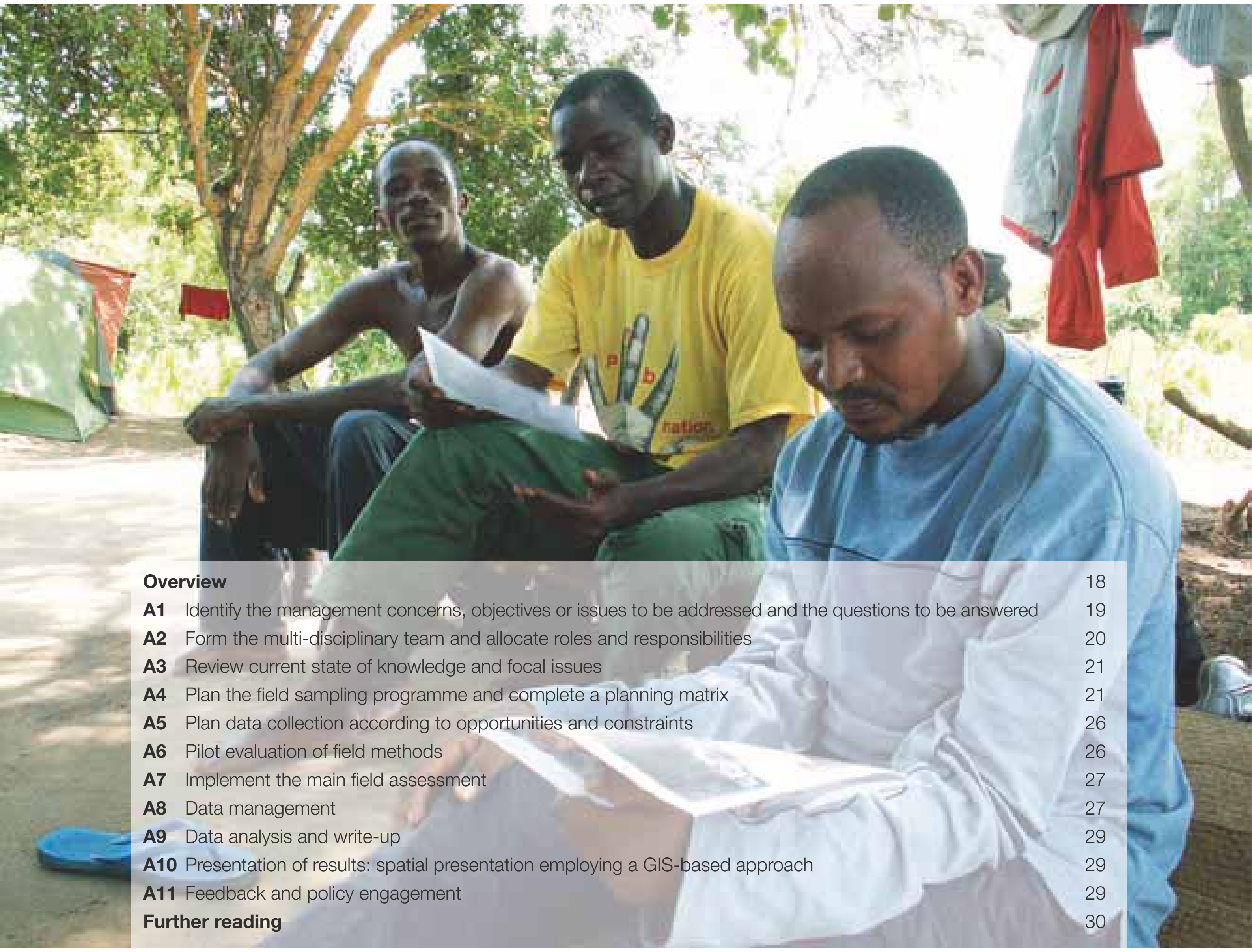

**Figure 10: Adapted Sustainable Livelihoods Framework illustrating how biodiversity and economic valuation information can contribute to improved understanding of local livelihood systems (after Springate-Baginski and Blaikie 2007)**

# Chapter 2

## How to conduct an integrated wetland assessment

*Oliver Springate-Baginski, Eddie Allison, Lucy Emerton, William Darwall and David Allen*

This chapter provides a 'how to' guide for practically applying the integrated approach to a wetland assessment. It separates the assessment activities into three stages (preparation; field assessment and analysis; presentation and engagement) and eleven component steps. It gives recommendations based on our experience of using the toolkit in the two case studies presented in Section III.





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## How to conduct an integrated wetland assessment

*This section discusses how to plan and implement an integrated assessment. It includes the following stages:*

- ✔ *Preparation, orientation, and planning*
- ✔ *Field data collection*
- ✔ *Analysis and presentation*

## Overview

Putting integrated assessment into practice presents many challenges; most people have specific technical skills and experience which apply to only part of the process. For integration to work, everyone in the field team needs to have an awareness of the whole process. This will involve expanding the boundaries of each person's own study discipline, feeding into areas with which they are not familiar, and receiving input from researchers in other areas who may not understand the rationale or constraints of their own area. While this is challenging, such integration presents many opportunities to learn about the wider context of conservation and development which may lead to new insights into the problems facing conservation and development initiatives. There are obvious overlaps between the approaches already used in the three research areas. The challenge here is to maximise the synergies between these approaches, while minimising the costs and complexities of carrying out assessments across such a broad range of expertise.

Below, we present an integrated approach to wetland assessment, in order to demonstrate how the different approaches can be combined, and the natural links between them. The process follows the general approach of an integrated assessment using an integrated survey team, as

### *BOX 3: INTEGRATION IN PRACTICE: CHALLENGES AND BENEFITS*

The three main elements of the assessment (biodiversity, economic valuation, and livelihood) need to be coordinated and harmonized at each stage to maximise the value-addition of the integration process.

**Challenges of integration:** *integration is difficult to achieve because of*

- Disciplinary boundaries and jargon – those working in one discipline may not appreciate or understand the value or relevance of work in another
- Practical challenges of bringing together people from different disciplines – it is difficult to organize!
- Lack of existing models and tools for integrated work

**Benefits and synergies:** *integration is worth the effort because*

- It provides a more complete valuation of a wetland than can be achieved through separate studies conducted under each of the respective disciplines
- It helps to identify and address any conflicts of interest between objectives pursued by individual disciplines
- It leads to more systematic fieldwork, optimizing investigators' time and reducing respondent fatigue

**Practical ways to do this include:**

- Team preparation and awareness raising: clarification of concepts and issues so that all members, no matter what their specific background, attain a basic understanding of the overall process and its conceptual basis
- Holding an integrated field trial exercise: to learn to work together and practise the integrated approach, exploring the same issues from the different perspectives
- Frequent team interaction and communication; regular sharing sessions within the team across the disciplines during fieldwork to develop insights

**Table 3: Stages of conducting the integrated assessment**

| STAGE | STEP |
|---|---|
| 1. Preparation orientation, and planning | A1. Identify the management concerns, objectives, or issues to be addressed and the questions to be answered |
| | A2. Form a multi-disciplinary team and allocate roles and responsibilities |
| | A3. Review current state of knowledge and focal issues |
| | A4. Plan the field sampling programme and complete a planning matrix |
| | A5. Plan data collection according to opportunities and constraints |
| 2. Conducting the field assessment | A6. Pilot evaluation of field methods |
| | A7. Implement the main field assessment |
| | A8. Manage data |
| 3. Analysis, presentation, and engagement | A9. Analyse data and write-up |
| | A10. Presentation of results: spatial presentation employing a GIS-based approach |
| | A11. Stakeholder feedback and policy engagement |

illustrated in Figure 5. Here, all parts of the assessment are integrated, including the definition of the management issue which the assessment will address, the planning stages, carrying out the fieldwork, data processing and analysis, and the reporting and presentation to decision-makers and management stakeholders. The stages of integrated assessment are summarised in Table 3 and discussed in more detail in sections A1 to A11. The challenges and benefits of such an approach are outlined in Box 3.

## A1 Identify the management concerns, objectives, or issues to be addressed and the questions to be answered

- *Serves to focus the assessment*
- *Involve multiple national, regional and local stakeholders through a preliminary workshop or scoping mission*
- *The management issue should itself be 'integrated' in the sense of encompassing both environmental and social issues*
- *From the general management issue develop more specific questions*

Before undertaking a wetland assessment it is important to understand the management context, and to clearly define the issues which will be addressed. If the management issues are not clarified, and understood by all, the assessment runs the risk of lacking focus and cohesion. It is critical at this initial stage to ensure the various stakeholders and managers are fully involved in discussions and in formulating the aims of the assessment. The management issue can then be used to generate specific questions as a focus for the assessment.

The management issue should account for both conservation and development concerns, and this should be clearly reflected in the wording (see Box 4). It is likely to address current threats to the wetland (see B10), such as changes in water level or flow due to upstream dams or water abstraction, problems with over-harvesting or destructive harvesting practices, or proposed developments with potential negative impacts on biodiversity and local livelihoods. The assessment planned to address these issues should aim to demonstrate the wetland's combined ecological and social values for the attention of decision-makers so that informed policy decisions can be made to reduce or mitigate any loss of value.

In many cases the conservation and development agendas may be complementary; for example, the safeguarding of a globally unique habitat type, such as a flooded forest, may also improve livelihood security by maintaining fish stocks which rely on the flooded forest for spawning or feeding grounds. However, in some cases the two agendas may be conflicting; for example, where a threatened fish species is an important food source but

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*Scoping workshop in Dar es Salaam to identify the key management issues for the Mtanza-Msona case study assessment*

### *BOX 4: EXAMPLE QUESTIONS FORMULATED THROUGH NON-INTEGRATED AND INTEGRATED APPROACHES*

**Single discipline management questions**

*Biodiversity Assessment*

- Which areas of wetland have the highest diversity of globally threatened resident and migrant bird species?
- Which areas of the wetland provide seasonally flooded habitats?

*Economic Valuation*

- What is the total economic value of birds harvested from the wetland?
- What would it cost to provide the flood-control services supplied 'for free' by riparian wetlands?

*Livelihoods Analysis*

- What role does bird-hunting play in household subsistence and income generation?
- How effectively do participatory institutions for wetland resource use represent the interests of the poor?

**Integrated management questions**

✔ In the face of plans for alternative use of the wetland, how can we comprehensively document the current value of wetland resources to livelihoods, highlighting the potential loss of biological and livelihood value if the development activities proceed unmitigated?

✔ How can the wetland harvest activities of the poor be regulated to maintain or enhance their contribution to livelihoods without threatening important species or damaging wetland functions?

✔ How can the trade in wetland products be sustained and organized to bring greater benefits to those who actually live in wetlands and depend on them for a livelihood?

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*The Mtanza-Msona integrated assessment team*

current harvests are not sustainable, or where the conservation agenda may be of little interest locally (e.g. the conservation of a river dolphin which does not contribute to local livelihoods in any way). In these cases, considerable effort will be required to find a solution which has clear benefits for local people while satisfying any external objectives such as the conservation of threatened species, or production of power for beneficiaries some distance from the wetland itself.

Clarification of the management issue and the definition of key questions is best achieved through conducting a scoping mission or preliminary workshop to consult with local stakeholders. Such activities may also provide opportunities to gain permissions to work in the area and to identify people with appropriate expertise to take part in the assessments.

## A2 Form a multi-disciplinary team and allocate roles and responsibilities

Overall, the team should aim to provide following fields of expertise:

- *biodiversity survey*
- *economic valuation*
- *livelihoods survey and participatory research methods*
- *possibly ethnobiological methods*
- *georeferencing and spatial mapping*

*A team leader should be appointed who has a general understanding and appreciation of all relevant disciplines.*

### A2.1 Composition of the project team

The team should include specialists in each of the three main disciplines of biodiversity survey and conservation, economic valuation of wetland resources, and assessment of sustainable livelihoods. A team leader should be appointed who has an understanding and appreciation for the values and objectives of each of these three main disciplines. People with such an interdisciplinary background may be hard to come by but one area of study which is already multidisciplinary in this way is ethnobiology (or ethnobotany, ethnoecology) – a suitable person may be drawn from this pool of expertise.

The team should also contain a balanced gender composition as far as possible. Including both women and men in the team is particularly important for household and group interviews.

### A2.2 Roles within the team

The team leader plays a key role in ensuring that the assessment is conducted in an integrated manner. This requires that all team members are very well briefed in advance on the wider objectives of the assessment and that they fully appreciate the value and relevance of all information input from other disciplines. The team leader will need to ensure that the field sampling programme and literature surveys are designed such that each team member knows to collect all relevant information in addition to that directly relating to their own fields of interest. For example, a visit to a local market may provide information relevant to biodiversity conservation (e.g. the species harvested and their harvest locations), economic valuation (e.g. the income derived from the species harvested), and value to local livelihoods (e.g. the importance of the species as a key source of nutrition). It is therefore essential that each team member is fully briefed to collect all relevant information as the opportunity arises – such opportunities will be easily lost without a thorough briefing prior to conducting the assessment. The focus of this approach is the training of all individuals within the team to recognise and collate information from across disciplines.

Alternatively, integration can be achieved through bringing together a team of individuals specialized in each of the relevant disciplines to work together on a survey – this will also serve to encourage understanding of each other's methods and to increase the amount of information that can be collected. For example, if an economist does a market survey alone they may not notice if the fish being sold are of a single species or a number of different species – such information may be critical to the management of that resource. If a biodiversity specialist is also present for the survey then they should note the diversity of species and the necessary samples can be taken for later identification. Collecting information in an integrated way allows the link to be made between the resource (species) and value, and through to livelihood aspects such as the wealth class, gender or ethnicity of the fishers.

Local people should also join the team as resource persons whenever possible. This can be of great benefit in gaining the trust of interviewees, and in gaining access to local knowledge on the location and use of wetland resources. The team should, however, be aware of any socio-political issues that may affect the quality of data collection. For example, if local power elites or protected area staff join the team they may intimidate local respondents or make them feel they must give the 'right' answer rather than the truth – and so affect the quality of the data. Sensitivity in dealing with this issue is most important.

## A3 Review current state of knowledge and focal issues

✔ *Identify and gather existing information*
✔ *Review information*

Before fieldwork commences a desk study should be conducted to collate all available relevant information from the existing literature. Sources of information will include published papers, 'grey literature' (e.g. project and government reports), and online databases (such as the IUCN Red List of Threatened Species™). Potential information sources to investigate include government departments, aid agencies, and conservation organisations. Local or national government agencies are a useful source for maps, census data and other government statistics. University staff can also provide very useful advice on sourcing relevant information.

Researchers must be well briefed to ensure they look for and capture all information of relevance to the management issue. This will require recognition and collation of information for all relevant disciplines beyond their own immediate fields of interest.

The literature survey will not only provide much information of relevance to the management issue but will serve to identify information gaps as a focus for the subsequent field assessment, and may additionally identify new issues for inclusion within the field assessment.

The literature survey should also normally aim to identify the current and predicted future threats to the wetland site in question. Given the potential for both upstream and downstream impacts on the site, this may therefore require the geographic focus of the literature survey to extend beyond the wetland site itself to include information for the wider catchment.

Key information and potential information sources may include:

- Trade and value of wetland species or species products: CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora; www.cites.org); wetland livelihoods reports (e.g. www.wetlands.org or www.worldfishcenter.org), FAO (The Food and Agriculture Organization of the United Nations; www.fao.org)
- Wealth/Poverty status: National/District census data, livelihoods reports, health statistics (from health organization) or studies from NGOs or medical centres in the area, World Health Organisation

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*Project planning workshop for the Mtanza-Msona case study*

- Maps: Government mapping agencies, aerial photography companies, NGOs (see M2 and M3)
- Species information: IUCN Red List, local and international conservation NGOs, universities, local wildlife societies

### A3.1 Review information from the literature

On completing the literature survey, the team members need to meet to review the information collated. This allows key information gaps to be identified BEFORE planning the field assessment.

## A4 Plan the field sampling programme and complete a planning matrix

This step involves:

- *defining the geographic boundary for the survey*
- *defining a temporal boundary for the survey*
- *selecting species groups to survey*
- *identifying the wetland values to quantify*
- *defining the socio-economic boundaries – which groups to interview*
- *completing a planning matrix*

### A4.1 Identify which wetland values are priorities to quantify

There is a subset of cross-cutting information relevant to biodiversity conservation, economic valuation, and assessment of livelihoods (Figure 11). A particular management issue will relate to a different subset of the information, including some pure biodiversity information (e.g. a list of species present and

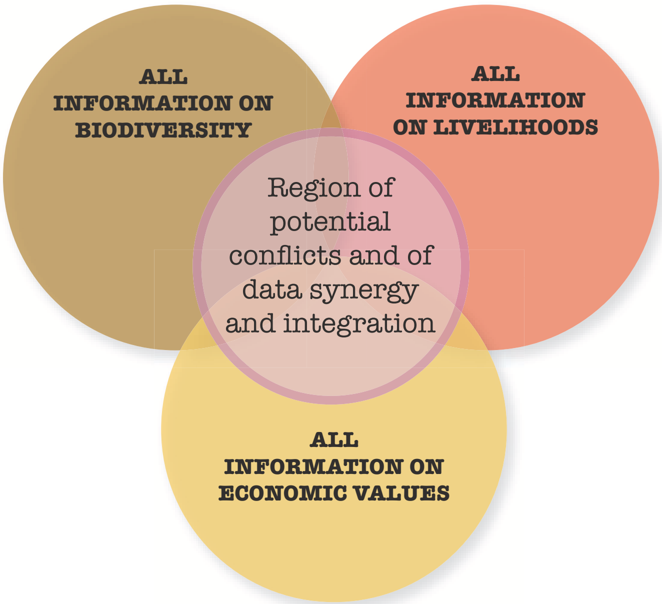


**Figure 11: The economic valuation and biodiversity and livelihood assessment information sets. The region of overlap illustrates where the objectives of biodiversity conservation and of economic and livelihoods development policy potentially conflict, but also where there are benefits and synergies from the integrated assessment approach**

**_BOX 5: WHY ALL BIODIVERSITY AND LIVELIHOODS INFORMATION MAY BE RELEVANT TO AN INTEGRATED STUDY_**

While biodiversity forms the basis of a household's natural capital, it is nevertheless also important to consider other forms of capital that the household possesses, such as financial and physical capital, both to understand the relative importance of natural capital to the household, and because these other forms of capital may influence the ability of households to benefit from the natural capital (e.g. physical capital such as nets and traps are needed to capture fish and crabs).

Likewise while households may benefit directly from fish, crabs and molluscs by eating or selling them, other species groups also need to be assessed to contribute to our understanding of the ecosystem's health and threats to the ecosystem; certain indicator groups, such as dragonflies and molluscs, can be useful in doing this, although they may have little direct relevance to livelihoods

their conservation status), some pure livelihoods information (e.g. a list of the ethnic groups present), and information which bridges the disciplines such as information on the value of biodiversity to livelihoods (also see Box 5).

At this stage of the planning process, the team needs to decide which subset of information to collect. This needs to be determined in an integrated way, involving researchers from the different subject areas, with a strong focus on identifying the links between the various information sets. Figure 12 shows the main types of information likely to be required by any integrated study, and the more obvious links between them.

### A4.2 Defining the assessment boundaries

This step involves defining the extent of the study, based on feasibility, budget, timetable, expertise, and natural, political, and social constraints (to name a few). It will result in a conceptual demarcation of the physical location(s) and socio-economic group(s) on which the study will focus.

### A4.3 Defining the geographic boundary

The study area itself should be clearly defined. Examples of wetland areas that could be a focus for study might include: the resource-use areas of a village or district; a wetland conservation site or protected area (e.g. a Ramsar Site or National Park); an ecologically defined area, such as a floodplain, estuary, or the catchment of a river or tributary; or an area containing a species or habitat of particular conservation or livelihood interest. Wetland boundaries are often fluid, and may vary between seasons and over time – it is therefore important to agree and map the exact boundary for the area on which the study will focus. The majority of the primary data will be collected within this boundary.

In almost all cases there will, however, be a need to collate secondary information from an area which extends beyond the boundaries of the core assessment area. For example, due to the high degree of connectivity within and between wetland systems, threats to a wetland site are likely to come from activities both upstream and downstream and sometimes distant from the wetland itself. In addition, secondary information may be available only on a large scale; for example, species information may be available for the entire river catchment or country only, and census information may be available at the district or regional level. Finally, in certain cases primary data collection may need to extend beyond the core assessment area, such as when people come from outside the immediate area to use the wetland resources at certain times of year, or where wetland resources are traded outside the assessment area.

### A4.4 Defining the temporal boundary

Information collated for a single point in time may not be sufficient to answer many of the key questions for the assessment. For example, if the management issue is livelihood security which happens to be highly dependent upon a seasonal resource, such as migratory fish species, then the assessment should aim

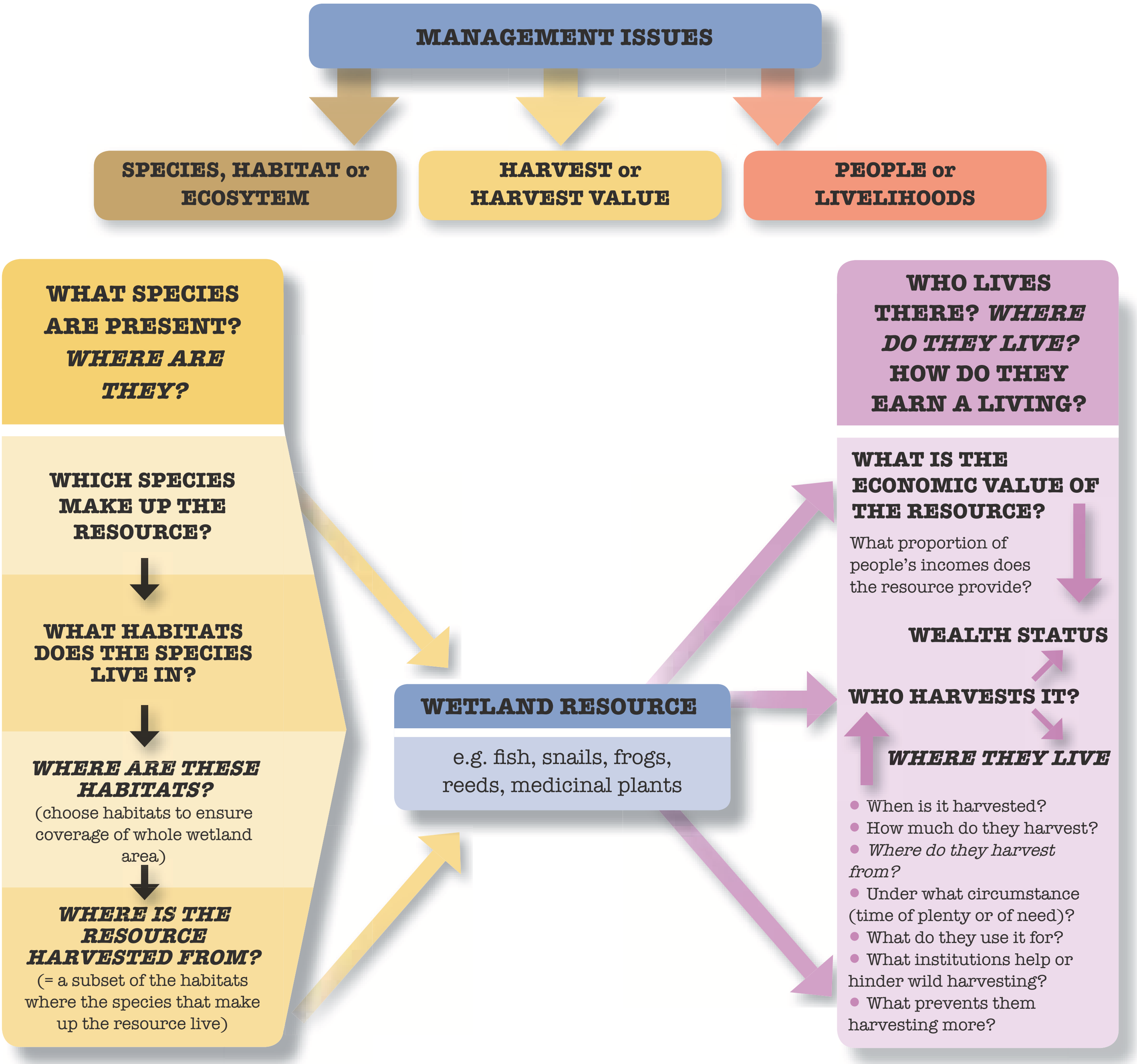


**Figure 12: The main information required as part of an integrated assessment, using wetland resources to link between species and livelihoods information, and highlighting the spatial information components (shown in italics)**

to cover a complete annual cycle. As most tropical wetlands experience seasonal differences in water level and flow, with subsequent effects on wetland resource use, the study period should usually aim to include both a dry season and a wet season assessment. In cases where it is not possible to visit the site in both seasons effort should be made to ask respondents how their livelihood activities, resource availability, and resource use change seasonally. Many species of birds and fish, for example, are migratory, and the timing of biodiversity survey will be important.

### A4.5 Selecting species groups to survey

It is not practical to survey all species within a wetland site so we advocate an approach in which a subset of species is assessed to provide a representative cross-section of the main components of a functioning wetland ecosystem. Selected species groups should aim to include those that are directly utilized, such as fish, as well as those with less obvious direct uses but which are nonetheless essential to the maintenance of a healthy functioning wetland ecosystem.

The species groups selected should be easy to identify and supported by a reasonable level of pre-existing information. We recommend: fin fishes; shell fishes (molluscs); dragonflies and damselflies; crabs and crayfish; frogs and toads; reptiles; birds; mammals; and selected aquatic plants. Given the wide range of trophic levels and ecological roles encompassed within these species groups, it is proposed that information on their distributions and conservation status, when combined, will be sufficient to provide a useful indication for the overall health of the associated wetland ecosystems.

### A4.6 Define the socio-economic boundary

Wetlands typically generate benefits for many stakeholders, both on- and off-site, and the human populations which receive these benefits or impact on wetlands may also vary between seasons or over time. It is therefore important to delineate the populations, stakeholders, and levels of scale that the assessment will focus on, and to have a thorough understanding of the policy, institutional and socio-economic context in which the wetland under study is being managed and utilized. This toolkit places an emphasis on the poorest members of wetland communities, and the socio-economic boundaries should be chosen taking this into account (for example, this might mean paying particular attention to seasonal migrants).

### A4.7 Identify which wetland values to quantify

Wetlands yield multiple goods and services and may also impart economic costs (e.g. as possible sources of disease). These costs and benefits may be direct and readily valued (e.g. provision of building materials) or indirect and difficult to value (e.g. purification of drinking water). Ideally all relevant costs and benefits should be valued in order to present a broad overview of the economic stocks and flows associated with the wetland (see Figure 51: Checklist #1). In reality only a subset of these may be valued, and these should be chosen on the basis of their relevance to the management issue (see Figure 52: Checklist #2). It is therefore most important to appreciate, and to make absolutely clear in the final report, that the wetland valuation undertaken is sure to underestimate the full benefit of maintaining that wetland as a healthy functioning ecosystem. Proposed alternative uses of the wetland may therefore, in some cases, appear to offer greater economic benefit than provided through preserving the wetland when the contrary may be true.

### A4.8 Complete a data collection planning matrix

The completion of a data collection planning matrix (Table 4 filled out for illustration, and a blank matrix is included in the Appendix) is a critical part of the assessment integration process. The objective is to ensure that all relevant information is collected through the minimum survey effort thus avoiding multiple time-consuming and expensive surveys being conducted at the same site when a well planned integrated assessment could have achieved the same result through a single visit. In this way the information returns from a single survey are maximised and we avoid the need for multiple surveys focused on collection of discipline-specific, and consequently restricted, information. For example, information on species' diversity, economic value, and importance to livelihoods may *all* be obtained during a single *integrated* survey, such as to a market, if the appropriate planning is carried out in advance. Survey returns can be maximised in this way through employing an integrated survey team composed of several experts from across the relevant disciplines, or though training a single surveyor in the full range of information required and on the methods required to obtain that information.

In order to maximise the information yield an integrated survey can be designed through completing a planning matrix (Table 4) as follows:

A) **The *management issue* being addressed is clearly defined in Box ❶ of the planning matrix.** This provides the starting point for determining the full range of information types required to address the management issue. For example, if the issue is very specific then the required survey information will likely be restricted to collation of only a few information types. If the issue is broader, such as a requirement to demonstrate the full value (direct and indirect) of a wetland, then the survey will need to collate a wider range of information using a greater number of survey methodologies.

B) All **data types required** to address the management issue are identified. A check mark (✗) is put against each of the '*Required data types'* in Box ❷. Please note — The data types shown are drawn from the Species Information Service database (SIS; see A8) and are the key data required to assess the conservation status of a species using the IUCN Red List Criteria; only a small subset of the potential range of data types are currently shown — any additional data types will need to be added as required for each specific assessment.

C) The range of **appropriate survey methods** is identified and the relevant methods can then be selected from Section II of this toolkit (or found elsewhere if necessary). Under each of the survey methods listed in Box ❸ a check mark is put against each of the required data types that can be collected using that particular survey method. For example, if species common names are identified in Box ❷ as being required you would put a check mark in each column under the survey methods through which this information could be obtained. For example the demonstration matrix in Table 4 shows that information on *species common names* might be obtained through i) market surveys, ii) biodiversity assessments, iii) focus group interviews, and iv) literature survey.

**Table 4: Assessment planning matrix**

❶ ***Specify management issue*** **being addressed (or purpose of assessment):**

e.g. *"How will a ban on resource harvesting (to meet objectives of biodiversity conservation) impact on local livelihoods?"*

❷ **Identify required *data types:***
Basic data requirements for an integrated assessment
- *select those required to answer the management issue in question*
- *add in any new data type needed*

❸ ***Select appropriate survey methods:***
*(see Section II for methods)*

| | ***Required data types*** | Household questionnaire | Market surveys | Biodiversity assessments | Focus group interviews | Key informant interviews | Wealth ranking | National/District data | Literature survey | Other Method… |
|---|---|---|---|---|---|---|---|---|---|---|
| | | E1–E6, L4–L9, L12–L13 | B9 | B1– B11 | L6, L7, L12, L11 | L12 | L9 | L5 | A3 | |
| **Species status and distribution** | ✗ ➔ | | ✗ | ✗ | ✗ | | | | ✗ | |
| **Habitat quality/ecosystem status?** | | | | | | | | | | |
| **Species common names** | ✗ ➔ | | ✗ | ✗ | ✗ | | | | ✗ | |
| **Drivers of threats** | | | | | | | | | | |
| **Socio-economic status of target communities** | | | | | | | | | | |
| **Access rights to resource** | | | | | | | | | | |
| **Resource use** | ✗ ➔ | | ✗ | | ✗ | ✗ | | | ✗ | |
| **Value to livelihoods** | | | | | | | | | | |
| **Economic value of ecosystem services (and disservices)** | ✗ ➔ | | | | | | ✗ | | ✗ | |
| … | | | | | | | | | | |

Once the matrix has been completed it should become clear which types of information should be recorded when undertaking each type of survey. For example, before undertaking a market survey the researcher can look down the relevant column under 'Market Survey' in Box ❷ of the planning matrix and see the full range of relevant information types they need to collect – these will be the ones with check marks against them. In the example matrix in Table 4 you will see that a market survey can be used to provide information on i) species status and distribution, ii) resource use, iii) value to livelihoods, and iv) species common names.

The end product is the planning framework for an integrated assessment where the planning matrix, once completed, provides guidance on the full range of information that can be obtained through each survey method. This approach minimises the need for additional researchers (from the other disciplines) to revisit the same informants at a later date to gather additional information – it saves time and money, reduces interviewee fatigue, and ensures data are collected in a common format which can be integrated across disciplines as the data are linked at source.

### A4.9 Linking information

A significant difficulty encountered when integrating the findings from independently executed surveys is in linking the different sets of information for analysis. An integrated assessment aims to ensure the relevant information is collected in a format that will allow the data to be linked and analysed. The following provide examples of links (➔) between different types of data:

1. **Uses of natural resources ➔ identification of the species making up the resource**
   To link socio-economic information to biodiversity information, it is necessary to identify the component species of the resource when it is identified during work on economic valuation or livelihoods assessment. This requires socio-economic researchers to ask which species (using local names) people are referring to when they talk about

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*The combined biology, livelihoods, and economic assessment team at the Stung Treng Ramsar site*

resources, and for biodiversity specialists to match local names to the Latin names of species (or to specimens which can be identified later)[1]

2. **Natural resource harvest locations ➔ species found in those habitats**
   Local harvest locations should be georeferenced using a Global Positional System (GPS) unit so that they can be mapped and cross-referenced to the habitats which have been surveyed by the biodiversity specialists (see Chapter 3)

3. **Uses of natural resources ➔ user groups relying on those resources**
   When biodiversity surveys or economic valuations provide information on who harvests or uses resources and when, the researchers also need to be aware of distinctions which the livelihoods team are interested in making, such as differences in ethnicity, gender, age, household size, home location, and migration patterns of the user groups, and when the resource is important according to season, income, health or state of need. Again this may be achieved if the biodiversity or economics researchers pass on information about the species which are harvested (with their local names) to the livelihoods team so they can bring that information into their own surveys, focus group meetings or key informant interviews

## A5 Plan data collection according to opportunities and constraints

✔ *Develop logistics for the field survey*
✔ *Produce assessment timelines*

Many factors will influence the content and timing of the field assessment. These are likely to include:

- *Time (deadlines, other obligations)*
- *Funding (budget and financial reporting deadlines)*
- *Expertise (skills and experience of team)*
- *Resources (transport, field equipment, computers and software)*
- *Politics (permits, permissions, access, conflicts)*
- *Institutional structures (networks, capacity, relationships)*
- *Social and cultural considerations (festivals, languages, customs)*
- *Natural events (seasonal factors and risks)*

These issues need to be considered during the early planning phases of the assessment and should be discussed and reviewed with local people and other stakeholders during an early scoping trip to the area. Seasonal issues such as access to sampling sites must be discussed and planned for.

## A6 Pilot evaluation of field methods

✔ *Develop and adapt integrated field tools*
✔ *Train the survey team*
✔ *Develop team understanding of the multidisciplinary approach*

A short pilot survey prior to initiation of the main field survey is essential. The pilot serves a number of purposes the most important of which is to help team members fully understand the objectives and field methods employed by the other members of the team. All team members should be encouraged to explain what information they are interesting in collecting and why it has relevance to the wider goals of the assessment. This pilot survey is the time when all team members should be encouraged to ask questions on any aspects of the work with which they are not familiar. This process is essential to success in building an integrated team with a joint understanding and purpose.

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*The Stung Treng Ramsar site biology team visits a fish trap during the initial biology survey*

*David Allen/Darwin Integrated Wetland Assessment Project*

*A focus group meeting held in Mtanza-Msona during the integrated wetland assessment*

The pilot survey should involve a brief initial trial period (ideally at least one or two days), either at a local wetland site or (preferably) at the assessment site itself, during which the team can practise applying the assessment methods and get used to working together. Added benefits from the pilot survey include:

- opportunity for team members to discuss the assessment objectives and to ensure all are in agreement - adapting plans will be much easier at this early stage
- identification and solving of unforeseen logistical issues
- opportunity for fine tuning of survey methodologies
- development of team spirit – working together for the first time as a multi-disciplinary team will undoubtedly be challenging
- if held at the assessment site, opportunity for the assessment team to familiarize themselves with the area and confirm the accuracy of maps, and to meet local communities and stakeholders.

## A7 Implement the main field assessment

✔ *Maintain field team networking and communication through daily meetings*
✔ *Maintain rapport with respondents based on mutual respect*
✔ *Observe research ethics*
✔ *Review the data emerging, identify any gaps, and amend fieldwork approach if required*

A detailed field survey plan should have been developed at this point and the survey team will have been assembled and have worked together during the pilot survey. The local residents should have been consulted and fully understand and agree with the purpose of the study, and be willing to facilitate and participate in the work. All necessary permissions should have been obtained.

A successful survey will benefit greatly from daily team meetings. The focus of these meetings might include:

- discussion of the day's findings and experiences
- planning and clarifying the next day's work
- collation, tracking and storage of information obtained by the various team members
- discussion and proposal of solutions to any problems that may have arisen
- ensuring that all essential linking information is being collected

The collection of linking data is most important. For example, local names of natural resources, as collected using socio-economic methods, should be linked to any samples or photographs of species collected through biodiversity surveys. Species common names can then be matched with scientific names and the findings of the biodiversity and socio-economic surveys can be linked and analysed as one. Likewise it is essential to ensure that habitats named as areas of resource harvesting can be matched to those habitats surveyed for species' composition. This is achieved through georeferencing of all survey areas using GPS equipment (see Chapter 6 for more information on mapping requirements).

These daily meetings will undoubtedly place an extra burden on the team, and therefore need to be kept brief and relevant to the work of the whole team. The importance of these meetings needs to be emphasised to all team members at the start of the survey to encourage their participation. As the team members get to know each other better on an informal level much can be discussed over dinner, although a short formal meeting will be necessary to plan the next day's work.

An ethical approach to research must be followed and the ground rules should be made clear to all team members before beginning the surveys. Although this is a complex area, at core this means clearly explaining to respondents why you are collecting data, what you will do with the data, respecting their right to anonymity, and not representing or sharing data gathered without their prior informed consent.

## A8 Data management

✔ *Good practice in data management*
✔ *Data storage and management options – IUCN Species Information Service (SIS)*

Good practice in data collection, storage, and management must be observed. Serious consideration should be given to obtaining access to a laptop computer and power supply during the field survey to ensure data are managed and backed up effectively. Some key practices include:

- customising data collection sheets for local use during the pilot survey
- assigning and clearly defining data management responsibilities
- daily checking of data sheets – this should not be left to the end of the survey
- regular write-up of field notes while fresh in the collector's mind
- early identification of information gaps in sufficient time to address them during the survey
- translation of data into the reporting language as necessary should ideally be completed with the interviewer in order that nuances in meaning are captured
- data should be entered as early as possible into a standardized database (for example, the IUCN SIS database), in open-source (free) software such as OpenOffice Base or Calc (see www.openoffice.org), or in suitable products such as Microsoft Access or Excel
- data should be backed up as often as practical (at least daily during the data-entry period)

As highlighted above (e.g. see *A4.9*) it is important to compile and store the data in a way which recognises the links between the different types of data, and facilitates integrated data analysis. One tool which can help to do this is SIS (http://sis.iucnsis.org) which has been designed to link data on species conservation, threats, ecology, utilisation and livelihoods values through the species scientific name.

The SIS data management system is now discussed in more detail as one example of a potentially useful tool for storing and managing information sets as would be generated through an integrated wetland assessment.

### A8.1 Data management using SIS

SIS is designed for both web-based use (restricted to registered users with access to the IUCN Red List database), and as a standalone version. The standalone version can be downloaded from http://sis.iucnsis.org. SIS does not hold georeference (spatial) data, so this information will need to be held and managed in a separate spreadsheet or database for later export into a Geographic Information System (GIS) package such as ArcView or ArcGIS. At present the SIS database is strongly focused on collation of data on species ecology, threats, conservation status, and utilization. The modules for storing information on the species' value to livelihoods are still quite limited and mainly serve to highlight those species of value to livelihoods as future subjects for additional, more detailed, livelihoods assessment. Nevertheless, this database represents a tool that does effectively integrate information on biodiversity, economic, and livelihoods values.

The major types of data linked to each species scientific name in SIS include:

- **Taxonomy:** this module holds information on the taxonomy of a species (i.e. Kingdom, Phylum, Class, Genus and Species). This information will be sourced during the literature survey. Also included are species common names which enables information from biodiversity surveys (where scientific names may be used) to be directly linked with data collected through socio-economic surveys (where species common names might be recorded)
- **General Information:** this includes a number of sub-sections, and would largely be completed where possible using published literature. All information should be referenced to source documents (papers, books) or to the experts who provided the information. Information can be input for:
    - ***Distribution:*** a general description of the species' geographic distribution
    - ***Population***: information on a species population size
    - ***Habitat and Ecology***: short notes describing a species' ecological requirements
    - ***Major Threats***: known and predicted threats to the species, in order of importance
    - ***Conservation Measures***: conservation measures that are either in place or are recommended
- **Extent of Occurrence:** a basic electronic map can be created to show the estimated distribution range of the species
- **Countries of Occurrence:** Country names are selected to indicate where a species is native, extinct, reintroduced, introduced or vagrant.
- **Habitat Preferences:** a species' preferred habitats can be selected from a list of options
- **Major Threats:** the major threats (past, present, and future) to the species can be selected from a list of options
- **Conservation Measures:** this provides a list of possible conservation measures which can be selected as 'in place' or 'needed'
- **Ecosystem Services:** the main ecosystem services associated with the species can be selected from a list of options and ranked by perceived importance. The geographic reach of the service benefits can also be indicated as local, national, regional, or global
- **Utilization:** human utilization of a species is recorded here. Information on the purpose or type of use (food, fuel etc,) is recorded as of importance at the subsistence, national, or international level. The primary forms removed from the wild are recorded along with the source of specimens (the wild, farmed etc)
- **Livelihood Value:** this section is designed to hold general livelihoods information collected by non-experts, as well as more detailed case study data; such as might be collected through an integrated wetland assessment. The section requires information on the quantity of a species that is

harvested, its monetary value, what products are made from it, who are the main users, and how much it contributes to people's livelihoods. It is possible to enter information for one or more products derived from the same species

- **Red List Assessment:** the risk of extinction for a species is recorded and the rationale is documented according to the IUCN Red List Categories and Criteria

The information stored in the SIS database will, for example, allow you, for a designated wetland which has been subject to an integrated assessment, to list and locate all threatened species in the wetland that are of economic value and of importance to local livelihoods.

*Kong Kim Sreng/Darwin Integrated Wetland Assessment Project*

## A9 Data analysis and write-up

✔ *The importance of linking data elements*
✔ *The benefits of spatial analyses*

The absolute importance in linking all aspects of the data through a common data element, in this case recommended to be the species scientific name, becomes very clear at the stage of data analysis. If the appropriate spatial and temporal links have also been established then the data can be analysed in a truly integrated manner. For example, correctly linked data would enable analyses to determine, for a specified lake: i) the conservation importance of the lake in terms of threatened species present; ii) the market value of species harvested from the lake; and iii) the sector of the local community most dependent upon those species. Potential conflicts of interest might also then be identified if, for example, harvesting levels are thought to be threatening the long-term survival of a threatened species, and solutions might be sought. Without the ability to identify species valued at the market place as threatened species (e.g. through linking common and scientific names), and to link the market survey data to the harvest location and species importance to local livelihoods, such integrated analyses would not be possible. Spatial analyses then provide great potential for identifying areas of potential conflict of interest and areas of importance to species conservation and local livelihoods. The spatial methodologies are dealt with in some detail in Chapter 6.

## A10 Presentation of results: spatial presentation employing a GIS-based approach

Decision-makers, whether in conservation or development sectors, are primarily concerned with choosing between different uses of land, funds, and other resources. For example, decisions might be required to: i) manage a wetland under strict protection or to allow for some form of sustainable use; ii) build a dam, irrigation scheme, or housing estate; iii) determine which infrastructure design option to invest in; or iv) zone a wetland for conservation or convert it to settlement or agriculture (assessing damage to a wetland). The assessment results need to be presented in ways that make sense to decision-makers, to help them weigh up the different funding, land, and resource management choices that wetland decisions involve. Spatial mapping provides a very powerful tool for presenting such complex information in a relatively simple manner.

Spatial mapping tools allow the visual presentation of information from across disciplines. The overall aim is to overlay a series of maps (or 'layers') to identify, for example, areas where conservation and development issues require priority action, and/or face conflicts of interest. This can be achieved using GIS technology.

Overlay maps might include information such as species' distributions, resource use areas, the value of resources, and where the people live who benefit. All this information can be presented on a single map in order to highlight those areas where biodiversity provides an essential resource to local communities, and particularly to the poorest members of those communities. The maps shown in Chapter 6 demonstrate how this might be achieved.

## A11 Feedback and policy engagement

An assessment alone will not have the desired impacts. To ensure that the assessment effectively informs policy and practice it is important that key stakeholders are engaged from the outset, and that the findings are promoted in a manner likely to ensure they are acted upon. This requires that the assessment outputs are presented at both local and national meetings/workshops where ample opportunity is provided for a constructive dialogue between all stakeholders and policy-makers. For this to be effective it is important that project outputs are translated into the local

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*A workshop held for key stakeholders in the management planning process for the Stung Treng Ramsar site*

language. The main project findings should be presented both in detail, as technical reports, and as policy briefs where the main findings and recommendations are summarised.

### A11.1 Local feedback

As soon as fieldwork is completed the field team should reflect upon and develop the initial findings. The initial findings can then be shared with the local stakeholders in a workshop, particularly involving the local people who have participated in and contributed time to the study. Local stakeholders can then determine how the assessment findings might be employed to address the management issue.

### A11.2 National feedback

The development of national wetland-related policy is likely to be a continuously evolving process in any country, as different organizations, interest groups and arms of the government seek to influence policy, management, and use of wetlands. If the assessment process is to successfully contribute to improved wetlands conservation and management, the team will need to understand the current status of the policy process in order to identify how best to constructively engage. Engagement through national dialogue at workshops, and through presentation of project findings both as detailed technical reports and as policy briefs, will help to facilitate understanding and progress in moving forward on addressing the management issue.

The wetland assessment team should maintain an ongoing engagement with the key stakeholders throughout the assessment to ensure that the study remains focused on the main policy related issues, that stakeholders' views are taken into account, and that stakeholders at all levels develop a sense of participation and even co-ownership of the findings.

### Further reading


Atkinson, P., Coffey, A., Delamont, S. Lofland, J. and Lofland, L. 2001. *Handbook of Ethnography*. Sage, London, UK.

Brown, N., Boulton, M., Lewis, G. and Webster, A. 2004. *Social Science Research Ethics in Developing Countries and Contexts'.* ESRC Research Ethics Framework Discussion Paper 3 (v2), Department of Sociology, University of York and School of Social Studies and Law, Oxford Brookes University, Oxford, UK. Available at: www.york.ac.uk/res/ref/docs/REFpaper3_v2.pdf

De Laine, M. 2000. *Fieldwork, participation and practice: ethics and dilemmas in qualitative research*, Sage, London, UK.

Mauthner, M., Birth, M., Jessop, J. and Miller, T. 2002. *Ethics in Qualitative Research*. Sage, London, UK.

Scheyvens, R. and Storey, S. 2003. *Development Fieldwork: A practical guide.* Sage, London, UK.


### Useful links

- British Sociological Association: www.britsoc.org.uk/about/ethic.htm
- British Psychological Society: www.bps.org.uk/about/rules5.cfm
- Social Research Association, Ethical Guidelines 2003: www.the-sra.org.uk/ethics03.pdf
- Association of Social Anthropologists of the Commonwealth: www.asa.anthropology.ac.uk/ethics2.html
- OpenOffice.org open source software: www.OpenOffice.org
- IUCN Red List database: www.iucnredlist.org
- IUCN Species Information Service: http://sis.iucnsis.org

[1] In some cases it may be acceptable to work with morphospecies, either as identified by local people or by researchers who do not have access to suitable taxonomic keys or identification experts. In this case, rigorous survey methods can still be applied to mapping these species and assessing their conservation status. However local names may not have a 1:1 relationship with species as recognised by taxonomists: some species may be grouped under one local name, while others may be split. See B12 for a discussion of alternative methods of biodiversity assessment.



# Chapter 3

## Biodiversity assessment tools

*David Allen, Anna McIvor and William Darwall*

Species are the components of ecosystems, and their use underpins many rural livelihoods. This chapter gives practical guidelines and approaches for sampling biodiversity presence and abundance within freshwater wetlands. It presents survey methods for some key freshwater taxa (including fish, plants, molluscs, and dragonflies).



*David Allen/Darwin Integrated Wetland Assessment Project*

## 3 Biodiversity assessment tools

*This section presents the biodiversity assessment tools. It includes:*

- ✔ *An overview of the need for biodiversity assessment, and the methods used*
- ✔ *Guidance on planning and conducting biodiversity surveys*
- ✔ *Species-specific biodiversity sampling methods*
- ✔ *Assessment of threats and conservation status of freshwater species and ecosystems*
- ✔ *Alternative methods for biodiversity assessment*

*For collecting information on physical wetland characteristics we recommend an initial literature review is used to swiftly gather contextual information.*

*The physical wetland characteristics set the context for the habitats, ecosystem services, species and livelihoods that we will assess through an integrated wetland assessment.*

- ✔ *What are the conditions that sustain the wetland ecosystem?*
- ✔ *How do species, ecosystems and livelihood strategies depend on physical characteristics?*
- ✔ *What threats, such as global climate change or hydrological disturbance, impact upon the sustainability of the system?*

*In order to understand the habitat for wetland ecosystems, general contextual data are needed on the following issues relating to the study site:*

- *Topography (river basin) and geology (e.g. geological strata and soil types)*
- *Climate and climate cycles*
- *Hydrological regime – seasonal flows and hydrology*
- *Sedimentation*
- *Vegetation types*

*Data can be collated during the preliminary literature review stage of the assessment. Although detailed data may not be available for a particular assessment area, it will usually be available for river basins or at other sub-national scales from government departments or universities.*

## B1 Overview

### B1.1 Background: why assess the status and distribution of biodiversity?

'Biodiversity' refers to the diversity of species of plants and animals on Earth. The term 'biodiversity', which did not come into common usage until the late 1980s (Wilson 1989), includes all genes, species, and ecosystems, and the ecological processes of which they are a part (Gaston 1996). Species are often taken as the unit upon which assessments of the status of biodiversity are made. They have come to be used as the common currency to express biodiversity. Data for species status (such as the IUCN Red List of Threatened Species) tend to be more readily available on the global scale, especially for those more charismatic taxa. Ecosystems may also be used as a measure of biodiversity but, in particular for wetland systems, they remain poorly classified and mapped.

Wetland biodiversity provides enormous direct and indirect benefits to people. Provisioning services from wetlands, such as nutrition (notably fish) and fibre are essential for human well-being. Inland fisheries in developing countries often provide the primary source of animal protein for rural communities as well as a vital source of income in many cases, and flood plains provide important grazing for many pastoralists. Supporting and regulating services (such as nutrient cycling) are critical to sustaining ecosystem functions that deliver many benefits to people (MEA 2005). Wetland ecosystems also play an important role in the regulation of global climate change by sequestering and releasing significant amounts of carbon, as well as providing many other functions locally, regionally and internationally.

Despite the clearly recognised benefits provided by wetlands they continue to be lost at an unprecedented rate and their constituent species are thought more threatened than any other species grouping (see, for example, Ricciardi and Rasmussen 1999, Revenga *et al.* 2005). The main threats to global freshwater species include: overexploitation (of species and water resources); water pollution; flow modification; destruction or degradation of habitat; and invasion by exotic species (Dudgeon *et al.* 2006). Pollution problems are pandemic. Flow modifications are ubiquitous in running waters, most often in regions with highly variable flow regimes where people have the greatest need for flood protection and water storage (e.g. water storage dams), but also as a result of hydroelectric generation through the construction of dams. Habitat degradation is brought about by an array of interacting factors such as conversion for agriculture, pollution, forest clearance and resultant changes in surface run-off and general wetland drainage and water abstraction. Invasions by exotic species change the ecological balance through predation, disease, competition and, in some cases, habitat destruction. The high degree of connectivity within aquatic systems often means that impacts such as pollution or invasive species spread far more rapidly than is usual in terrestrial systems.

Even given the knowledge that wetlands and their associated species are a highly valuable resource undergoing a serious decline globally, the ecological requirements for their maintenance and continued productivity are seldom included in decision-making processes for the development potential of wetlands. For example, in China and India, where approximately 55% of the world's large dams are situated (WCD 2000), limited consideration has been given to the downstream allocation of

Jens Kipping

Chlorocypha cancellata*, a rainforest species from central Africa*

water for biodiversity (Tharme 2003). A high priority is now placed on the development of wetland systems worldwide for provision of water for drinking, sanitation, agriculture, and hydropower in order to meet the Millennium Development Goals (see: www.un.org/millenniumgoals) of improved access to water, energy and sanitation. With this in mind it is essential that the potential impacts of such development on wetland biodiversity, and the livelihoods that depend on it, be considered within the development planning processes.

One of the major bottlenecks in bringing wetland ecosystem needs into the decision-making process is a lack of readily available information on the distributions and ecological requirements of species, together with a consideration of the integrating of information into decision-making processes, such as *environmental flows* (for example, see www.eflownet.org). Even where such information is made available it must be presented in a suitable format if the impacts of wetland development are to be minimised or mitigated for.

In summary, the purpose of assessing the threatened status and distribution of species is to enable effective conservation of biodiversity and livelihood values through presenting information on species in a format that can be integrated into the decision-making processes. The data will also serve as a baseline for monitoring the impacts of any development or management interventions, and will enable adaptive management and evaluation of any mitigation measures put in place.

### B1.2 Overview of biodiversity methods

In order to demonstrate the value of freshwater species to livelihoods, we first need to know what species are present, their abundance, and where they are. This section describes the methods needed to collect, store, and display this information. The methods used to assess the species' risk of extinction are also described, in order to assign each species with an IUCN Red List Category and determine the major threats and ecological requirements for each species.

Having defined the management issue to be addressed and the bounds of the study area, it is necessary to choose which taxonomic groups to focus on; these should be chosen in collaboration with the livelihoods and economics team members, in the context of the management questions which form the focus of the study.

Ideal focus taxonomic groups might include those that are:

- Most easily identified given the skills available
- Most highly utilized, especially by poorer members of the communities within the project area
- Those where the most information already exists

The available information on these species groups then needs to be collated through literature review and expert opinion, such as that from local researchers and organizations, government agencies, or museum collection curators. Much information will be found in the literature; additionally some data may be available in existing databases. These sources will provide preliminary species lists for the area, as well as information about the life history, habitats, and ecology of species, as well as known threats and current conservation measures. All this information can be stored within the Species Information Service database (Chapter A9), a purpose-made spreadsheet, or a GIS database.

It is likely that fieldwork will be needed to supplement the species lists that have been developed through literature review and to collect information on where (georeferenced locations, using a GPS unit) species are found. For each species group, it is likely that a variety of sampling methods will be required. The help of taxonomic experts may be needed for species identification, and the availability (and cost) of taxonomic experts is likely to influence the selection of taxonomic groups that are included in the survey. Where species cannot be identified in the field, specimens can be collected, suitably labelled, and preserved for later identification. Local names can be used in place of scientific names, but care needs to be taken that local names refer to individual species, rather than groups of similar-looking species. The species can then be mapped to the freshwater habitats in which they are found using GIS.

It is important to ensure integration between the data collected by the field teams. The best option is to have a fully integrated team i.e. a livelihoods expert accompanies the biodiversity team and *vice versa*. This might not always be practicable or possible; in these cases, team members need to be aware of the information requirements of the other teams. For example, biodiversity fieldworkers should collect relevant information on species' use (trade, consumption, and utilization) and be sure that the information is passed on to the other teams so that the economic and livelihood value of the species can be researched and incorporated into the report.

The species data collected can be used to assess the risk of extinction to the species, using the Red List assessment methodology (Chapter B11). The species information, maps and Red List status can then be combined with information from other parts of the assessment, using linking information such as the local names for species and the habitat areas from which they are harvested. Following analysis, it can be presented in a suitable format for decision-makers, including maps which integrate the information in a visually accessible and easily understandable way (see Chapter 6).

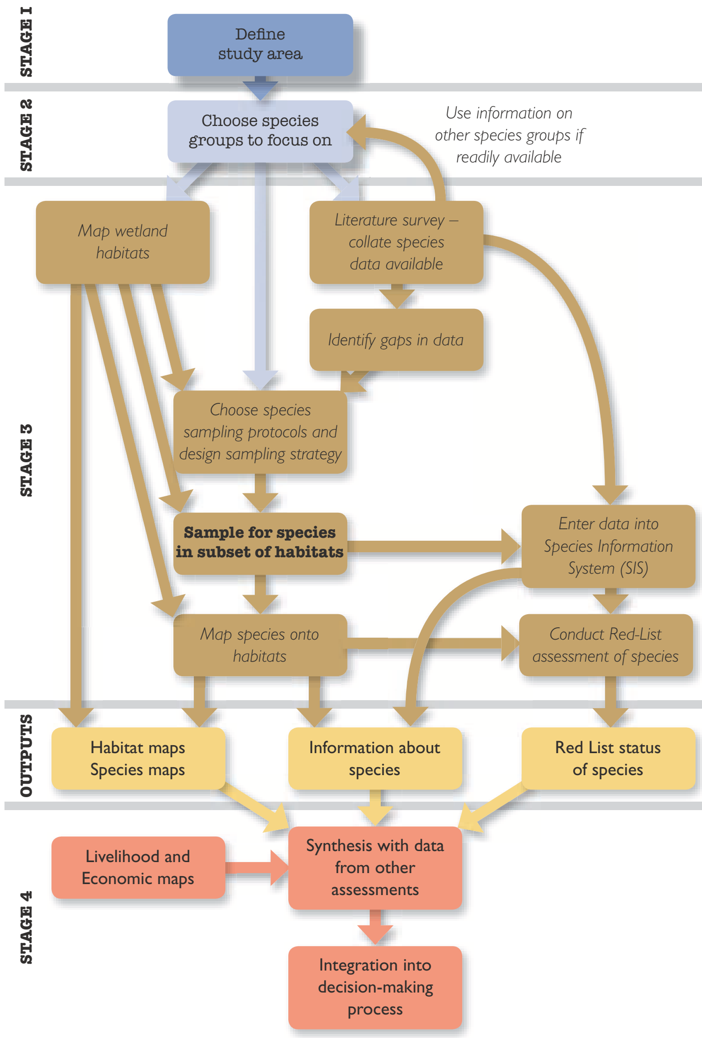



**Figure 13: Suggested planning flow diagram for the biodiversity component of an integrated wetland assessment. At each stage it is vital that opportunities for collecting linking data to the economics and livelihoods components of the assessment are followed up, and that communication is maintained with the economics and livelihoods team members**

### B1.3 Key resources

CBD. 2006. *Guidelines for the rapid ecological assessment of biodiversity in inland water, coastal and marine areas*. CBD Technical Series No. 22/Ramsar Technical Report No. 1. Joint publication of the Secretariat of the Convention on Biological Diversity, Montreal, Canada, and the Secretariat of the Ramsar Convention, Gland, Switzerland. Available at: www.cbd.int/doc/publications/cbd-ts-22.pdf

Sutherland, W.J. (ed.) 1996. *Ecological Census Techniques: A Handbook*. Cambridge University Press, UK.

## B2 Planning a field survey

Once the species groups to be included in the survey have been chosen and the boundaries have been defined, the field survey can be planned. The sampling protocols required for fish, molluscs, dragonflies and damselflies, amphibians, reptiles, birds, mammals, and aquatic plants are detailed in Chapters B4 to B8, and general notes on species surveys are given in Chapter B3. If other taxonomic groups need to be surveyed, relevant protocols can often be found on the internet, in relevant literature (e.g. Sutherland 2000) or by contacting experts on those species (contact the IUCN Species Survival Commission to locate experts from the relevant Specialist Groups).

### B2.1 Fieldwork planning

1. Determine how much time is available for biodiversity surveys (i.e. number of days in the field and number of people with biodiversity expertise)

2. Decide what other activities are needed in addition to the biodiversity survey, such as documenting conservation issues and threats to biodiversity, market or focus group (e.g. fisher focus group) surveys, mapping habitats (see Chapters M1 to M7), collecting linking information such as the local names of habitats and species etc.
3. Choose appropriate biodiversity survey methods and make an estimate of how long they will take
4. Given the time needed to survey each site (and to travel between sites), how many sites can be surveyed? Choose survey sites such that all wetland habitat types present are surveyed (see Chapters M5 and M6), and ensure that the work is coordinated within the survey teams so that species of livelihood and economic importance are included in the biodiversity survey
5. Determine whether the survey needs to be undertaken at different times of the year to take account of seasonal variability, such as species migrations, rainfall, and water flow. For example, in low-rainfall areas, some species may be dormant and hidden for much of the year
6. In conjunction with the other members of the assessment team draw up a timetable of work. Ensure that time is made for team meetings to share information and discuss issues that arise

### B2.2 Planning, integration and analysis

Figure 13 shows a suggested flow diagram for biodiversity assessment activities. Clearly these steps do not take place in isolation, and it is important that biodiversity survey planning and activities are closely coordinated with those of the livelihoods and economics assessments, both in terms of the data (used, for example, to inform the threat assessment arising from unsustainable levels of utilization) and the mapping stage, where it will be important to bring in data on the locations of area/habitats that are valuable to livelihoods. Prepare data record sheets in advance and test them during the pilot assessment.

For more information on the process of undertaking an integrated assessment, see Chapter 2.

## B3 Conducting species surveys

This section describes general protocols for field surveying. Subsequent sections describe field survey methods specific to the different species groups (Chapters B4 - B8).

### B3.1 Choosing sampling protocols

Develop a standard sampling protocol for each species group to be followed at each sampling location. Below are some suggested sampling methods for some key freshwater taxa.

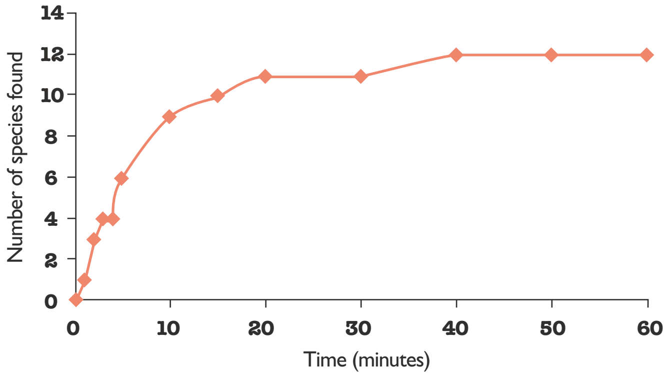



**Figure 14: An example of a species discovery curve, illustrating the decline in the rate of accumulation of new species over time**

The methodology chosen will depend on the nature of the area and on the time, funds, expertise, human resources, and equipment available for sampling.

There are a wide range of existing freshwater sampling methodologies available via the internet and a brief search will produce a number of suitable methods for the taxa you wish to survey. Many of these will be appropriate to different situations and levels of skills, funding and resources. Ensuring that an integrated approach to data collection, management, and presentation is maintained is the key factor.

### B3.2 Sampling intensity and duration

For some groups such as birds or dragonflies and damselflies, timed searches may be an appropriate survey approach. Ideally the time given to survey should be chosen by sampling a small number of sites intensively and recording how many species are located per unit of time. The number of species found over accumulated time can be plotted as species discovery curve (see Figure 14). In this example, after 10 minutes 75% of species have been located, so you might choose to sample for 10 minutes at each location, or for 20 minutes to find more than 90% of species present. The decision will depend on the available time and the extent of the area to be sampled. This information can be used to decide the best use of available time to obtain sufficient data for the maximum number of sites.

To calculate abundance, it is important that the same amount of sampling effort (in this case time given to searching) is applied at each location.

### B3.3 What to record

The following information should be recorded for each species found:

- the name of the recorder and date of sampling

Suitable for use if there are few species at each location

**BIODIVERSITY DATA COLLECTION SHEET**

Sheet no.

Name of recorder | Date | Wetland Habitat Type

Taxonomic group(s) being sampled

Sampling **methods** used and time/effort put in:

**Records**

| ID/ no. | Location GPS Lat/Long /Way Point no. | Species identified? | Specimen collected? | Photo(s) taken? | Species name OR Specimen no. AND/OR no.s | Habitat where found and notes on ecology | Local name(s) for species, habitat, location | Notes on use, value, any other information |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

**Figure 15: Example of biodiversity data collection sheet**

- the local name of the sampling location and the species (if local guides are present to give this information), as well as additional information on the use, value and cultural role of the species
- the georeferenced location (determined with a GPS)
- if the species cannot be identified a specimen should be collected or a photo taken. Record the reference number of the specimen or photo, the habitat the species was found in, and any other useful notes on the ecology of the species, such as its abundance
- the sampling method used and the effort/time spent sampling

An example recording sheet is shown in Figure 15 (for a full version see Figure 49 in the appendix). This will need to be tailored to meet the needs of individual surveys.

### B3.4 Identification to species level

It is likely that the ability to identify species will determine which taxonomic groups are selected for survey as there is little point in collecting specimens or photographs if they cannot be identified. If good keys to species groups are available it may be possible to identify species in the field or later on from specimens or photos. Taxonomic experts can also be contacted for help, but this should be done early, and may need to be factored into the budget as expertise can be expensive. Alternatively it may be acceptable to use lower levels of taxonomic identification (e.g. family or genus) or to classify specimens into 'morphospecies' (see Chapter B12).

Species which can be identified in the field to scientific name or local name (as long as the local name is specific to an individual species) need not be collected. Species requiring identification should either be collected (storage protocols are described for each species group in the following sections) or photographed.

## B4 Fish survey sampling methods

Fish are relatively easily surveyed for and are vital to nutrition and livelihoods across many parts of the world. Fish form the most important wetland product on a global scale providing the primary source of protein for nearly one billion people worldwide (FAO 2002).

A range of survey techniques will need to be used to obtain a complete inventory of the fish species present in the survey area. Local fishermen and women can be employed to conduct the initial survey, for instance by recording their catches, or by collecting examples (voucher specimens) of the species caught by the fishing community. This is an efficient way of making an inventory of local fish species. Gaps in the area surveyed can be filled later using additional methods (for example capturing less commercial species) and in additional locations, possibly fishing at times not normally fished by local fishers (e.g. at night). Fish need be collected only if immediate identification is not possible and specimens can be stored in either alcohol or formalin. The methods below have been largely drawn from Backiel and Welcomme (1980).

### B4.1 Market surveys

Visiting markets in the area provides a good opportunity to collect integrated data, such as which species are being traded, where the species come from and who the fishers are, and the value of different fish species (see Chapter B9). Photographs can be taken to make a library to show when asking local people for information on when and where species are caught, and how much they are bought and sold for.

Following these initial surveys researchers can accompany fishers to fishing sites to sample their catches and to collect location data (using a GPS) on where species are caught.

### B4.2 Conducting a fish survey

Local fishers may not fish in all the wetland habitat types present within a survey area, so some habitats may have to be sampled separately. Either local fishers can be employed to collect fish samples in these areas using their own gear under the guidance of the survey leader, or separate fish surveys can be conducted.

A variety of fish survey methodologies are summarised below. The choice of method and how it is employed will depend on the habitat being sampled, and water depth, clarity, flow, and vegetation will need to be considered (Côté and Perrow 2006). Fishing equipment used by local fishers can be used for the survey, but it is desirable to use a range of sampling methods to overcome method-specific biases, to conduct day and night sampling, and to sample in places where less commercial species are found.

*B4.2.1 Nets*

Gillnets are versatile, low cost, and easy to operate. They can be used in lakes of any size, in deep or shallow water, over bottoms too rough for seine nets, and on a large or small scale. Their main disadvantage is that they may not catch largely sedentary or bottom-dwelling species, and a wide range of mesh sizes are needed to ensure capture of the full range of fish sizes present. They are suitable for collecting qualitative information on the species present, as required during rapid species assessments, and can easily be placed in a wide range of freshwater habitats.

*Kong Kim Sreng/Darwin Integrated Wetland Assessment Project*

*Fish traps in Stung Treng Ramsar Site, Cambodia*

Gillnets vary widely both in their physical structure (dimensions, colour, mesh size, twine material and thickness, hanging and rigging of weights and floats) and in how they are set (perpendicular or parallel to shore; in straight lines, zig-zags or looped to form traps; anchored in place or drifted with currents). The choice of net types and method will depend on the type of water and species of fish to be sampled.

Seine nets are suitable for collecting rapid samples but can be used only where the river or lake shore grades into a hard, gently sloping bottom with no obstacles such as rocks or submerged branches. When skilfully employed they can capture the majority of fish within the sample area. However they are expensive unless they can be rented from local fishermen, and a boat is usually required to take the net out in a sweep of the area being sampled.

Cast nets can be employed to fish in most wetland habitats but they require a certain degree of skill for effective use.

*B4.2.2 Other methods*

Traps come in a wide range of sizes and designs including small 'basket traps' and 'fence traps' which direct the fish into baskets. Local fishermen will often have designed traps most suitable for the area to be surveyed.

A hook and line is one of the most common methods used for catching fish. Requiring only a single baited hook and line, it is cheap and easy to use. Alternatively long lines of hooks can be used, and these may be left tethered to posts for a period of time or overnight. This method is selective for carnivorous species that readily take the bait.

Electrofishing requires specialised equipment operated by trained personnel. It is quick, requires few people and little physical exertion; however it is dangerous for both fish and operators, and the equipment is expensive. It is mainly suitable for use in flowing water less than 2 m deep.

Explosives and poisons such as rotenone should not be used.

### B4.3 Where to sample and how to standardize fishing effort

The full range of wetland habitats present should be sampled, as described in Chapter M5. Within each habitat type, it is recommended to sample from as many sub-habitats as possible to get comprehensive species lists (within a lake for example, there may be shallow vegetated areas, deep areas and rocky shores).

Kong Kim Sreng/Darwin Integrated Wetland Assessment Project

*Gastropod collection by villagers in Stung Treng Ramsar Site, Cambodia. Molluscs were also observed on sale in the local markets, and the project collected data on prices both within villages and at local markets*

Sampling effort can be standardized using Catch Per Unit Effort (i.e. how much is caught by fishing for one man-day in each habitat using the same fishing techniques).

### B4.4 Preparing specimens and identification

Where fish can be identified to species on-site there is no need to collect specimens. If there is uncertainty as to the identification of the fish, a mature adult specimen of each species should be collected if possible. Fish should be killed using an anaesthetic such as benzonocaine if this is available, then preserved in either formalin or alcohol. Formalin is simple and cheap, but toxic to humans, so alcohol may be preferred. Fix fish in 70% alcohol before storing them in 40% alcohol (Sutherland 2000). Attaching a permanent label directly to the specimen, or placing fish and labels in pierced plastic bags within a larger container of formalin or alcohol avoids the need for several individually labelled containers. The colours of fish should be noted or photographed, as they are removed by alcohol. For large fish which cannot be collected for practical reasons, photos should be taken, including diagnostic features and an object for scale (such as a ruler).

### B4.5 Key resources

Backiel, T. and Welcomme, R.L. 1980. *Guidelines for sampling fish in inland waters.* EIFAC Technical Papers (EIFAC/T33). Available at: www.fao.org/docrep/003/AA044E/AA044E00.htm

Côté, I.M. and Perrow, M.R. 2006. *Fish*. In: *Ecological Census Techniques: A Handbook* (ed. W.J. Sutherland); 2nd edition. Cambridge University Press, Cambridge, UK.

Nielsen, L.A. and Johnson, D.L. (eds.). 1983. *Fisheries Techniques*. American Fisheries Society, Bethesda, USA.

Sutherland, W.J. 2000. *The Conservation Handbook: Research, Management and Policy*. Blackwell Publishing, Oxford, UK.

## B5 Mollusc sampling methods

### B5.1 Introduction

Freshwater molluscs provide vital additional nutrition in many parts of the world, and play a key role in maintaining wetland ecosystems through their control of water quality and nutrient loads. They are however one of the most threatened groups of freshwater taxa, with key threats including pollution, dams, drainage, and siltation.

The degree of utilization of molluscs by people for food (or, occasionally, for fishing bait and other purposes) varies greatly across the world. Where molluscs are consumed a market survey (Chapter B9) may reveal if they are traded, and which species are utilized and are preferred.

Freshwater molluscs are typically divided into two groups; gastropods (typical snails) and bivalves (mussels for example). The following sections give methods for surveying each of these.

### B5.2 Gastropods

Gastropods can be collected using quadrats, sweep netting through vegetation, dragging a hand-net over the under-water substrate surface and washing/scrubbing rocks. The various methods described are suited to different environments.

*B5.2.1 Quadrat sampling*
Quadrat sampling is suitable for shallow, slow-flowing areas, as well as for shallow edges of pools and lakes. A quadrat can be made locally (a simple square frame of a standard size, often 0.5–1.0 m) and constructed from any rigid material, sometimes with a grid of wire or string to subdivide the quadrat into small, more easily searched squares.

A series of quadrat samples ranging from a minimum of eight to as many as 16 should be collected from within each sampling site to produce a total area sampled equal to about 5–10 $m^2$ for each habitat location. Quadrat samples may be: i) concentrated in areas perceived as representing the most suitable habitat to enhance the possibility of detecting the target species; or ii) placed systematically along a river or lake shore if the area appears to be relatively homogeneous.

In coarse substrate areas, molluscs should be either hand collected or brushed from individual stones into a tray, net or sieve. The bedrock or stones can be scrubbed underwater with a brush so that dislodged snails are swept into a submerged net or sieve placed downstream. Alternatively, rocky substrates can be placed in a tray underwater and carried to a more convenient location for processing.

Areas with fine substrate (such as muds, sands, or silts) are sampled by excavating bottom sediment from within the quadrat to a depth of about 3 cm using a dip net or sieve with an effective mesh size of 0.5 mm or smaller. The sample should be washed through a sieve to remove as much substrate as possible. Generally a 0.25–0.5 litre volume of sieved ‘concentrate’ from each such site is an adequate sample.

*B5.2.2 Sweep-netting*
Areas with rooted aquatic vegetation may contain large numbers of gastropods. In shallow areas a hand net can be swept through the vegetation, and the vegetation vigorously shaken to dislodge molluscs. In deeper waters a grapnel (a weighted three-way hook on a rope) will bring vegetation to the surface, which can then be washed into a bucket to retrieve attached gastropods. The number of sweeps should be standardized between sites such that the sampling effort is equal.

*B5.2.3 Other methods*
Some gastropods will also be found using the methods for sampling small bivalves, as described below.

*B5.2.4 Preparation of specimens for storage and identification*
Specimens should be cleaned after collection to remove as much debris and as many other organisms as possible. Specimens are more easily observed and sorted if they are submerged in clean water. *Relaxation* (immersing the specimen in a water/menthol solution overnight) is used to encourage the snail body to come out of the shell, making the soft parts available for species identification.

Where samples contain large volumes of substrate (sand or fine gravel) and small numbers of molluscs, separation and relaxation of specimens is not practical. Preserve the sample in the field (using either 70% isopropyl or ethyl alcohol). The sample should then be re-sieved in the laboratory to remove fine sediment and plant and animal detritus, and the sample examined through a low-power binocular microscope for small or inconspicuous molluscs.

For long-term preservation, the specimens should be placed in a solution of 70% ethyl alcohol, 15% glycerin, 15% water, and buffered to pH7. While it is preferable to keep the soft parts of snails, if it is considered sufficient to identify gastropods only to genus or family (e.g. in a rapid assessment) just the shells can be kept. To remove the soft parts, place the snails in boiling water and then pull the soft parts out of the shell with forceps.

### B5.3 Large freshwater bivalves (more than 2.5 cm in length)

Larger bivalves tend to be found in shallower areas, although they may also be found at lower densities at greater depths. If a boat is available, dredging is probably the quickest and easiest method. Otherwise hand-sampling or using a hand-net from the bank are the best methods.

*B5.3.1 Dredging*
A dredge (Figure 16) can be used to collect large freshwater bivalves either by throwing it into the water from the bank or by pulling it along behind a boat travelling upstream. The mesh size defines the size of the smallest bivalve collected, and its use may be limited by the substrate, depth, and flow of a river. To standardize sampling, it is recommended to drag the dredge across a standard distance a fixed number of times (five transects of 10 m for example) at specified points in the river. Alternatively a fixed sampling time can be used. It is not a very quantitative sampling method but is generally quick and easy in shallow waters (less than 8 m) where most mussels are found.

*B5.3.2 Using a grab*
Grabs are more quantitative than dredges but sample a smaller area of substrate, so more grabs are required to sample the substrate sufficiently to detect most of the species present. They work at greater depths and higher flows than dredges. They are less effective on some substrate types such as very firm substrates. A

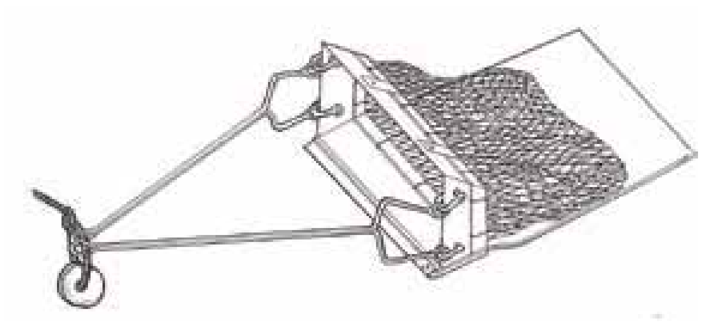


**Figure 16: A hand-dredge for mollusc sampling**

standard number of grabs should be taken from each sampling point, and the area sampled can be calculated from the area of gape of the grab. Grabs are often heavy and unwieldy, so need to be used from a relatively sturdy boat. A winch or pulley system may be needed for retrieval as the grab needs to be heavy to ensure penetration of the substrate.

*B5.3.3 Hand-sampling*

This is only feasible in the shallow margins of rivers where it is possible to easily reach the bottom substrate. However, these areas often contain the highest densities of mussels. Hand sampling can be made quantitative by either sampling within quadrats or doing timed searches. It is suitable in both very turbid rivers with muddy substrates and clear waters, where mussels may be located by sight (e.g. using a glass-bottomed bucket). Where mussels are at relatively high densities it is the quickest and easiest method of sampling.

*B5.3.4 Using a hand-net*

If the water is shallow and easily accessible, mussels can be sampled using a standard hand-net with a relatively large mesh bag, which is dragged across the substrate surface either from the bank or from within the water. However if mussels are present at low densities they may not be detected using this method. This method can be made quantitative by doing timed searches.

*B5.3.5 Scuba-diving*

This is expensive and often not practical, requiring a lot of expertise, expensive equipment, and presenting various safety issues. It is widely used in North America in relatively shallow rivers with very low turbidity so that mussels can be searched for by sight using timed searches.

*B5.3.6 Preserving mussels for later identification*

Mussels should be rinsed with water to remove mud. Mussel identification is often by shell characters, so the soft parts may not be needed (check identification keys if available for local species). If the soft parts are required, preserve in 95% ethanol (which should be changed after a couple of days as the mussels may release lot of water on opening). If only the shells are required, live mussels can be placed in boiling water until they open and the soft parts removed. Recently-dead mussels are often found, so it may not be necessary to kill live specimens. Both valves (shells) should be kept and held together to enable identification.

**B5.4 Smaller freshwater bivalves (less than 2.5 cm in length)**

Smaller bivalves can be collected by a wide range of sampling methods including netting, sweeping submerged vegetation (as described for gastropods), or kick-sampling (see B6.4.1).

*B5.4.1 Hand-netting*

An ideal hand-net to use for this purpose is a robust, aluminium-framed pond net (approximately 0.4 m square), with a nylon mesh bag (0.3 m deep, 0.5 mm mesh; Figure 17). Most bivalves live close to the surface of the substrate and can be collected by skimming the sample net through the top 2–3 cm of sediment from the bank or a small boat. Agitate the net in the water to sieve out mud and silt. The material can then be washed into a white sorting tray or bucket before passing it through a 4 mm sieve to collect the larger specimens and to remove coarse debris, and then through a 0.5 mm sieve to collect remaining bivalves. Specimens can be picked from the sediment by examining a small quantity in a glass dish under a binocular microscope at x6 to x10 magnification.

*B5.4.2 Dredging*

For water bodies deeper than 1.5 m, samples can be collected using a hand dredge (as described in B5.3). Although these are usually equipped with a relatively coarse-sized mesh (>4 mm), on soft substrates they rapidly become clogged with fine sediment so can be used only over short distances. The captured sediment can then be passed through sieves in order to pick out smaller bivalves.

*B5.4.3 Processing and storage of bivalves*

Samples can be stored in water or preserved in alcohol. Small bivalves will remain fresh for 3–4 days when stored in their



**Figure 17: A hand-net for sampling small bivalves**

native water and kept in a refrigerator. If live specimens are to be returned to their original habitat they should be examined under a cold light source – a short period out of water will not kill them. For longer term storage they should be preserved in 70–80% alcohol (Industrial Methylated Spirit, IMS). Alternatively specimens may be placed on absorbent paper and allowed to air-dry.

Identification sometimes requires internal examination of the hinge features which requires the separation of the two valves. For freshly collected specimens and those preserved in alcohol, the valves may be opened and the animal removed by immersing in boiling water. Articulated specimens that are totally dry can also be boiled to separate the valves but some may require chemical treatment by placing them in a solution of domestic bleach (50/50 with water). This will dissolve the hinge ligament but the *periostracum* (a thin organic coating or 'skin' which is the outermost layer of the shell) and soft parts of the animal will be destroyed. As soon as the treatment is complete the separated valves should be washed in water to remove the bleach and allowed to dry. The bleaching will whiten the shell and enable features of the hinge line to become more clearly defined.

### B5.5 Further information

A comprehensive guide to sampling for freshwater mussels is given by Strayer and Smith (2003). Information on collection of smaller bivalves has been taken from a protocol used for sampling small bivalves in the UK (Killeen *et al.* 2003) which may need alterations for use in larger tropical rivers. The information on gastropod sampling has been taken from Furnish, Monthey and Applegarth (1997).

### B5.6 Key resources


Furnish, J., Monthey, R., and Applegarth, J. 1997. *Survey Protocol for aquatic mollusk species from the northwestern forest plane*. Version 2.0 - October 29, 1997. U.S Department of the Interior, Bureau of Land Management. Accessed on 22/1/2009 at www.blm.gov/or/plans/surveyandmanage/SP/Mollusks/acover.htm

Killeen, I., Aldridge, D., and Oliver, G. 2003. *Freshwater Bivalves of Britain and Ireland*. Occasional Paper 82. Field Studies Council, UK.

Strayer, D. L. and Smith, D. R. 2003. A guide to sampling freshwater mussel populations. *Am. Fish. Soc. Mono*. 8:1-103.


## B6 Dragonfly and damselfly sampling methods

### B6.1 Introduction

Dragonflies and damselflies (Odonata) are relatively easy to sample, requiring limited equipment, and can be a valuable indicator of overall ecosystem health. Adult dragonflies are not restricted to wetlands, but all larvae are aquatic and water is essential to their lifecycle. Many species spend part of their lifecycle within woodlands for example, or forage within non-wetland habitats. It is important to include a range of habitat types if a comprehensive survey is being attempted.

Jens Kipping

*Dragonfly and damselfly sampling in the Okavango Delta*

### B6.2 Sampling for adults

*B6.2.1 Habitats*

Dragonflies and damselflies occur in all types of freshwaters and in nearby habitats. They often prefer sunny places where they can bask, but there are also species which live in shade. Wide-ranging species may also be found in temporary or disturbed habitats such as puddles, rice fields and ditches; specialist and endemic species are more likely to be found in pristine forest and wetland habitats and in small micro-habitats such as seepages (where water oozes from the ground), the spray-zone of waterfalls, wet trickles on rock faces, torrents, small pockets of water in tree holes (*phytotelmata*) or small pools and swamps in forest. As many potential habitats should be sampled as possible, not only river banks.

*B6.2.2 Survey methods*

Dragonflies and damselflies may be surveyed by collecting or by observation using close-focus binoculars; however some species (especially in the tropics) are difficult to differentiate visually and the collection of voucher specimens is recommended. To catch them use a large hooped net on a long stick (a 40–75 cm diameter hoop with a handle 1–2 m long is suitable with extendable poles if possible). The netting is usually white, green or black and the bag of the net needs to be deep enough to fold it closed, so that the dragonfly is not able to escape when you flip the rim over the net to trap it in the bag.

The most effective technique is to wait until the adult dragonfly is just past you, and then swing the net from behind. Some species

David Allen/Darwin Integrated Wetland Assessment Project

*Dragonflies can be held between the fingers or thumb and finger for examination and photographing, and then released unharmed. This is an adult female* Anax tristis *from Dai Lake, Mtanza-Msona, the first record for this species from the Rufiji District, Tanzania*

are more easily caught when they alight on a perch or while basking on logs, or at certain times of day. Watching the habits of a species before trying to catch it will yield greater success. When possible, only sample mature males to minimise impacts on breeding populations.

To reduce the number of specimens collected, develop a reference collection of species present. Once familiar with local species it may be possible to record species by observation only, or by catching them and re-releasing them. Even if a species' scientific name is not known the species may be recorded by referring to a reference specimen which will later be identified to species.

Once caught dragonflies are best held with the wings folded together between the thumb and forefinger (or two fingers). Larger species can be held at the thorax or legs provided at least three legs on one side are grasped. If handled carefully most individuals will fly off unharmed once released (Dijkstra 2006).

*B6.2.3 Preservation*

Make a note of the specimen's colours (particularly eye colour) or take a photograph (as the colours can fade on storage) and place the specimen briefly in acetone to kill it and then place the wings together and straighten the abdomen. Place the specimen in porous paper envelopes (Figure 18), recording the specimen number, date, photograph details, and collection location on the envelope. Place in acetone (only pure acetone is suitable, not that sold for cosmetic use) for 12-24 hours. Remove from acetone and dry in air. If pure acetone is not available, the specimens can be killed in alcohol and then dried well with silica gel or in the air in arid environments.

### B6.3 Sampling for exuviae

Exuviae are the casts skins of the penultimate larval stage of dragonflies and damselflies; some (very few tropical species) can be identified to species level. They can also provide useful information about where species breed. Good places to look for exuviae include rocks along the edge of the water, debris sticking out of the water, emergent aquatic vegetation such as reeds and rushes, tree snags and branches, wooden posts, bridge abutments, pilings and so on. Generally exuviae are found only a few inches above the level of the water, but occasionally they may be up to 2 m above the water level. They are easiest to find when looking from the water towards the shore. No special equipment is needed to collect them but ensure that they are well dried before storage.

### B6.4 Larvae

Damselfly and dragonfly larvae are aquatic and are most commonly found in ponds, marshes, lake margins, shallow areas of streams and the slower reaches of rivers and streams, or in water-filled hollows within trees. Some species occur in brackish pools and estuarine habitats. Larvae are most easily collected by kick-sampling (below) in shallow areas or sweep-netting amongst aquatic vegetation. Some may also be caught by dredging (for example when surveying for bivalves).

*B6.4.1 Substrate sampling*

Small pools are best sampled with a small dip-net (or a kitchen sieve can be used), while rivers are best sampled with a hand-net or kick-seine. Kick-sampling involves placing a net about 30 cm downstream and disturbing the substrate with the feet.

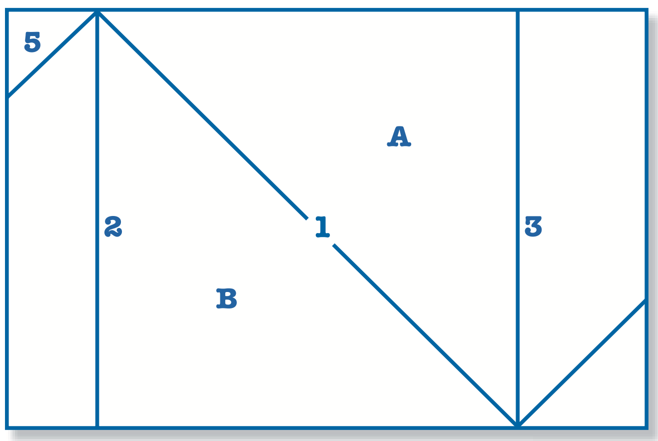



**Figure 18: Template for making paper triangles**

David Allen/Darwin Integrated Wetland Assessment Project

*Air-drying adult dragonflies after immersion in acetone for 24 hours*

Organisms that are dislodged will be collected by the net or screen as they are washed downstream. Empty the net into a pan or screen to pick out larvae. The hand-net can also be used to sample underneath undercut banks and to sweep through aquatic vegetation growing in slow-moving or still portions of the stream or river. Sample among and underneath woody or leafy debris accumulations as these habitats often harbour a great number of specimens (Bright 1999).

Preserve specimens in 70% alcohol. Do not put too many specimens in a container as they may damage each other before they die. If a lot of debris is present in the container with the organism consider using 95% alcohol to compensate for dilution. In either case, replace with fresh alcohol frequently.

### B6.5 Further information

There is extensive information on the internet describing how to sample for dragonflies and damselflies. The *Asia Dragonfly* website (www.asia-dragonfly.net) provides an excellent guide by Viola Clausnitzer, KD Dijkstra and Vincent Kalkman (follow the link labelled *How to: Studying Tropical Dragonflies and Damselflies*). The Michigan Odonata Survey (http://insects.ummz.lsa.umich.edu/MICHODO/mospubs/) has several useful technical notes, such as *Collecting Specimens for the Michigan Odonata Survey*; *Odonata Collecting Instructions*; *Sampling Protocol for Juvenile Odonata*; and *Preserving Adult Odonata*.

The International Odonata Research Institute's Odonata Information Network (www.iodonata.net) has several useful pages particularly the *Collecting and Preserving Dragonflies Frequently Asked Questions* page which has extensive discussions on the best nets to use and preservation techniques. Notes on kick-sampling can be found at www.environment.fi and in the Western River Basin District Project (Walsh 2005).

### B6.6 Key resources

Bright, E. 1999. *Sampling Protocol for Odonata Larvae*. Michigan Odonata Survey Technical Note No. 2. Insect Division, Museum of Zoology, University of Michigan, U.S. Available at: http://insects.ummz.lsa.umich.edu/MICHODO/mospubs/MOSTN2.pdf

Dijkstra, K.-D. B. and Lewington, R. (illus.). 2006. *Field Guide to the Dragonflies of Britain and Europe*. British Wildlife Publishing. Gillingham, Dorset, UK.

Walsh, A. 2005. *Small Streams Risk Score Method Manual*. Western River Basin District Project, Galway County Council, Ireland. Available at: www.wrbd.ie/PDF/SSRS-Training-manual_11_01_06.pdf

## B7 Sampling methods for non-fish vertebrates associated with wetlands: amphibians, birds and mammals

### B7.1 Introduction

Non-fish vertebrates such as amphibians, reptiles, birds, and mammals can be used as indicators of the ecological integrity of wetland habitats. They can be used to prioritize wetland habitats for conservation, and the relative importance of different sites (for breeding, feeding, or resting) can be determined. In many instances local communities depend on these groups as supplementary food resources, and for income through the trade in bush meat, traditional medicines, the pet trade, or other animal parts such as fur and skins. As with other taxonomic groups market surveys and community questionnaires can be invaluable for collecting information on traded species as well as quantities and values.

A variety of sampling techniques can be used to document species composition, richness, density and relative abundance of non-fish vertebrates associated with wetlands. Field guides or identification keys will facilitate the identification of individual species in the field and are available for most countries or regions for both birds and mammals, and to a lesser extent for amphibians and reptiles. If a species cannot be identified in the field a specimen collection might be considered, but the impact of collection on the local population should be assessed.

### B7.2 Amphibian and reptile survey methods

Many species of amphibians and reptiles (herpetofauna) tend to be nocturnal so night sampling will be required. Amphibians in particular may be low in abundance during drier seasons, and

**Table 5: Standard sampling techniques to record herpetofauna**

| TECHNIQUE | INFORMATION GAINED | TIME [x] | COST [y] | PERSONNEL [z] |
|---|---|---|---|---|
| Visual encounter surveys | Species richness | Low | Low | Low |
| Quadrat sampling | Density, relative abundance and species richness | High | Low | Medium |
| Transect sampling | Density, relative abundance and species richness | High | Low | Medium |
| Drift fences and pitfall traps | Relative abundance and species richness | High | High | High |

[x] Relative time investment

[y] Relative financial costs: High – expensive; Medium – moderately expensive; Low – relatively inexpensive

[z] Personnel requirements: High – more than one person required; Medium – one or more persons recommended; Low – can be done by one person

sampling should preferably be undertaken during the wetter seasons, which usually coincide with their breeding period. Some standard sampling techniques to record amphibians and reptiles are highlighted in Table 5 (adapted from Heyer *et al*. 1994).

A visual encounter survey (VES) is the easiest and lowest cost technique to document amphibians and reptiles associated with a wetland. This involves one or more people walking through an area or habitat for a prescribed time period, systematically searching for amphibians and reptiles. Time is expressed as the number of person-hours of searching in each area. A VES can be easily carried out in a number of quadrats along a transect of specified distance.

Quadrat sampling consists of laying out a series of small quadrats (or strip quadrats) at randomly selected sites within a habitat and thoroughly searching each quadrat for amphibians and reptiles. The quadrats should be separated by adequate distance to avoid presampling disturbances. Quadrats can vary in size between 1 x 1 m and 8 x 8 m according to the density of amphibians and reptiles in a particular locality – use a larger quadrat if the animal density is low.

Amphibians and reptiles tend to respond differentially to environmental gradients governed by moisture, vegetation cover and so on. The transect methodology can be used to sample either across these habitat gradients or within habitat types, where randomly located narrow linear strip transects (i.e. 2 x 50 m, or 2 x 100 m) are laid out, and the portions of habitats within the transect are thoroughly searched for herpetofauna.

The drift fence and pitfall trap method involves the use of drift fences (low barrier made from plastic or fabric 0.4–0.5 m in height and 5–50 m in length) that direct animals into traps placed on either side of the barriers. The traps can be pitfalls (made from buckets or plastic pipes, for example), funnel traps or a combination of the two. Drift fences and pitfall traps can be placed around ponds, marshes, and in stream/river banks, arranged either in a linear manner, or in a combination of arrays.

### B7.3 Bird survey methods

Birds, being generally conspicuous, are relatively easily surveyed and counted, though some skill in identification, especially of bird calls, is required. Some standard sampling techniques to record birds, and their costs and benefits, are highlighted in Table 6 (adapted from Sutherland 2000, and Sutherland *et al.* 2004).

Many bird species are highly seasonal, either moving between seasons to follow suitable habitat, or as part of larger migratory movements. This is especially true in the case of many wetland birds and it is important that this is taken into account when designing the survey timetable. In general, sampling should be undertaken during both drier and wetter times of the year.

The species discovery curves (SDC; see Figure 14) and McKinnon Lists (ML; McKinnon and Phillips 1993) involve similar techniques where the cumulative (total) number of species recorded is plotted against sampling effort (i.e. number of observer hours/days for SDC, and number of lists of 20 bird species for ML). The McKinnon Lists method enables the comparison of bird species richness in different sites through the curves in the plot. The species discovery curve for a particular site shows the point at which further effort is unlikely to reveal further species in a particular locality.

*Gita Kasthala/Darwin Integrated Wetland Assessment Project*

*A drift fence with bucket traps being installed along a lake shore*

**Table 6: Standard sampling techniques to record birds**

| TECHNIQUE | INFORMATION GAINED | TIME [x] | COST [y] | PERSONNEL [z] |
|---|---|---|---|---|
| Species discovery curves | Species richness | Low | Low | Low |
| McKinnon Lists | Species richness | Low | Low | Low |
| Timed point counts | Density, relative abundance and species richness | High | Low | Medium |
| Line transects | Relative abundance and species richness | High | Low | Medium |

[x] Relative time investment
[y] Relative financial costs: High – expensive; Medium – moderately expensive; Low – relatively inexpensive
[z] Personnel requirements: High – more than one person required; Medium – one or more persons recommended; Low – can be done by one person

A point count is a count of species (and individuals) undertaken from a fixed location for a fixed time period (for example 10–20 minutes). Points should be at least 200 m apart to prevent double counting. Line transects involve observer(s) moving along a fixed route and recording the birds they see on either side of the route. Transects can be carried out by walking on land or by boat. The total transect length will vary according to the size of the wetland, and individual transects range from 100–1000 m. It is also possible to conduct timed point counts at fixed distances along a line transect or in a range of habitat types.

### B7.4 Key resources

Heyer, W.R., Donnelly, M.A., McDiarmid, R.W., Hayek, L.C. and Foster, M.S. (eds). 1994. *Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians*. Smithsonian Institution, USA.

McKinnon, J. and Phillips, K. 1993. *A field guide to the birds of Borneo, Sumatra, Java and Bali*. Oxford University Press, Oxford, UK.

Sutherland, W.J. 2000. *The Conservation Handbook: Research, Management and Policy*. Blackwell Publishing, UK.

Sutherland, W.J., Newton, I and Green, R.E. 2004. *Bird Ecology and Conservation: A Handbook of Techniques*. Oxford University Press, UK.

## B8 Plant survey methods

### B8.1 General approach

Because of the high diversity of wetland plants it will probably be necessary to restrict surveys to aquatic plant species of direct importance to humans, such as plants used for food, animal fodder, or construction materials. To discover which wetland plants are used researchers can adopt a mixture of approaches, linking in with the work of the livelihoods team:

- wetland walks
- local market surveys
- household interviews
- key informant interviews
- focus group interviews (e.g. traditional medical practitioners)

Wetland walks can be invaluable for collecting information about which plants are utilized; visit a chosen range of wetland habitats with local people and ask them which plants are used and what for (using standard ethnobotanical techniques). Plants which they point out as being important to local livelihoods can then be identified (if a taxonomic expert is present), or collected for later identification (as described below). Such an approach is recommended where time is limited, providing information which is suitable for integration with the economics and livelihoods data.

If more time is available, it may be possible to do a more thorough survey of the aquatic plants of the area. The aquatic flora can be roughly divided into macroalgae, submerged vascular plants, emergent vascular plants and bank-side vegetation, with a possible fifth category of seasonally-flooded terrestrial plants.

Bank-side flora and seasonally-flooded terrestrial flora may be surveyed by establishing transects with a rope and identifying all plants to a certain distance on either side of the transect. The transect length and width will depend on the time available for the survey – a standard length is 100 m. Several shorter transects randomly spaced throughout a habitat are preferable to one long transect, but a long thin transect is preferable to a short broad transect. Alternatively, quadrats may be marked out at randomly selected (see Sutherland 2000) locations across a site and all plants with their roots within the quadrat recorded. A larger number of smaller quadrats are preferable to a small number of large quadrats.

Similar approaches may be used for submerged and emergent vegetation, where transects may be marked out in the water using buoys (these can be made from an empty bottle or a balloon attached to a rock with a rope whose length is approximately the same as the water depth), and all plants that are visible from a boat or collected with a grapnel along the transect are recorded.

Alternatively, sampling can be done from predetermined, randomly-chosen locations in the water located using a GPS, either from within a set area (e.g. an imaginary 3 x 3 m quadrat next to the boat) or with a standardized number of throws of the grapnel (Madsen 1999). It is also possible to survey along transects laid out perpendicular to the shoreline, thereby encompassing all forms of aquatic vegetation.

Emergent, bank-side, and terrestrial plants can be collected by hand. Macroalgae are often found in mats at the surface and may also be collected by hand. Submerged vegetation and deeper algae may be collected using a grapnel or any kind of weighted hook or rake attached to a rope. Alternatively a dredge or grab may be used; these are likely to damage plants, but may bring up tubers or rhizomes which could be useful in plant identification. Diving is also an efficient method of surveying submerged aquatic vegetation, although it may be costly and requires divers who are sufficiently qualified and experienced.

### B8.2 Collection and storage of plants

Plants which cannot be identified in the field should be collected for later identification. Aim to collect healthy, full-sized leaves still on the stem, as well as any flowers and fruiting bodies. For trees, it may be helpful to collect a small specimen of bark. For each sample record the date, name of collector, and location (name and GPS location, and altitude) where the sample was taken, as well as additional information on colours (as these are likely to fade on drying, especially flowers), local names and use, if any. In the field, specimens should be stored in a press (see below) as soon after collecting as possible. Place the plant flat between sheets of newspaper with layers of corrugated cardboard, if available, between the plants to allow air to get into the stack. The plants should be arranged in a way which demonstrates the characteristics necessary for identification (i.e. showing both sides of leaves and the underside of flat flowers) as well as fruit and seeds. In damp areas or where it may be some days before the specimens can be properly dried in a herbarium, or if pressing succulent plants, the paper should be replaced every few days. Fruits may be dried whole, or sliced and pressed, or preserved in 70% alcohol and stored separately, ensuring that they are clearly labelled. Cones and wood should be labelled and air-dried. As they are collected, place the stack of specimens between two boards, kneel on the entire stack and tighten with straps or a rope around the press.

David Allen/Darwin Integrated Wetland Assessment Project

*The heart-shaped leaf in the centre of the image is an aquatic plant* Ipomaea aquatica *collected from the margins of the Rufiji River and utilized as a vegetable by the Mtanza-Msona villagers. The plant in the background (Water lettuce* Pistia stratiotes*) is an introduced invasive aquatic plant found in small clumps and large dense mats across the Mtanza-Msona wetlands, both in the Rufiji River and in lakes. Dense mats of* Pistia *disrupt fishing activities, especially in the lakes*

Plant presses can be purchased, but can also be easily made from rectangles (approximately 75 x 75 cm) of hardwood or plywood board or a wooden lattice (good for allowing more rapid drying of the specimen). Adequate small presses can be made from wire grids, such as a cake tray.

If drying is not possible in the field, stacks of plants pressed within newspaper can be sprayed with alcohol or a litre of 70% alcohol can be poured over a 20 cm stack of specimens kept sealed in a plastic bag. The resulting specimens may be blackened and brittle and need to be checked on a regular basis to be sure that they are not heating up, but the specimens will still be satisfactory for identification.

Succulents should be killed by submergence in boiling water for a few seconds as the tissue will then dry more quickly and it will also prevent them growing new shoots in the press.

Mosses are usually placed directly into a paper packet for drying and are not pressed. Liverworts tend to shrivel so some gentler pressing is sensible. Lichens, collected on their substrate if possible (for example, cut on a sliver of bark from a tree), can be simply air dried in most cases and do not require pressing. Mosses, liverworts and lichens are usually stored in paper packets. Macroscopic algae can be pressed and dried, freeze dried or stored in 40% alcohol (although they lose their pigments in alcohol). Flimsy algae are best placed on a herbarium sheet underwater and then gently lifted and drained.

If specimens are required for long term storage in a herbarium, rather than simply for identification, then further treatment will be required, and advice should be obtained from a herbarium curator. Victor *et al.* (2004) (www.sabonet.org.za/reports/

publications_report25.htm) and Bridson and Forman (2004) are excellent resources on the collection of plant specimens and the development of a herbarium.

### B8.3 Identification

Depending on the skills of the assessment team members, plants can either be identified in the field with field guides and keys where they exist (e.g. Cook 1996), or later with the assistance of herbarium staff.

Field guides are available for some families of plants and for some geographical regions. Plant identification keys are available for many more plant families, but often require a higher level of botanical knowledge to use. Increasingly, plant keys, floras and other resources are becoming available on the internet, often produced by the major botanical gardens. For example:

- Interactive key to the rattans of Lao PDR
  www.kew.org/data/rattanslao
- Interactive key to the flowering plants of the Neotropics
  www.kew.org/science/tropamerica/neotropikey.htm
- Aluka Africa plant resource database
  www.aluka.org/page/content/plants.jsp
- eFloras
  www.efloras.org

### B8.4 Further information

For more information on line transects and point sampling see Madsen (1999).

For the identification of aquatic plants Cook (1996) is an excellent resource, with a key covering the vascular aquatic plants of the world.

### B8.5 Key resources

Borrini-Feyerabend, G., Pimbert, M., Farvar, M.T., Kothari, A., and Renard, Y. 2004. *Sharing Power: Learning by Doing in Co-management of Natural Resources throughout the World*. IIED and IUCN. Available at www.iapad.org/sharing_power.htm

Bridson, D. and Forman, L. (eds.). 2004. *The Herbarium Handbook*. Third Edition. Kew Publishing, London, UK.

CBD. 2006. *Guidelines for the rapid ecological assessment of biodiversity in inland water, coastal and marine areas*. CBD Technical Series No. 22 / Ramsar Technical Report No. 1. Joint publication of the Secretariat of the Convention on Biological Diversity, Montreal, Canada, and the Secretariat of the Ramsar Convention, Gland, Switzerland. Available at: www.cbd.int/doc/publications/cbd-ts-22.pdf

Cook, C.D.K. 1996. *Aquatic Plant Book*. SPB Academic Publishing, The Hague, The Netherlands.

Madsen, J.D. 1999. *Point and line intercept methods for aquatic plant management*. APCRP Technical Notes Collection (TN APCRP-M1-02), U.S. Army Engineer Research and Development Center, Vicksburg, USA.

MEA. 2005. *Ecosystems and human wellbeing: Wetlands and water Synthesis*. World Resources Institute, Washington, DC. Available at: www.millenniumassessment.org/documents/document.358.aspx.pdf

Ramsar Handbooks for Wise Use. Available at: the Ramsar Wise Use Resource Centre www.ramsar.org/wurc/wurc_index.htm

Sutherland, W.J. 2000. *The Conservation Handbook: Research, Management and Policy*. Blackwell Science, UK.

Victor, J.E., Koekemoer, M., Fish, L., Smithies, S.J. & Mössmer, M. 2004. *Herbarium essentials: the southern African herbarium user guide. Southern Africa Botanical Diversity Network Report* (SABONET) Report No. 25. National Botanical Institute, Pretoria, South Africa. Available at: www.sabonet.org.za/reports/publications_report25.htm

## B9 Market surveys

A full presentation of market survey methodologies is beyond the scope of this toolkit, but an awareness of some of the issues that should be considered when planning a market survey is important.

### B9.1 Introduction

In the context of biodiversity assessment we define *market survey* here as meaning a survey of the physical market, the location where natural resources and products are sold. However, a market survey may also encompass research into the structure and institutions of a market from an economic and sociological perspective to understand how the market functions, who has access to the market to buy or sell, and so on.

Surveys of markets (including informal bartering or exchange between households within a community) can be a valuable way to collect data on which species are being harvested from a wetland. Market surveys can also provide a key opportunity for the field survey teams to integrate their work and obtain cross-cutting data on livelihood and economic values.

It is important to consider potential biases in market surveys. Not all species or products are openly traded, either because they or their trade are illegal, or because their trade takes place in informal markets, perhaps between or within households. Cross-checking between results from market and household surveys, though time-intensive, may show discrepancies in volumes that reveal undisclosed trade in illegal or threatened species.

Edward Allison/Darwin Integrated Wetland Assessment Project

Morning fish market in Stung Treng

Kong Kim Sreng/Darwin Integrated Wetland Assessment Project

Freshwater snails for sale in Stung Treng Ramsar Site

A market survey can provide data on species economic value, the quantities being traded, the economic status of the households which are harvesting and selling the resource, as well as provide information on institutional factors that impact upon livelihoods and biodiversity, such as legislation and the effectiveness of regulation. Surveys can also highlight key areas of conservation concern, such as the trade in threatened species or their parts, as well as drivers of trade (food, fuel or construction, medicinal use, the national or international pet or aquarium trade and so on).

Market surveys have been used extensively by researchers investigating the extent and impact of trade in wild species, and their reports provide good case studies for undertaking market surveys (for example, see Singh *et al.* 2006).

### B9.2 Approaches

It is suggested that a fully integrated team of researchers participate in a market survey to ensure that species being traded can be rapidly identified and that relevant information (purchase and sale prices, volumes, livelihood data on harvesters and traders, for example) is collected efficiently. The data collected should be jointly analysed to provide areas for potential follow-on work by the separate researchers, for example: locating and georeferencing harvesting areas, such as favoured fishing areas; identifying species and assessing their conservation status; identifying the wealth class of harvesters and traders, and so on.

Seasonality is likely to be important in planning the timing of market surveys to ensure that seasonal fluctuations in availability, harvesting levels, and prices due to climate and species migrations are taken into account. Similarly, some products are traditionally sold at particular times of day (e.g.

**Table 7: Suggested monitoring schedule for selected sites in Stung Treng town, Stung Treng Province, Cambodia (from Bezuijen *et al.* 2005)**

| DAY | MORNING (0600-0800) | MORNING (1100-1400) | LATE AFTERNOON (1400-1800) | OTHER (IF TIME) |
|---|---|---|---|---|
| 1 | 1. Survey food section – town market.<br>2. Enter data. | Visit Sokh Pheaph restaurant for lunch | 1. Survey jewellery vendors at town markets.<br>2. Monitor river road (town-6 km east to airport) for wildlife transport.<br>3. Enter data | |
| 2 | 1. Survey food section – town market.<br>2. Enter data. | Visit Sunntha restaurant (near market) for lunch | 1. Monitor river road (town-3.5 km west to boat landing) for wildlife transport.<br>2. Enter data. | 0500-brief survey of main boat landing |
| 3 | 1. Survey food section – town market.<br>2. Enter data. | Visit Prachum Tonle restaurant for lunch | 1. Monitor river road (town-6 km east to airport) for wildlife transport.<br>2. Enter data. | Visit Sunntha Restaurant (2nd outlet) for dinner |
| 4 | 1. Survey food section – town market.<br>2. Enter data. | Visit any new food outlet (random survey) | 1. Monitor river road (town-3.5 km west to boat landing) for wildlife transport.<br>2. Enter data. | 0500-brief survey of main boat landing |

**Table 8: Degradation and deterioration of habitats and ecosystems (qualitative/quantitative)**

| CONTRIBUTORY FACTORS | METHODS OF VERIFICATION (INDICATORS) | LINKS TO DRIVING INDICATORS |
|---|---|---|
| Loss/degradation of wetlands: reclamation, drainage | Landfill (area); drainage activities | Increased demand for land; expansion of agricultural land |
| Pollution of water from agrichemicals (fertilizers, pesticides etc.) and other effluents (oil etc.) | Dead/dying aquatic organisms.<br>Eutrophic conditions – growth of algal mats<br>Decline in aquatic species' abundance or distributions | Mis-use/over-use of agrichemicals;<br>harmful practices related to handling/ application of agrichemicals |
| Clearance of riparian vegetation | Area of riparian vegetation cleared | Agricultural activities (i.e. river bank cultivation use |
| Regulation of water flow | Upstream dams, diversions etc. (related reductions in water levels)<br>Extraction of surface or groundwater for agriculture, industry, or domestic use | Demand for irrigation water and energy (hydropower) |
| Waste disposal | Area of waste dumps | Ribbon development (settlements etc.) bordering wetlands |

**Table 9: Spread of invasive alien species**

| CONTRIBUTORY FACTORS | METHODS OF VERIFICATION (INDICATORS) | LINKS TO DRIVING INDICATORS |
|---|---|---|
| Deliberate and/or accidental introduction of invasive alien plants and animals | Presence and distribution/spread of invasive alien plant and animal species<br>Decline in native species' abundance or distribution<br>Loss or degradation of habitats or ecosystem function | Expansion of agriculture, aquaculture, ornamental fisheries etc. |

fish) and such variations also need to be considered. See Table 7 for an example of a sampling programme undertaken as part of a survey of markets and outlets in Stung Treng, Cambodia (taken from Bezuijen *et al.* 2005).

## B10 Assessing threats to freshwater species and ecosystems

Information on threats and changes to the wetland environment as well as evidence of change in the health, abundance, and distribution of wetland species is required to inform the assessment of the conservation status of wetland species (see B11), and to gain an understanding of processes and drivers of change within the survey area.

Information on degradation and deterioration of habitats and ecosystems (Table 8), spread of invasive alien species (Table 9), and on over-exploitation and destruction of species (Table 10) can be collected by direct observation during the course of biodiversity survey, as well as by focus group and key informant interviews, and through market surveys (see B9).

Key threats can be mapped and presented in the project GIS (see M9).

## B11 Assessing the conservation status of species

Conservation actions are often based on the location of threatened species and determining the conservation status of species within the integrated assessment study area will potentially have a significant impact on the final analysis and recommendations arising from the integrated assessment process.

A vital part of the integrated assessment process will be to identify species present within the study area through the biodiversity, livelihoods, and economic valuation fieldwork and to ascertain their conservation status if possible. The IUCN Red List is widely recognised as an independent measure of a species' conservation status and this is preferred where the species has already been assessed against the Red List Criteria. Undertaking a comprehensive conservation status

**Table 10: Over-exploitation and destruction of species**

| CONTRIBUTORY FACTORS | METHODS OF VERIFICATION (INDICATORS) | LINKS TO DRIVING INDICATORS |
|---|---|---|
| Illegal poaching of animals (birds, mammals, reptiles etc.)<br>Unsustainable harvesting<br>Harvesting and trade of endangered species | Animals displayed for sale in local markets; traps observed; presence of hunters; information from locals; charcoal transport and sale etc. | Demand for bush meat |
| Harmful fishing and harvesting practices | Blast fishing, poisoning, electro-fishing etc. | Demand for fish |
| Logging (riparian trees) | Logged areas; log sawing pits; transit timber depots; timber products etc | Demand for timber |
| Collection of plants and animals for ornamental purposes (commercial trade) | Collections observed; specimens in local markets | Demand for animals and plants in the ornamental trade |
| Wanton/deliberate killing e.g. reptiles | Information from local communities | Fear/mythical beliefs |

assessment of all species within a wetland using the IUCN Red List Criteria is likely to be beyond the scope of an integrated wetland assessment project, and where this is the case, the following alternatives can be considered.

Three approaches can be taken, depending on the resources available: (i) search the existing global and sub-global (national and regional) Red Lists to see if the species present in the wetland have already been assessed (see B11.6); (ii) select a small number of key species that are known to be vital to local livelihoods, such as some fish species, and use the available data to assess their conservation status against the IUCN Criteria. Once data have been collated and entered into the SIS database, the threatened status of each species can be assessed according to the IUCN Red List Categories and Criteria (see www.iucnredlist.org); and (iii) use anecdotal information, for example, provided by key informants or through focus group discussions to indicate historical declines in a species' abundance or distribution within the assessment area, as well as the causes of the change. In each case, the SIS (see Chapter A9.1) database can be used to collate data from the biodiversity, livelihoods, and economic elements of the assessment.

### B11.1 The IUCN Red List of Threatened Species

The Red List, in conjunction with the comprehensive data compiled to support it, has become an increasingly powerful tool for conservation planning, management, monitoring, and decision-making (e.g. Rodrigues *et al.* 2006).

There are nine Categories in the IUCN Red List system: *Extinct*, *Extinct in the Wild*, *Critically Endangered*, *Endangered*, *Vulnerable*, *Near Threatened*, *Least Concern*, *Data Deficient*, and *Not Evaluated*, and a further two Categories that are used at the regional scale: *Regionally Extinct* and *Not Applicable*. Classification into the Categories for species threatened with extinction (Vulnerable, Endangered, and Critically Endangered) is through a set of five quantitative Criteria that form the heart of the system (Figure 19). These Criteria are based on biological factors related to extinction risk and include: rate of decline, population size, area of geographic distribution, and degree of population and distribution fragmentation.

### B11.2 The Red List categories and their application

**EXTINCT (EX):** A taxon is Extinct when there is no reasonable doubt that the last individual has died (that is, when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual). Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

**EXTINCT IN THE WILD (EW):** A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range.

**REGIONALLY EXTINCT (RE):** Taxa that are considered extinct within the region but populations still exist elsewhere in the world.

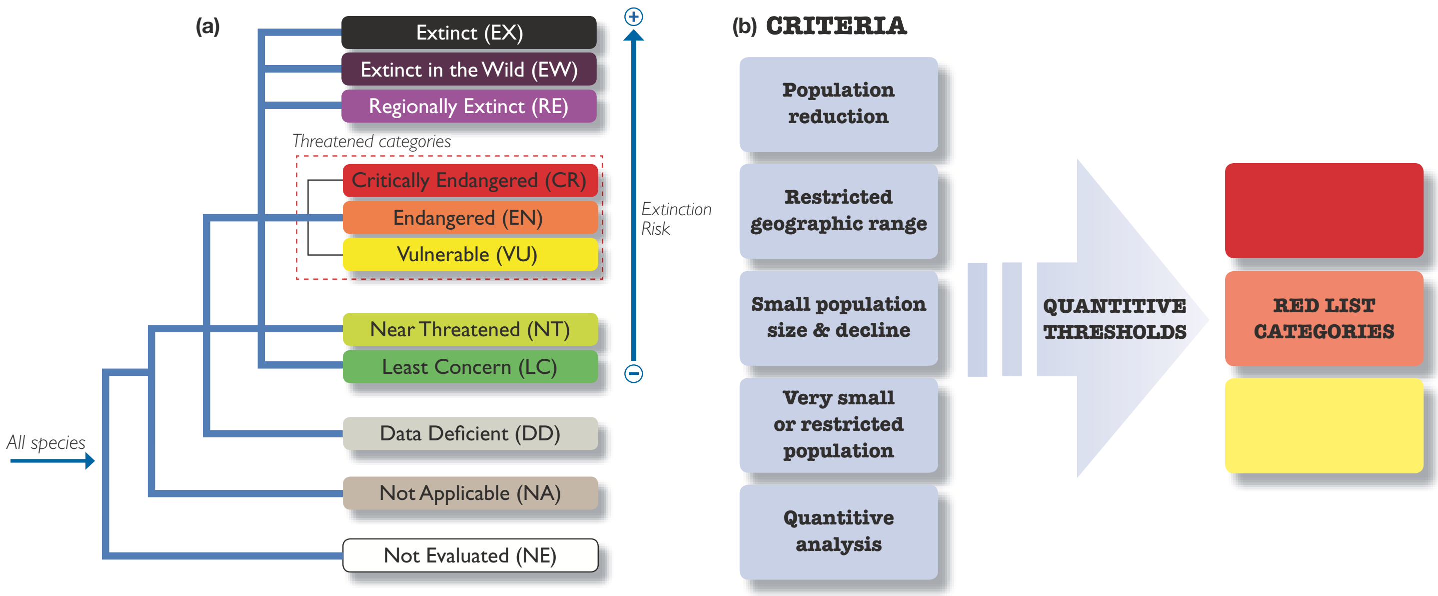



**Figure 19: IUCN Red List (a) Regional Categories and (b) Criteria**

**CRITICALLY ENDANGERED (CR):** A taxon is Critically Endangered when the best available evidence indicates that it meets any of the Criteria A to E for Critically Endangered (see *Red List Categories and Criteria* booklet (IUCN 2001) for details) and it is therefore considered to be facing an extremely high risk of extinction in the wild.

**ENDANGERED (EN):** A taxon is Endangered when the best available evidence indicates that it meets any of the Criteria A to E for Endangered and it is therefore considered to be facing a very high risk of extinction in the wild.

**VULNERABLE (VU):** A taxon is Vulnerable when the best available evidence indicates that it meets any of the Criteria A to E for Vulnerable and it is therefore considered to be facing a high risk of extinction in the wild.

**NEAR THREATENED (NT):** A taxon is Near Threatened when it has been evaluated against the Criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for, or is likely to qualify for, a threatened Category in the near future.

**LEAST CONCERN (LC):** A taxon is Least Concern when it has been evaluated against the Criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this Category.

**DATA DEFICIENT (DD):** A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this Category may be well studied and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this Category indicates that more information is required and acknowledges the possibility that future research will show that a threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

**NOT APPLICABLE (NA):** Taxa that have not been assessed because they are unsuitable for inclusion in a regional Red

*Jens Kipping*

Notiothemis robertsi, *a widespread species of dragonfly from central Africa*

**Table 11: Summary of the five Red List Criteria (A–E) used to evaluate if a taxon belongs in a threatened Category (Critically Endangered, Endangered or Vulnerable). This Summary needs to be used in connection with a thorough understanding of the full Red List Guidelines (IUCN 2001)**

| Use any of the Criteria A–E | Critically Endangered | Endangered | Vulnerable |
|---|---|---|---|
| **A. Population reduction** | Declines measured over the longer of 10 years or 3 generations | | |
| **A1** | ≥ 90% | ≥ 70% | ≥ 50% |
| **A2, A3 & A4** | ≥ 80% | ≥ 50% | ≥ 30% |
| **A1.** Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible **AND** understood **AND** have ceased, based on and specifying any of the following: **(a)** direct observation; **(b)** an index of abundance appropriate to the taxon; **(c)** a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality; **(d)** actual or potential levels of exploitation; **(e)** effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites. | | | |
| **A2.** Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased **OR** may not be understood **OR** may not be reversible, based on (a) to (e) under AI. | | | |
| **A3.** Population reduction projected or suspected to be met in the future (up to a maximum of 100 years) based on (b) to (e) under AI. | | | |
| **A4.** An observed, estimated, inferred, projected or suspected population reduction (up to a maximum of 100 years) where the time period must include both the past and the future, and where the causes of reduction may not have ceased **OR** may not be understood **OR** may not be reversible, based on (a) to (e) under AI. | | | |
| **B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)** | | | |
| **B1.** Extent of occurrence (EOO) | < 100 km² | < 5,000 km² | < 20,000 km² |
| **B2.** Area of occupancy (AOO) | < 10 km² | < 500 km² | < 2,000 km² |
| **AND at least 2 of the following:** | | | |
| **(a)** Severely fragmented, **OR** Number of locations | = 1 | ≤ 5 | ≤ 10 |
| **(b)** Continuing decline in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** area, extent and/or quality of habitat; **(iv)** number of locations or subpopulations; **(v)** number of mature individuals. | | | |
| **(c)** Extreme fluctuations in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** number of locations or subpopulations; **(iv)** number of mature individuals. | | | |
| **C. Small population size and decline** | | | |
| Number of mature individuals | < 250 | < 2,500 | < 10,000 |
| **AND either C1 or C2:** | | | |
| **C1.** An estimated continuing decline of at least: | 25% in 3 years or 1 generation | 20% in 5 years or 2 generations | 10% in 10 years or 3 generations |
| (up to a max. of 100 years in future) | | | |
| **C2.** A continuing decline **AND** (a) and/or (b): | | | |
| **(ai)** Number of mature individuals in each subpopulation: | < 50 | < 250 | < 1,000 |
| OR | **OR** | | |
| **(aii)** % individuals in one subpopulation = | 90–100% | 95–100% | 100% |
| **(b)** Extreme fluctuations in the number of mature individuals. | | | |
| **D. Very small or restricted population** | | | |
| **Either:** | | | |
| Number of mature individuals | < 50 | < 250 | **D1.** < 1,000 |
| | | | AND / OR |
| | Restricted area of occupancy | | **D2.** Typically: AOO < 20 km² or number of locations <5_ |
| **E. Quantitative Analysis** | | | |
| Indicating the probability of extinction in the wild to be: | ≥ 50% in 10 years or 3 generations (100 years max.) | ≥ 20% in 20 years or 5 generations (100 years max.) | ≥ 10% in 100 years |

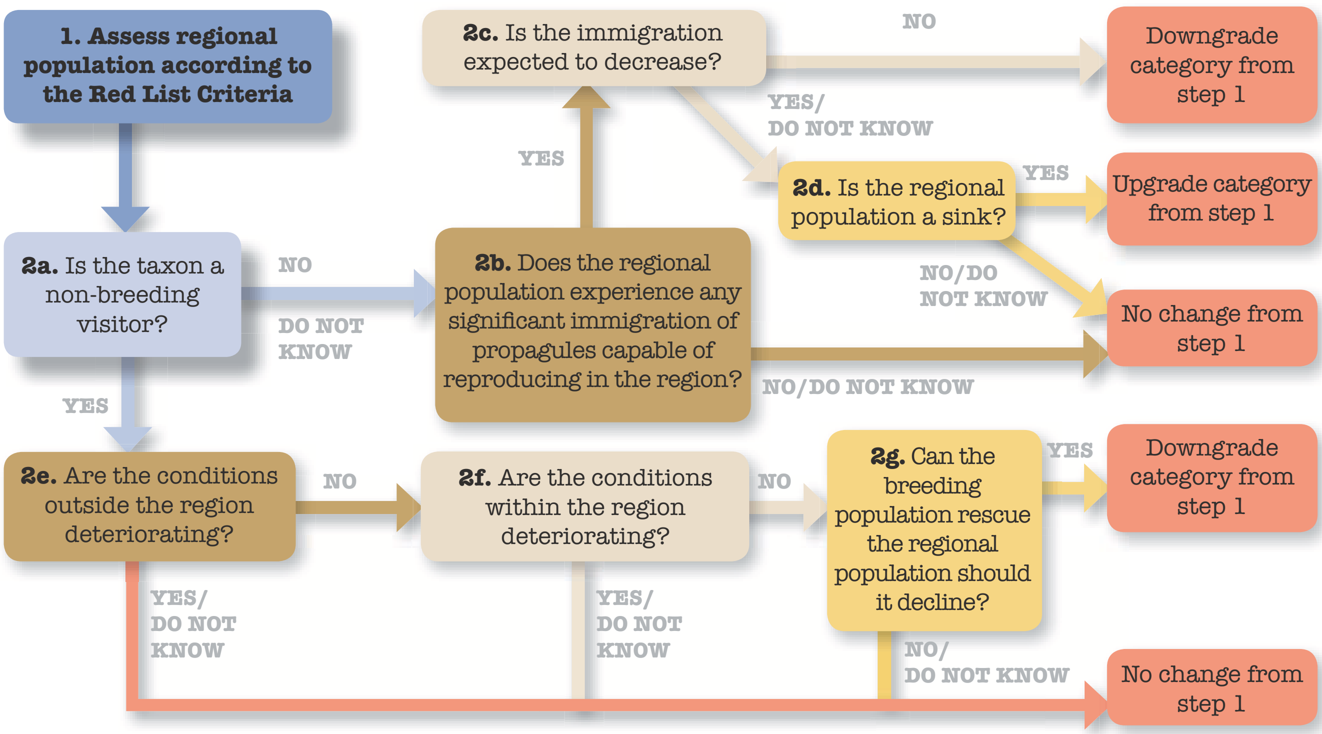



**Figure 20: Conceptual scheme of procedure for assigning IUCN Red List category at the regional level**

List (e.g. a taxon that occasionally breeds in the region under favourable circumstances but regularly becomes regionally extinct; see the *Guidelines for Application of IUCN Red List Criteria at Regional Levels* (IUCN 2001) for other examples of when this category might be used).

**NOT EVALUATED (NE):** A taxon is Not Evaluated when it is has not yet been evaluated against the Criteria.

### B11.3 The Red List process

The process of Red Listing involves compiling data on a species (either globally or within a defined region) and then assessing that species against a set of criteria to predict the risk of that species going extinct. This process is described in detail in the *Red List Categories and Criteria booklet* (IUCN 2001) and a one-page summary of the Criteria used for the threatened Categories is also available (see Table 11). To summarise, each species is assessed against each of the criteria A-E. The final category of threat to the species is then determined as the highest level of threat assigned under any of the criteria.

### B11.4 Regional assessments

The Red List Criteria were initially developed for application at the global scale (i.e. to assess the global population of a species). Red-listing (the process of assessing the conservation status of a species using the Red List Criteria) is also possible at smaller scales; at the regional, national and sub-national level. Certain adjustments are made to the methods used for global assessments, but the process is otherwise the same. Two additional categories are included for regional assessments: **RE** and **NA** (see Chapter B11.3 above).

Figure 20 shows a conceptual scheme of the procedure for assigning an IUCN Red List Category at the regional level. In Step 1 all data used should be from the regional population, not the global population. The exception is when evaluating a projected reduction or continued decline of a non-breeding population; in such cases conditions outside the region must be taken into account in Step 1. Likewise, breeding populations may be affected by events in, for example, wintering areas, which must be considered in Step 1.

In Step 2 various conditions relating to external factors affecting the population (e.g. immigration) are evaluated to decide whether to ‘upgrade’ or ‘downgrade’ the assigned Red List Category. If the regional population is a demographic ‘sink’ and the extra-regional source population is expected to decline, the preliminary Category from Step 1 may be upgraded (i.e. EN upgraded to CR; VU upgraded to EN; NT upgraded to VU). If the regional population experiences a ‘rescue effect’ (from an external demographic ‘source’) through immigration from outside the region, the preliminary Category from Step 1 may be downgraded (i.e. CR downgraded to EN; EN downgraded to VU; VU downgraded to NT). Other categories (EX, EW, RE, DD, NA, NE and LC) cannot be downgraded or upgraded. Importantly, if a species being assessed is endemic to the assessment region, no regional adjustments are required.

*Kong Kim Sreng/Darwin Integrated Wetland Assessment Project*

Hylarana macrodactyla*, a widespread frog from southeast Asia that has been assessed as Least Concern according the IUCN Red List. The species was found during the Stung Treng integrated wetland assessment*

See the *Guidelines for Application of IUCN Red List Criteria at Regional Levels* (IUCN 2001) for further details on the procedures to follow, especially for Step 2.

### B11.5 Applying the Red List categories to wetland species

The Red List methodologies were designed to be applicable to all species but in practice certain adaptations are necessary when assessing riverine species and creating their distribution maps. For example, the distribution range of a wetland species, an important criterion used to assign a Red List Category, is often calculated to include the total surface area of water and land within the associated river or lake catchments where the species has been recorded, even though it is clear that the species is not found on land. In order to take account of such issues a document has been prepared to guide assessors of freshwater species (contact the IUCN Freshwater Biodiversity Unit, Cambridge, UK for more information).

### B11.6 Assessing the conservation status of species during integrated wetland assessments

The presence of threatened species within a wetland site may have significant implications for decisions on the future conservation or development of a wetland site. It would therefore be useful to know if such species are present. The IUCN Red List website (www.iucnredlist.org) should be consulted to see if the species present in the site have already been assessed as threatened at either regional (see the 'Initiatives' tab on the main page of the Red List website) or global scales. In many cases the Red List status of species present will not yet have been assessed and the surveyors may consider conducting their own Red List assessments for those species. The feasibility and benefit of assessing the conservation status of species present within the assessment site is highly dependent upon: i) the size of the wetland site, and ii) the proportion of the species' total population that is restricted to that site. If the site is very small and contains only a small proportion of the species' global population then it is not considered practical to conduct a Red List assessment at that scale. If, however, the site is reasonably large (a large river or lake catchment for example) then it might be useful to conduct an assessment to determine the species' risk of extinction within that catchment. The selection of species to assess might therefore be based on criteria such as: i) those species with a high value to local livelihoods or ii) species endemic to the assessment area. Such an exercise will help to highlight the presence of any species at risk of local or global extinction.

An increasing number of freshwater species are being assessed at the global scale, and assessments are also being undertaken at the regional and national scales. All species of birds are assessed on a regular basis by BirdLife International, and global assessments of all freshwater crabs, mammals and amphibians have been completed. Global assessments are planned or under way for reptiles, dragonflies and damselflies, freshwater fishes, and molluscs, as well as some plant groups (cycads and conifers, for example). All global assessments can be downloaded from the Red List website (www.iucnredlist.org), which can be searched using a range of criteria including taxonomy, location, habitat and system (freshwater, marine or terrestrial). In addition, species are increasingly being assessed at the sub-global (regional, national and even sub-national) scale (see Chapter B11.4) through a range of processes, for instance:

- regional assessment projects undertaken by IUCN (e.g. the IUCN Pan-Africa Freshwater Biodiversity Assessment project and the IUCN European Mammal Assessment)
- regional and national assessments undertaken by national governments, academic institutions or NGOs (e.g. ZSL National Redlist project http://regionalredlist.com/)

Some of the regional assessment data, for example from the Pan-Africa freshwater assessment (see www.iucn.org/species/freshwater) and similar forthcoming initiatives in Asia will be available through the Red List website (www.iucnredlist.org; see the 'Initiatives' tab).

**BOX 6: PARTICIPATORY RESEARCH ON FISH SPECIES AND FISH-BASED LIVELIHOODS**

The Mekong Wetlands Biodiversity Programme worked with local villagers to document fish species and fishery-related issues in the Lower Songkhram River Basin in Thailand[1]. People from four villages took part between May 2003 and April 2005. Within the flooded forest on the river floodplain, Thai Baan researchers identified 208 types of vegetation and fungi that local people consume or use. Twenty-eight types of riverine sub-ecosystems were distinguished according to local terminology, many of which are important fish habitats particularly for spawning. One hundred and twenty four species of fish, six species of turtle, four species of shrimp, 10 species of molluscs and four species of crabs were identified and photographed, and notes were made on their ecology, such as whether they migrate, how far they migrate and when. The researchers also considered the status of fish species, noting that 14 species are now rarely caught (considered 'endangered') and 12 species are no longer seen, and likely to be locally extinct. Local people are uniquely placed to collate this information, as they adapted their livelihoods over many years to utilize the fish resources based on a deep understanding of fish migration patterns, feeding and spawning, flood patterns and fish habitats.

Advice on submitting assessments, as well as the information required and the format of assessments can be obtained from the IUCN Red List Unit (redlist@iucn.org).

### B11.7 Key references


IUCN. 2001. *Red List Categories and Criteria (Version 3.1).* IUCN Red List Unit, Cambridge, UK.

IUCN. 2008. Guidelines for Using the IUCN Red List Categories and Criteria. Version 7.0. Prepared by the Standards and Petitions Working Group of the IUCN SSC Biodiversity Assessments Sub-Committee in August 2008. Downloadable from http://intranet.iucn.org/webfiles/doc/SSC/RedList/RedListGuidelines.pdf


## B12 Alternative methods for biodiversity assessment

While species-based methods of assessment are widely used and accepted, they also encounter difficulties – such as the lack of available taxonomists, problematic definitions of species, and even the species concept itself (e.g. Mishler and Donoghue 1982, Turner 1999, Wheeler and Meier 2000). Species diversity may not be the most important diversity-related attribute of an ecosystem (Bengtsson 1998, Schwartz *et al.* 2000), leading some to move away from species-based conservation approaches to approaches with a broader focus on environmental conservation (Pickett *et al*. 1997).

The choice of conventional species-based measures of diversity as advocated in this toolkit has both advantages and disadvantages. The main advantages include that the results will be comparable with past and future surveys of the same type and that the survey outputs are likely to be broadly acceptable to a wide range of people. Importantly, the species-based approach makes it possible to link with Red List procedures which currently provide the basis for much conservation planning.

The disadvantage of using conventional taxonomic-based measures of biodiversity include the limited knowledge of taxonomy of many poorly-studied taxonomic groups, and the scarcity of taxonomic experts; these knowledge gaps constrain the range of taxa that can be chosen for survey.

A number of alternative approaches have been developed for use by major biodiversity projects.

### B12.1 Parataxonomy

The use of non-specialist technicians as *parataxonomists* to distinguish '*morphologically recognisable taxonomic units'* (Oliver and Beattie 1993, 1996a, 1996b) for sorting large samples. Expert time is expensive and there are not enough experts available to carry out the large amount of routine sample processing required by major biodiversity surveys. Trials with insect species showed that with a few hours' training, non-specialist technicians and students performed with 87% accuracy compared to formally trained taxon-specialists (Oliver and Beattie 1993). This level of accuracy is likely to suffice for purposes of conservation management, where error variances and bias associated with sampling techniques are likely to over- or under-estimate species' richness by greater margins. Most major biodiversity projects in species-rich rainforests make extensive use of large numbers of parataxonomists (for example Tangley 1990, Cranston and Hillman 1992, Kaiser 1997).

### B12.2 Participatory biodiversity assessment and monitoring

Wetland resource users generally have a great deal of non-scientific indigenous knowledge about their environment and the species in it. Involving people living in wetlands in biodiversity assessment and monitoring has advantages besides being a cost-effective use of existing information:

- it minimises the requirements for expensive and sometimes distant expert input
- it involves local resource-users, who have a larger stake in

- the future of the resources than any government official or visiting scientist
- it serves to maintain dialogue and build co-operative understanding between local stakeholders, resource users, researchers, and resource managers

The importance of using indigenous understanding of natural resource systems to assess, manage and monitor natural resources, including biodiversity, is now widely recognised (see for example Hellier *et al.* 1999 and a review by Sillitoe 1998) beyond the boundaries of ethnobotany where it has long been a legitimate research method (Martin 1995). This approach has been used in the Lower Songkhram River Basin in Thailand (*Thai Baan*; see Box 6), as well as during the integrated wetland assessment undertaken in Stung Treng Ramsar Site (see Chapter 7) where the methodology has been called *Sala Phoum*, or village research.

### B12.3 The use of higher-taxon approaches

If the hierarchical taxonomic classification system has any objective validity, then it is obvious that higher levels of taxa provide integrative summaries of diversity within each level of classification. In principle, any level of taxonomic classification can be chosen for comparative analysis. By convention the species level is chosen, but where identification to species is not possible it is common to use higher-taxon approaches. There is some experience indicating that correlation between diversity at different taxonomic levels can be established (Balmford *et al.* 1996), although this is likely to be highly variable (Gaston and Williams 1993, Prance 1994, Williams and Gaston 1994, Anderson 1995). Balmford *et al*. (1996) found that using woody plant genera and families, rather than species, yielded comparable estimates of relative conservation value of tropical forest for 60–85% less cost than a species-based survey. It may be possible to use a much wider range of taxa, for lower sample processing effort, if the principle of higher-taxon comparisons proves acceptable. Biotic indicators of ecosystem health (which should be related to diversity) in aquatic systems are usually based on identification of macro-invertebrates to higher taxonomic levels, such as genus or family (Chessman 1995, Hilsenhoff 1988).

### B12.4 Rapid assessment techniques

In recognition that the task of determining a conservation strategy is urgent in areas where biodiversity is threatened, highly utilized and poorly known, a number of techniques for rapid assessment of conservation value have been developed (reviewed in Groombridge and Jenkins 1996). These techniques, which employ some of the approaches outlined above, vary in their data requirements, cost, and suitability for application for different purposes and at different spatial scales. This Integrated Wetland Assessment methodology is similar to the Rapid Assessment Programme (RAP) developed by Conservation International for surveys of poorly-known areas, using ‘surrogate’ or ‘indicator’ groups identified to species level by small teams of national and international experts (see Groombridge and Jenkins 1996). These surveys are then used to assess conservation value by assuming a relationship between these ‘indicator’ groups and total diversity and habitat quality. The main drawbacks of the methodology are the reliance on specialist taxonomic expertise (beyond standard field identification skills) and the assumptions made about relationships between indicator diversity and total diversity.

Other rapid assessment methods include Conservation Biodiversity Workshops, Conservation Needs Assessments, Gap Analysis and Biodiversity Information Systems (Groombridge and Jenkins 1996). Some of these methods do not require additional survey work and aim to make best use of existing information, including socio-economic data that can be overlooked by biodiversity specialists.

### B12.5 Key resources

Conservation International’s Center for Applied Biodiversity Science – Rapid Assessment Programme http://science.conservation.org/

Groombridge, B. and Jenkins, M.D. 1996. *Assessing biodiversity status and sustainability*. WCMC Biodiversity Series No 5. World Conservation Press, Cambridge, UK.

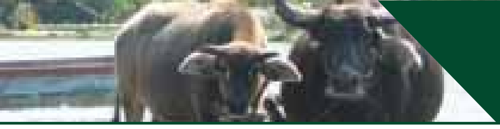
### Further reading

CBD. 2006. *Guidelines for the rapid ecological assessment of biodiversity in inland water, coastal and marine areas*. CBD Technical Series No. 22 / Ramsar Technical Report No. 1. Joint publication of the Secretariat of the Convention on Biological Diversity, Montreal, Canada, and the Secretariat of the Ramsar Convention, Gland, Switzerland. Available at: www.cbd.int/doc/publications/cbd-ts-22.pdf

MEA. 2005. *Ecosystems and human wellbeing: Wetlands and water synthesis*. World Resources Institute, Washington, DC. Available at: http://www.millenniumassessment.org/documents/document.358.aspx.pdf

Ramsar Handbooks for Wise Use. Available from: the Ramsar Wise Use Resource Centre www.ramsar.org/wurc/wurc_index.htm

[1] Fish Species in the Wetlands of the Lower Songkhram River Basin – Local Knowledge of the Fishers in the Lower Songkhram River Basin. IUCN and WANI. Available in Thai with an English introduction from: www.mekongwetlands.org/Common/download/Thai_Fish_Book_2.pdf



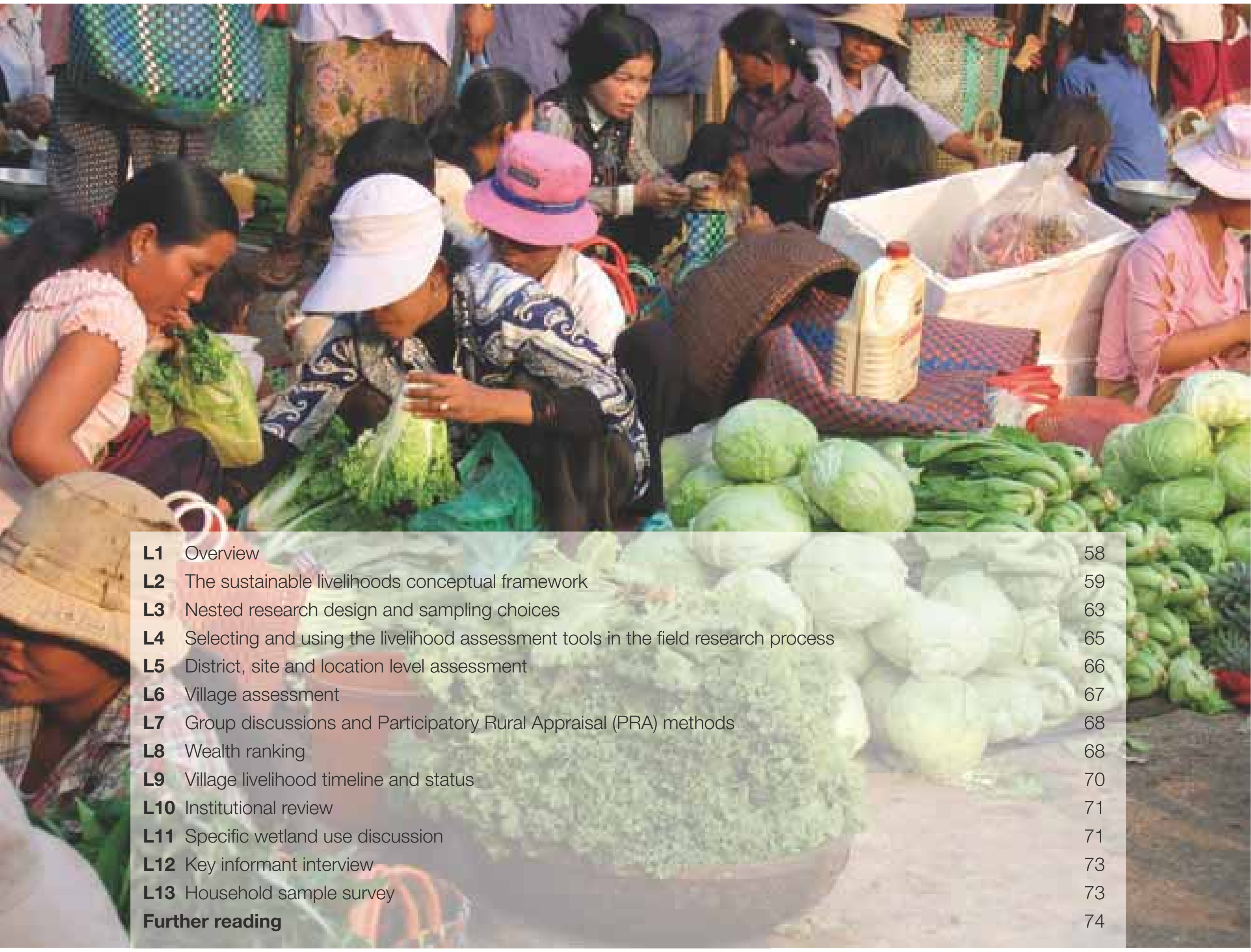


# Chapter 4

## Livelihood assessment tools

*Eddie Allison and Oliver Springate-Baginski*

This chapter presents livelihood analysis concepts, and provides an operational model for livelihood analysis in the context of wetland systems. It recommends a generic 'nested' sampling approach, and gives guidance on a range of data collection methods.





*Eddie Allison/Darwin Integrated Wetland Assessment project*

# 1 Livelihood assessment tools

*This section presents the livelihood assessment tools. It includes:*

- ✔ *A discussion of the sustainable livelihoods analytical framework and its application to the wetlands management context*
- ✔ *Research design and sampling*
- ✔ *Guidance on selecting and using the tools presented*
- ✔ *The livelihood research tools*

## L1 Overview

Livelihood assessment involves the application of the sustainable livelihoods analytical framework to rural households' productive activities and related socio-economic systems and conditions. Livelihoods analysis emerged from rural development research during the 1980s, as it became recognised that for many households, particularly the poorer ones, agricultural systems alone were not their only — or even their main — economic basis. A growing awareness of the diversity of rural livelihood practices, and the dependence of many rural households on common property or open access natural resources (for instance fisheries, common forests and grazing lands) has led to the widespread use of livelihood analysis, leading to a better and more detailed understanding of how rural households access and use natural resources.

In the wetlands management context that concerns us here, livelihood analysis is used to understand the following:

- The livelihood status, patterns and strategies of wetland-dependent individuals and households, and how these are changing over time
- The particular livelihood features and constraints of poor households, as distinct from the better-off or richer families in wetland communities
- The institutional context of wetland-based livelihoods at village level, with emphasis on the factors that inhibit or facilitate livelihood choices and options for the poor
- Community natural resource management institutions and their interactions with the livelihood strategies and access to resources of the poor in these communities

In pursuit of these aims, a 'modular' field research method is advocated as illustrated in Figure 21.

The method consists of four key steps:

- District, site and location level assessment (involving gathering of secondary data and interviews)
- Village level assessment (involving an initial overall group discussion and Participatory Rural Appraisal (PRA) exercises to clarify social stratification, livelihood characteristics and institutional issues)
- Sub-group assessment (involving mainly focus group meetings and interviews)
- Household and intra-household level assessment (involving household survey for quantitative and qualitative livelihoods data collection, plus a set of components specific to livelihood wetland resource use)

This method seeks to ensure that livelihood oriented wetland use and use-values are systematically conceptualised within a livelihoods context, rather than the livelihoods research being

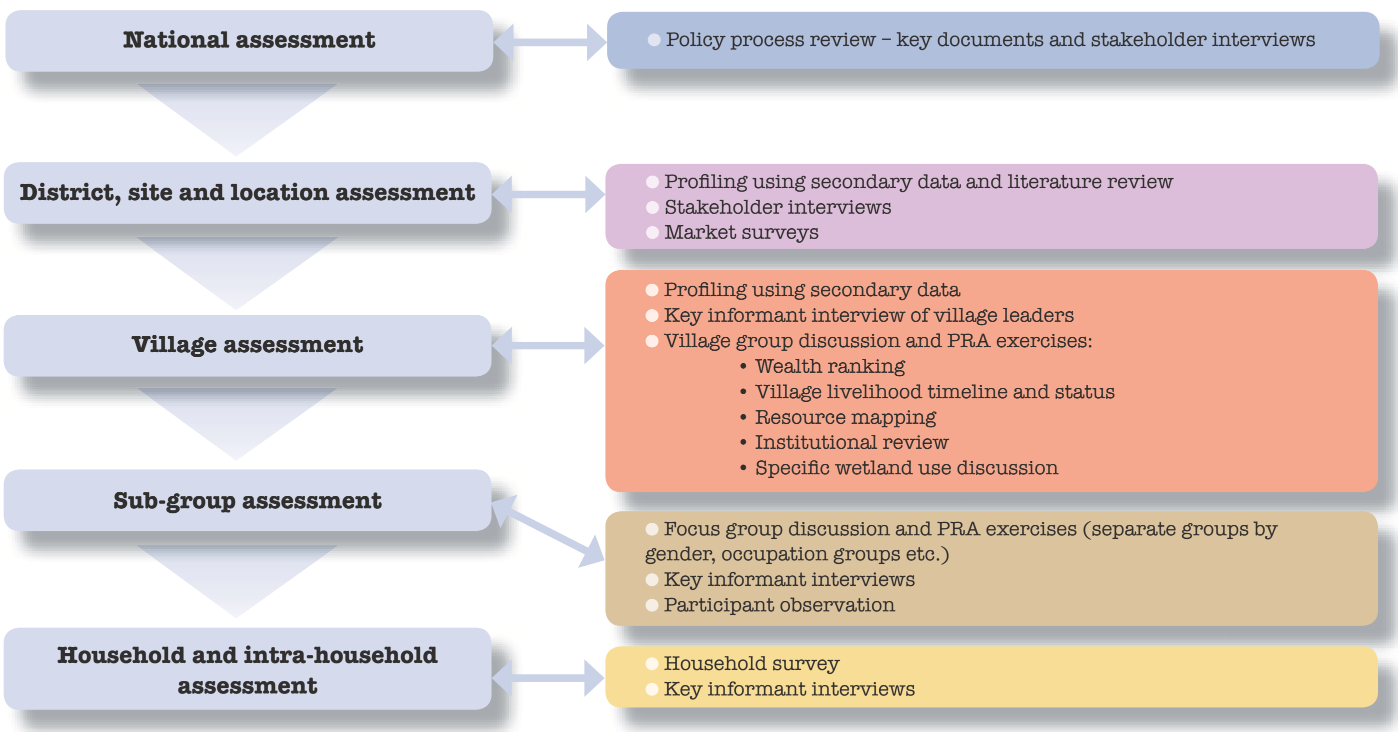



**Figure 21: Livelihood assessment: stages and methods**

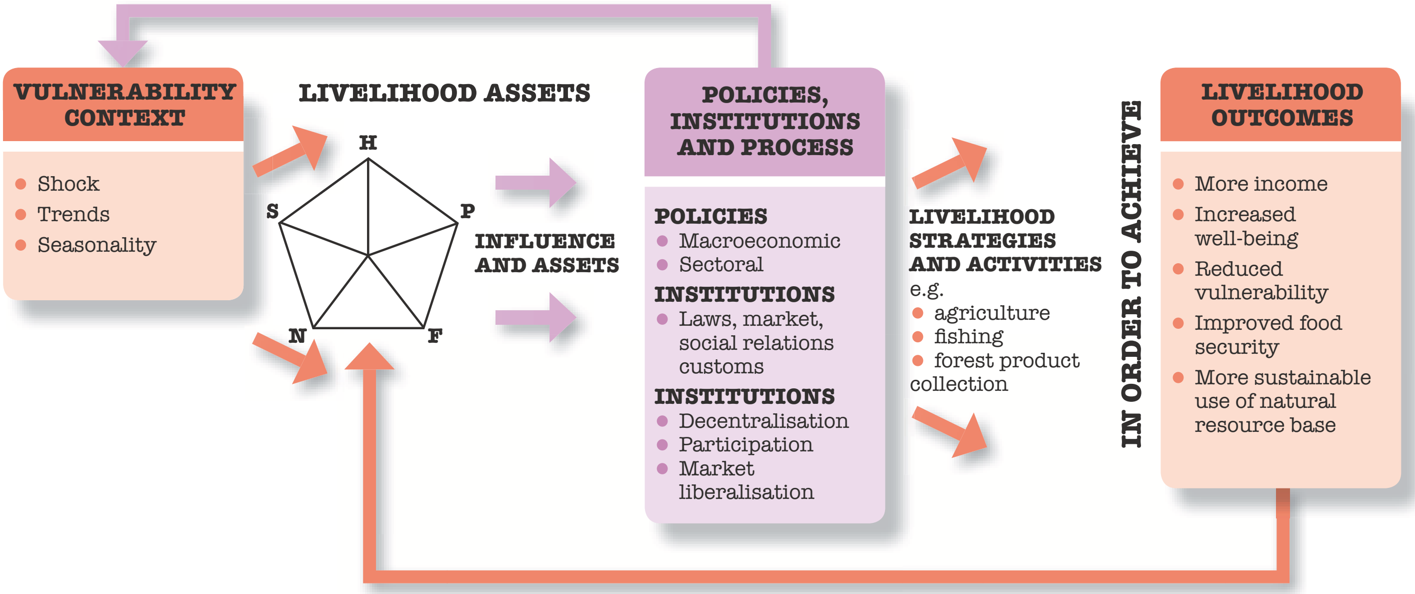



**Figure 22: The Sustainable Livelihoods Framework (SLF from DFID). Legend: H: Human; P: Physical; F: Financial; N: Natural; S: Social**

seen as peripheral to wetland biodiversity assessment studies. The overall framework for the livelihoods work is based on the Sustainable Livelihoods Approach, which is described in more detail in Section L2.

The following pages propose a set of fieldwork methods for investigating the livelihoods of households dependent on wetland resources in low income countries. The methodologies are based on the following criteria:

- Relatively easy to implement with a small team comprising one or two social science researchers trained to postgraduate level in conjunction with a wetland resource management specialist, and two to three field assistants or enumerators
- Can be achieved within a 7-10 day research period per village, with scope for return visits to validate information
- Achieves a balance between cost, feasibility and statistical representation or defensibility[1]
- Aims to involve wetland resource users, local authorities and village residents in the research process, through use of participatory techniques, return visits to synthesise and check preliminary findings, and to provide channels of communication of local-level issues to decision-makers at district, national and international level

This chapter seeks to provide a core livelihoods assessment toolkit. For reasons of space and brevity it is not intended to be a fully comprehensive and specialist methodology, such as would be needed for specific policy-oriented livelihoods research. The later would for instance require additional detailed focus on micro-macro institutional links (for example, the impact of fisheries regulations on local level fisheries management) and engagement with relevant policy processes in the countries where research is being conducted.

## L2 The sustainable livelihoods conceptual framework

The livelihoods framework has emerged from rural development debates as a conceptual approach to understanding and analysing how rural households depend for their security not only on agriculture, but also on a diversity of other natural resources. It brings together assets and activities of human populations and illustrates the interactions between them. The Department for International Development (DFID; UK government) has developed a standardised framework, as shown in Figure 22. The various components of the diagram are explained below.

The key concept illustrated here is that household livelihoods are based on the use of assets in livelihood strategies and activities. This is within a vulnerability context, and livelihoods are also mediated and affected by ‘policies, institutions and processes’. Ultimately activities lead to outcomes which are hopefully improvements of the existing condition in various ways.

The original livelihood model illustrated in Figure 22 has been gradually adapted and developed through field application (see Scoones 2009). Here we recommend use of a more explicitly operationalised model (Figure 23), to focus on the integrate wetland issues (based on Springate-Baginski and Blaikie 2007).

The fundamental social and economic unit is considered as the *household*, conceived as the social group which resides in the same place, shares the same meals and makes joint or coordinated decisions over resource allocation and income pooling.

Households depend on a range of productive *assets* or *capitals*, which they may either own privately, or access as common

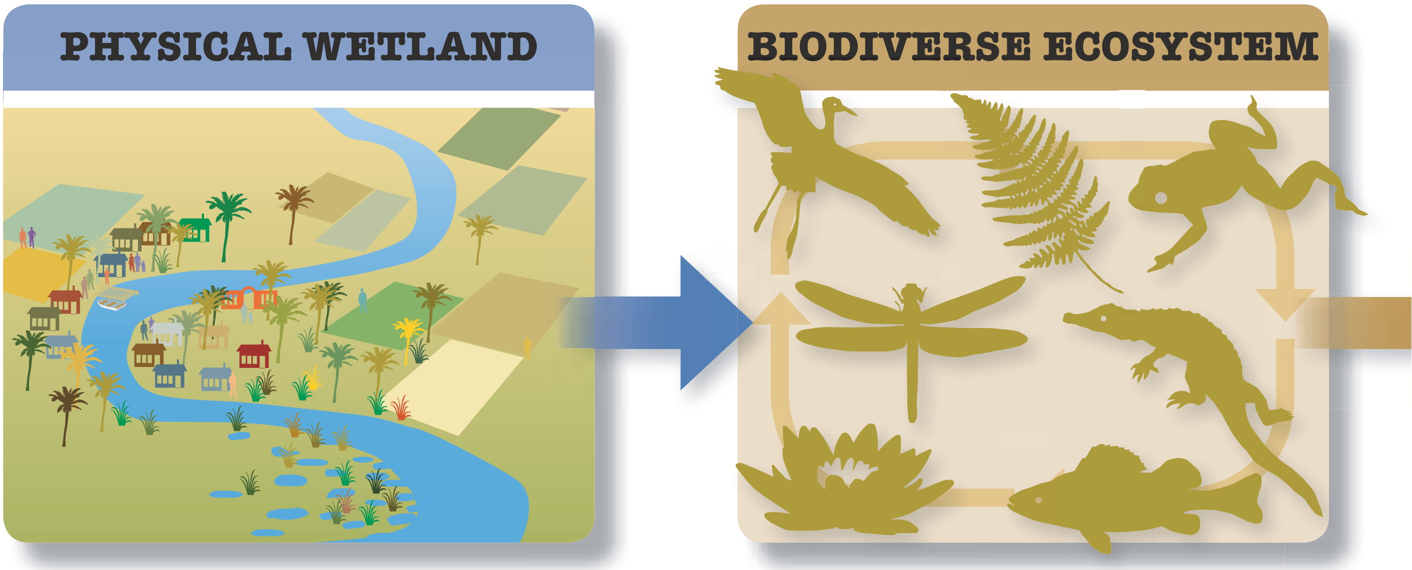



**Figure 23: Adapted sustainable livelihood analytical model**

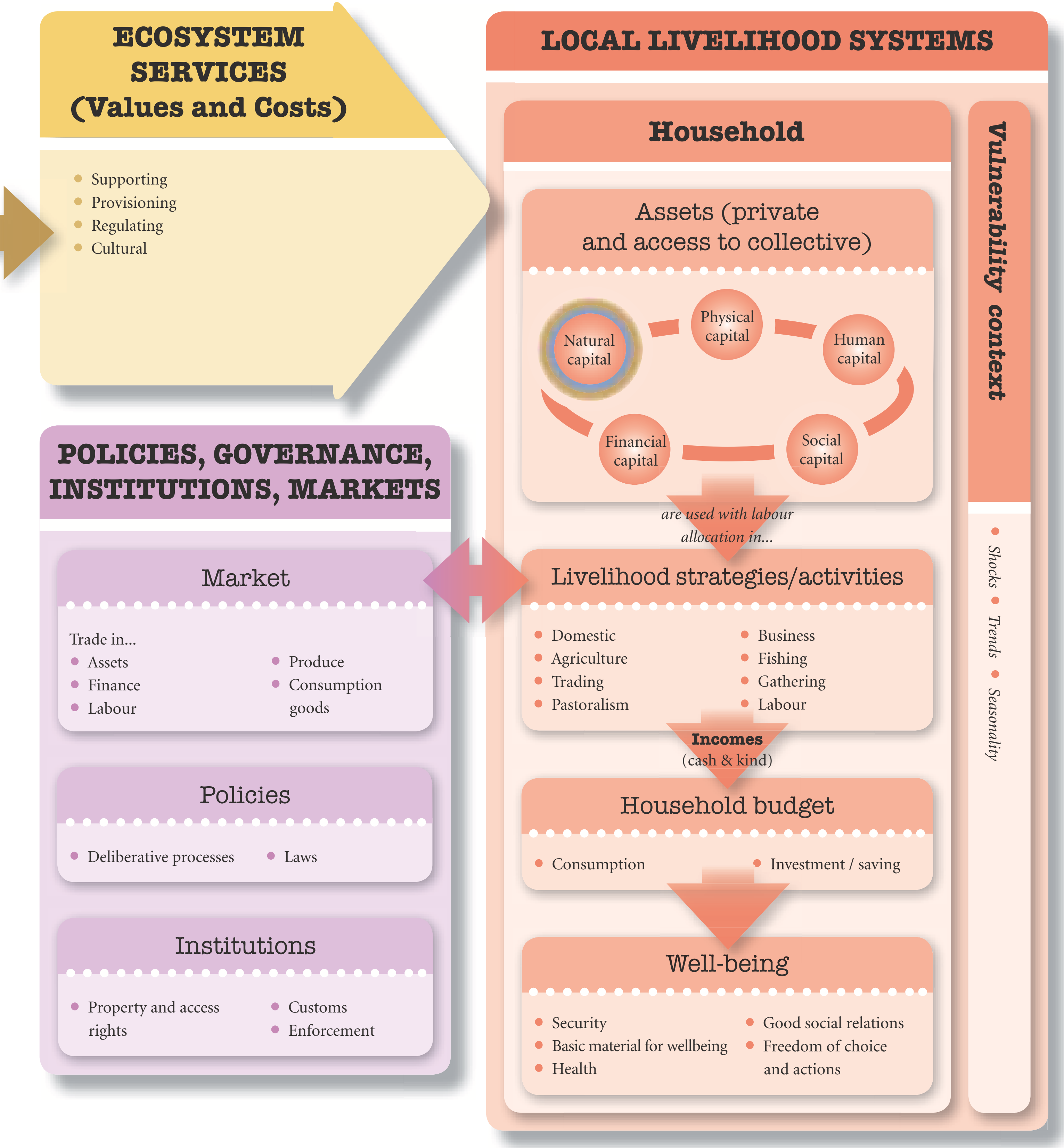
property, or even use as open access resources. These capitals are categorised into five distinct types:

- *Human capital*: this refers to the household members' 'capabilities' in terms of the number of members and their age, health, education, knowledge, skills, and capacity for work. Indigenous technical knowledge relating to species identification, harvesting and use is a form of human capital of particular interest here.
- *Physical capital:* this refers at household level to the physical equipment and tools that are used in production. At the most basic level it can include the house, boats and fishing gear, bicycles, livestock and so on. At community level it also includes access to infrastructure such as harbours, road networks, clinics, schools and so on.
- *Natural capital:* wetlands and the biodiverse ecosystems they support are seen as 'natural capital', in the sense that they are productive assets which provide a range of ecosystem services to households. Households may privatise areas through clearance for cultivation, and communities may also evolve customary institutions around common access and use of 'natural capital' such as fisheries in order to ensure sustainable offtake levels. Forms include fish stocks, areas of river or lake leased or accessed by licence, agricultural or forest land owned or accessed and so on.
- *Financial capital:* households' savings, credit (and debt, which is negative capital), insurance and so on. At the collective level it may be accessibility of credit.
- *Social capital:* the kinship networks, associations, membership organisations and peer-group networks that people can use in difficulties or turn to in order to gain advantage[2].

Households employ the productive capitals discussed above, in combination with their labour allocation in livelihood strategies, in order to generate incomes and wellbeing. Within communities a range of activities can be observed, including domestic activities (which are all too easily neglected by researchers through gender bias), agricultural cultivation, gathering or hunting/ fishing for a range of forest or wetland products, artisanal processing, trading, labouring and so on. Strategies can also relate to people's consumption choices (e.g. 'doing without' or the sale of assets).

Livelihoods incorporating small-scale fishing are typically occupationally diverse or geographically dispersed, and sometimes both (Allison and Ellis 2001; Allison 2005). Mobility and migration is an important component of many fisherfolk's livelihood strategies (typically involving both men in the catching sector, and women in the post-harvest sector).

The incomes generated (which may be in kind, for instance grain or fish, or in cash through trade), will then be allocated according to budgeting decisions. Some will be consumed, and some may be invested (for instance spent on productive assets or production inputs such as seeds) or saved (or indeed used to pay debts). Households exist within an uncertain environment, and livelihood sustainability is affected by external factors, referred to as the *vulnerability context*[3], reflecting the ever-present risk of seasonal fluctuations, other shocks, and underlying trends in livelihood conditions that are beyond the household's control. Trends might include decreasing catch rates, increasing prices for fish, and factors unrelated to fisheries that nevertheless impact on fishing households, such as rising costs of food staples or medicines. Shocks include storm damage to shore facilities, toxic algal blooms, fuel-price hikes and currency devaluations that affect the costs of fishing inputs and market prices for fishery products. At a household level, illness or death of a family member and the theft or loss of




a fishing net are obvious shocks. Household resilience against shocks can involve both short-term coping strategies and long-term adaptation measures (Ellis 1998).

Private assets represent private wealth. And as the distribution of private assets is typically uneven across households, those households with more assets are more 'wealthy', and are generally more resilient to socio-political or environmental shocks and more able to take advantage of opportunities.

Access to both assets and activities, and the level of incomes derived, is mediated, enabled or hindered by *policies, institutions, governance* and *markets.* This can include social relations, organisations and longer-term processes of socio-economic

Daniel Graf and Kevin Cummings

*A field assistant diving for mussels during survey work on the upper Chambeshi River (Upper Congo)*

change. It includes access and rights regimes and how they work – or don't. (These are of course at the heart of fisheries management.) The Sustainable Livelihoods Approach helps ensure that any fisheries or management intervention considers the range of resources that people may be able to draw on and the factors that may help some to do so, while hindering others.

Finally, this framework points to the households' livelihood outcomes, in terms of their state of *wellbeing*. A livelihood is sustainable if people are able to maintain or improve their standard of living related to wellbeing and income or other human development goals, reduce their vulnerability to external shocks and trends, and ensure their activities are compatible with maintaining the natural resource base – in this case the fish stocks and other aspects of the wetland ecosystem they are using. The MEA (2005) indicates a holistic range of wellbeing indicators relevant here:

- Security
- Basic material for good life
- Health
- Good social relations
- Freedom of choice and action

Understanding how people succeed or fail in sustaining their livelihoods in the face of shocks, trends and seasonality can help to design policies and interventions to assist people's existing coping and adaptive strategies. These may include improving access to education and health care facilities, strengthening rights to land for settlement and agriculture (i.e. not just rights of access to fish stocks), reforming local tax and licence systems, providing financial and enterprise development services (and not just credit for purchase of fishing gear) and promotion of diversification[4] – all issues seldom addressed in fisheries management and policy.

To summarise, in terms of assessing local livelihood systems as part of an integrated wetland assessment, we will be looking for data on:

- Household and collective capital assets (and the property and access rights relating to them)
- Household labour allocation to different livelihood activities across the year, and the types of resources used in activities
- Income levels (cash and kind)
- Household budgeting, between consumption, investment and savings
- Vulnerability context
- Policies, governance, institutions and markets, and the different ways in which they affect livelihoods
- Overall wellbeing
- Patterns of social stratification and wealth ranking

## L3 Nested research design and sampling choices

We recommend a 'nested' modular research design in which data are collected at different levels: from the site level, to sub-locations within it, to village/settlement level, to the household and individual level. This allows the research team to understand the multiple scales at which livelihoods are practised and influenced. Sampling choices are inevitable. It would be too costly in terms of time and money to ask every question to every individual in the target population, so we must narrow down data collection to just the key data we need, and ask a subset of the whole 'population' that should be as representative as possible, within the resource constraints. Therefore the first step is to identify the target population, and then to select within it according to sound principles. It is essential that we are explicit in HOW and WHY we select our study sample, in order to establish the credibility of the data. Sampling choices depend both on the size of the area and on the time and budget available. If severely constrained, cutting the number of household surveys is probably the best way to shorten the overall process without excessive loss of data quality.

Our suggested nested sampling approach:

1. **National and regional level:** Here we need to understand the policy and governance context of the wetland and its use. Policy and policy process review can be conducted through identification and interview of key informants, and review of key policy documents.
2. **The wetland site:** this will have been already selected. It will be important to gather secondary data and interview stakeholders and key informants at this level. Also a market survey can be conducted at the district headquarters.
3. **Locations within the wetland site:** we recommend purposive selection of up to three locations in the designated area. These should be chosen to reflect the variety of different physical, socio-economic and institutional circumstances (for example, varying across an environmental gradient from dry land to standing water, or the degree of remoteness from markets).
4. **Villages or settlements** (and subgroups within them): within each location we would recommend purposive selection of about three settlements. The aim in choosing the settlements is to represent the differing facets of the particular patterns of resource use being examined at the location. It is important here to be alert to the existence of any marginal or transient groups, and to include them.
5. **Households**: within the settlements we recommend a livelihoods sample survey of about 30 randomly chosen households in each village, thus typically 90 households in a wetland or Ramsar site. The exact number is not critical, and a common sense approach will be needed to vary the size of the sample if settlements are very small or very large. It is important to stratify the sampling of the households by wealth groups in order to bring out clearly the critical constraints experienced by poor households in particular.
6. **Intra-household**: particular individuals within households may be important to interview, for instance women or children who collect specific wetland products. These can be treated as key informants to add detail to the household survey.

### L3.1 Location selection

This implies establishing a set of criteria for choosing areas within wetland sites to undertake the assessments. These criteria are as follows:

- Representative livelihood patterns for that wetland (in a broad sense) and significant variations
- Relative extent of rural poverty in different places
- Presence of particular livelihood features considered important to understand for conservation management and policy purposes, or relating particularly to the management issue chosen as the focus of the study
- Geographical spread and agro-ecological or habitat variation
- Logistical feasibility (organisation, distances, budget and so on)

The first of these criteria is a difficult one involving balancing a number of considerations. The critical factor is that the research should be seen to have captured a 'typical' spread of wetland-based livelihood patterns, so that findings have policy and management relevance on a broad scale. An alternative way of looking at this is to avoid locations that are highly atypical in terms of the types of livelihoods and circumstances they represent (for example, the one location that has a fairly developed commercial fishery utilising large motorised vessels, or the one area where there is a luxury tourist resort providing employment).

### L3.2 Village selection

Having made a choice of locations or districts, and, usually, zones within those districts to conduct research, the next stage is village selection. Here again purposive choice of three villages should approximate a set of criteria, some of which are similar to those for selecting districts, while others are slightly different:

- Village selection should bear in mind poverty-relative wealth considerations, given the typical poverty reduction focus of livelihoods assessments
- Villages should differ from each other in some important respect, for comparative purposes
- This difference could be varying degrees of remoteness from infrastructure and services, for example: on a main road; on a dry season-only feeder road; lacking proper road access
- Alternatively, villages might differ in the degree of their reliance on the wetland resource, for example: heavily reliant on direct use of wetlands; less reliant; not very reliant

This last criterion has the important implication that just because livelihoods of people who live in or near wetlands are under investigation, this does not mean that all households interviewed need to rely heavily on that resource for their livelihoods. From a livelihoods perspective, as applied to wetland communities, it is interesting that families combine wetland resource use with other activities in a variety of different ways, and for various strategic reasons, and the extent to which a division of labour occurs so that some families specialise in natural resource use, while others do not (for example  those providing services to others).

### L3.3 Household selection

It is envisaged that the selection of households for interviewing in a sample survey should take place at the same time that qualitative, PRA-type, work is being conducted in a village, and it should be integrated as far as possible with work to value environmental goods and services and relevant biodiversity assessment activities (for example to ensure that information of habitats and species utilised are collected alongside information on their use and value).

The first stage of household selection is for a community wealth ranking exercise (Chapter L8) to be conducted, whereby village households are typically divided between poor, middle, and well-off categories. Then with a list of households in each income-wealth group, a random sample of 10 households is taken from each group. In summary:

- PRA wealth ranking of village households, resulting eventually in three income-wealth groups
- Random sampling from each income-wealth group
- Ten households from the well-off group
- Ten households from the middle group
- Ten households from the poor group
- This gives 30 households in total per village, and
- Ninety households per research district or location

One or two 'spare' households should be included in case selected households are unavailable or unwilling to participate.

While this procedure will yield a statistically defensible sample of households in wetland villages, it may not provide enough detail on the activity of wetland resource use if only a minority of households in the village actually engage in wetland biodiversity-related livelihood activities (as opposed to agriculture and non-natural resource activities). There are several alternatives here. One is to follow the procedure as stated so that at the very least the typical patterns of livelihood in the wetland village are captured, but to add additional wetland-resource dependent households equally across the wealth categories until a sufficiently large sub-sample of such households is captured. The minimum sample size of specifically wetland-dependent households that would enable general things to be said about wetland resource use as an activity in that community is 30 households.

Alternatively, if the objective of the assessment is so definitely oriented to wetland resource use as to exclude those households not directly using wild wetland products from the zone of interest, then the sampling frame can be re-specified accordingly. The entire process of undertaking wealth ranking and sample selection is then done only on those households identified as being involved with floodplain agriculture, hunting, fishing, and gathering of wetland products.

**Table 12: Data collection for livelihoods analysis**

| SCALE OF ASSESSMENT | GENERAL AREAS | SPECIFICS RELATING TO WETLANDS |
|---|---|---|
| District, site, locations | • Population level and status<br>• Institutional arrangements and local government<br>• Social service provision | • Physical characteristics and related livelihood use patterns<br>• Market conditions<br>• Conservation policy |
| Village and subgroup | • History of settlement<br>• Social stratification and wealth-ranking<br>• Main livelihood practices<br>• Spatial location<br>• Policies, institutions and processes | • Demography/migration<br>• Vulnerability/social exclusion<br>• Deliberative processes and governance relations<br>• Resource management |
| Household and intra-household | • Household assets and entitlements<br>• Activities<br>• Income sources<br>• Expenditure | • Entitlement to resource use<br>• Assets and tools for resource use<br>• Location of resource use activities<br>• Quantities and diversity of resources used/ extracted<br>• Incomes from wetlands (cash and kind) |

# L4 Selecting and using the livelihood assessment tools in the field research process

This section of the manual contains advice and guidelines for conducting the secondary data collection, key informant, and group or PRA-type research activities in sample villages.

A range of different livelihood assessment tools are needed to ensure that all relevant aspects of livelihood-based wetland resource use are recorded and linked through to economic valuation and biodiversity assessment. Recommended tools include:

- Profiling using secondary data and literature review
- Stakeholder interviews
- Market surveys
- Key informant interviews
- Village group discussion and PRA exercises
    - wealth ranking
    - village livelihood timeline
    - resource mapping
    - institutional reviews
    - others
- Focus group discussion and PRA exercises (separate groups by gender, occupation groups and so on)
- Participant observation
- Household surveys

The scale (district, village or household) at which the data are being collected will influence both the type of data (see Table 12), and the specific tool use to collate the information.

### L4.1 Introduction to livelihood assessment tools

The overall objective of using these research methods is the same whenever the objective is to discover the factors inhibiting the ability of people to find routes out of poverty. The interest is in people's livelihoods, whether they are improving or deteriorating, the factors that help them to construct stronger livelihoods, and those that weaken their ability to make a viable living. Also relevant are the factors that cause people to diversify their livelihoods (i.e. that increase the range of different activities that they undertake in order to gain a living).

The setting out of particular methods here should not be regarded as the only way of collecting the different types of information that is sought. It will often prove useful to seek the same information utilising several different methods (such as key informants, group meetings, or spot interviews with individuals) in order to triangulate different sources and reach a multi-faceted view of the topic under investigation.

Many of the sub-sections below pose livelihood issues in the form of questions, but it is not intended that these are necessarily asked in their current form. Researchers will need to think through how they will address each of the issues implied by the question, and what will be the best way of gaining the required understanding. Researchers should seek and note different perspectives, not aim for a single answer. There may, of course, be occasions when everyone widely concurs about a particular issue, but many others when they do not, and silences may sometimes indicate when individuals are reserving their view about something.

The following principles apply especially to Chapters L5 to L6:

1. Focus on ranges of experience and difference, not on 'averages'
2. The prime interest here is poverty, so we need to disaggregate understandings according to different households, strategies, relative poverty and wealth
3. Investigate gender differences for all of these issues, as appropriate
4. Seek understanding, not just description: the 'why', not only the 'what'
5. Probe on changes and trends whenever appropriate
6. Ask about problems, constraints or hindrances faced for any of the issues, if appropriate
7. Vary research methods according to what seems most appropriate – some of the issues that are listed here under group methods may be better approached through interviews with a range of different individuals
8. It is important to have a firm idea about how data gets recorded and written up – good records need to be kept during group meetings, perhaps by someone other than the facilitator, and notes should be written up straight afterwards; the same applies to semi-structured interviews with individuals and households

In summary, the purpose of the qualitative research can be summarised as identifying ways whereby it becomes easier for people to construct viable and improving livelihoods. This implies that:

- We need to know not just what people do, but why they do it. Understanding people's motivations and incentives is critical if they are to be engaged in conservation efforts
- We need to know what it is that enables people to do certain things relatively easily, but makes other things very difficult for them to start up or engage in
- What are the factors in the policy environment – which includes policy institutions of all kinds and levels – that help people versus those that hinder or block people's options and opportunities

The qualitative research methods (Chapters L5 to L12) should precede the sample survey, so that members of the community have already got used to having the assessment team around, and have had a chance to voice their views on a variety of different issues, before selected households are interviewed.

### L4.2 The importance of probing further in interviews

- *Blocking or inhibiting factors in people's livelihoods*: A key purpose of livelihoods assessment in the context of poverty reduction and conservation is to discover what stops people from doing things, as well as what helps people to do things. The factors that stop people from conserving resources or taking up new economic opportunities may not be at all obvious, either because they are regarded as 'normal' or because people feel they cannot do anything about them anyway. Cultural factors or social norms that prevent women or men from doing certain things is one example of the first type of reason. Licences and taxes imposed by district authorities is an example of the second type of reason. It is very important that researchers probe further when someone says something like "*this is not worth doing because*...". In many ways, some of the most important new insights of this research are likely to emerge from an understanding of these factors.

- *The Why? Not just the What?:* Field researchers sometimes have a tendency to stop further questions when they have discovered what is happening. For example: "*Do you keep goats?"* is a *what* type of question, and if the respondent says "*Yes*", then the field researcher usually moves on. However, for good livelihoods research, this type of question needs to be followed by why the person does this thing. From *why* questions all kind of other things can usually be pursued, such as why one thing is better than another, or why someone does this rather than something else. For example, "*Why do you keep goats?",* "*I keep goats because they provide me with a means of obtaining income when fish catches decline*", "*Are fish catches declining then, or do you mean seasonally?*". In this way a more complex view of the different reasons for pursuing a complex livelihood strategy can be revealed.

### L4.3 Outputs from livelihoods fieldwork research

The aim of the fieldwork is to generate a dataset and facilitate its analysis in order to answer the research questions and issues. Findings should be fed into ongoing policy processes such as poverty reduction strategy plans, decentralisation, Ramsar site management plans, and community-based or co-management of natural resources. The work may also provide an empirical foundation to current discussion about the utility of the 'livelihoods approach' for poverty reduction in the context of integrated conservation and development approaches.

### L4.4 Data entry, coding, variable names and analysis

After the fieldwork has been completed, the data on the survey forms should be transferred to computer, using a database entry system (OpenOffice Base (freeware) or Microsoft Access (proprietary software)). A database should be designed in which

*William Darwall/Integrated Wetland Assessment project*

*Non-timber forest products (NTFP), gathered from within the Stung Treng Ramsar Site being sold in Stung Treng Market*

data can be entered in the same format as it appears on the survey forms. The survey forms should be designed for codes to be entered at the time of completing the form, and so for the most part coding should be already done and codes can be entered directly to the computer. Similarly variable names should already be devised, corresponding to the cells for data entry. Data entry formats incorporating checks for data consistency should be provided.

## L5 District, site and location level assessment

*The main method used here is profiling – using secondary data collection, supplemented as required by key informant interviews. The purpose of this component is to be able to place the village and household level fieldwork in the context of the district and agro-ecological zone – and, most specifically, the wetland site where the assessment is taking place.*

Key items required are:

- District and site-level map showing chief agro-ecological zones, forests, rivers, swamps, lakes
- District and site-level maps showing location of survey villages, roads, towns

- District and sub-district demographic data
- Location, number, and level of schools in the sub-district where survey villages are located
- Location, number, and level of health facilities in the sub-district where villages are located
- Agro-ecological data for the district or sub-district where fieldwork is taking place: areas under forest reserves, cultivation, main crops or farming systems (see Chapter 6)
- Overview of conservation and management plans, policies and regulations in force (such as Ramsar designation and planning)
- Any other features of special or notable interest with respect to that district or sub-district, such as recent road upgrades, major public works (dams or irrigation schemes for example), new industries that have come into the district, major problems that are well-known for that district (stealing of nets, lack of transport to market)
- Change in the district: what are the main things that have been changing in this district over the past five years or so? Is it getting richer or poorer? Are income or wealth differences widening or narrowing between different parts of the district? Are people migrating away from or into this district? Are there any events in the last five years for which this district is well-known (environmental change, drought, civil unrest)?

A market survey is also important here to establish the trading conditions for wetland products.

## L6 Village assessment

*The main methods here are profiling using secondary data and key informants, supplemented where necessary by group or individual discussions.*

Key items required are:

- Name of community and parish; its location, with a map showing key features of village and surrounding area
- Number of households and village population
- Ethnic affiliations, linguistic groups, main religions
- Significant migrations into area over the past two or three decades
- Main current sources of livelihood in the village
- Change in the village: what are the main things that have been changing in this village over the past five years or so? Is it getting richer or poorer? Are people migrating away from or into the village?
- Institutions and organisations in the village; what institutions exist within the community? What outside organisations are represented or active within the community?
    - What traditional institutions exist (e.g. traditional chieftancy: is there a traditional chief? How is he (usually!) selected? What is his role? What other 'traditional' institutions exist?)
    - What political institutions exist (village chairman, elected councils, etc.)?
    - What formal organisations exist (e.g. community-level branches of development agencies, official cooperatives)?
    - What community-based organisations (CBOs) exist (fishermen associations, farmers groups, cooperatives, credit associations, social/religious organisations)?
    - What production services exist (e.g. agricultural extension, microcredit services, supply of nets, marketing)?
    - What social services exist (e.g. health clinics, schools)?
    - What non-government organisations (NGOs) exist and what do they do?
- What significant private businesses operate in the locality?
- What development initiatives have taken place within this community in the last 10 years? How were they implemented? What happened? (Probe for history, attitudes, comments). Relevant areas in wetland might include irrigation schemes for rice or crop horticulture, ecotourism, sport fishing and wildlife hunting
- Common property: what key productive resources are held in common by the community? What criteria, rules and

institutions govern access?

- Land tenure: what is the main type of land holding in the village (e.g. private ownership, customary tenure)?
    - If someone wants more land or to start-up farming here, how is access to land obtained?
    - How is ownership, access, control over land distributed between men and women?

Note: when establishing a list of the existence and function of organisations and institutions, it is also important to probe about their effectiveness. Do they actually do anything? How responsive are they to the needs of their members or to the community as a whole? Some supplementary PRA work may be required in order to establish some of these aspects e.g. institutional mapping/Venn diagrams, ranking. Also change is important – which institutions are declining and which are rising in importance?

### L6.1 Output

The output of this section should be a village-level report corresponding to the checklist given above. This report should also try to take a critical view of things that do not work, especially institutions that do not work well for the poor. Of special interest is to identify factors in the social and institutional environment that inhibit rather than encourage people from taking advantage of livelihood opportunities or creating new opportunities for themselves.

## L7 Group discussions and Participatory Rural Appraisal (PRA) methods

PRA-type work in villages does not need to utilise very complex or lengthy participatory techniques. In many instances, the type of information being sought can best be obtained via group discussions, and these may involve a general cross-section of the village, or groups formed around particular activities or issues (for example migrant fishermen, hunters, people engaged in the wildlife trade, women who gather wild foods, and so on). Sometimes these groups will suggest themselves due to the membership of people in a community management activity (for example a village natural resource management committee), but researchers should be alert to how representative the membership is of such self-defined groups, and sometimes group formation drawing on a wider population and deliberately including poorer members of the community will be more appropriate.

In other instances, specific understanding of strategies and constraints may be more accurately obtained through discussions with individuals and households. This is a matter of judgement on the part of the researcher, and so-called 'triangulation' whereby the same information is approached using several different methods should be considered, especially where there is a lack of clarity concerning the interpretation of issues or events.

The main areas of interest to be covered utilising qualitative research methods are set out in Chapters L5 to L11. These typically provide a checklist of the points that need to be covered in group meetings. They may also suggest other PRA-type activities that should be conducted such as mapping of the seasonal migration patterns of wetland resource users. Sometimes they ask for specific quantitative data on which a consensus view is sought such as past and current prices of fishing gear or fish sales, or perceptions on habitat and vegetation change or resource abundance changes.

It is important that PRA field notes are written up soon after conducting group activities, while the direction of the discussion, and key points raised, are still fresh in the mind of the facilitator. In some cases (see Figure 50 in the appendix) a format for summarising discussions on a single page is suggested.

## L8 Wealth ranking

PRA wealth ranking is best conducted by someone experienced in this method. Two main approaches seem to be followed: one depends on a consensus discussion in a focus group meeting; the other depends on household ranking by a number of individuals (key informants) or small groups, with the final division into categories determined by adding together individual rankings (this second method is described in detail below). Note that if done properly, wealth ranking will often yield more than three wealth sub-groups, therefore the re-organisation of the sample frame into three groups must take place after the wealth ranking by amalgamating adjacent sub-groups. Also, wealth ranking can be a valuable exercise in itself, independently of its function as a means of stratifying a household sample. The process of wealth ranking yields valuable information on the criteria utilised within the community to distinguish relative wealth and poverty. In addition, the wealth ranking exercise can be used to draw out information about the dynamics of poverty in the community (i.e. who is moving between wealth categories and what causes these movements).

Initially, this exercise should be conducted with participants themselves choosing the number of income-wealth groupings, and defining the criteria separating one group from another. This information has value for the livelihoods analysis in itself, and field notes from the exercise should be written up. As well as the groupings, the criteria utilised by villagers for distinguishing households are of research interest; for example, the rich may be distinguished by having land holding above a certain size, or cattle above a certain number, or possession of particular types of physical asset, or some combination of these or other

Kong Kim Sreng/Integrated Wetland Assessment project

*A* troung *(bamboo case) used by fishers in Stung Treng Ramsar Site to keep fish alive before transport to a market*

indicators. Also, the wealth ranking exercise may provide an opportunity to discover something about the direction of change — who is moving into or out of poverty in the village — and the reasons for this.

### L8.1 Output

The groups, criteria and other information about the dynamics of poverty discovered during the wealth ranking exercise should be written up for each village. The re-classifying into three groups results in the sample frame from which the stratified random sample of households is drawn (as described in Chapter L3).

### L8.2 A wealth ranking methodology

The approach described below follows the wealth ranking methodology of Grandin (1988) closely. Before wealth ranking, simple data collection forms should be prepared in order to record:

- Location, date, researcher name, key informant name and details
- The households ranked in the different groups
- Room for a few extra notes alongside each household name (see step 8 below)
- Room for notes on characteristics of different groups and differences between them.

The principal steps in wealth ranking are:

1. Agree with local facilitator and two or more key informants on:
   i) local concepts and language for describing wealth
   ii) number of wealth categories that informants identify
   iii) a working definition of a household

2. Identify several (three to four) reliable key informants. These should be generally honest, longstanding community members. It is best not to use community leaders or extension officers, but they may suggest candidates. If any informant is reluctant to group people by wealth another should be selected.

3. Introduction. Explain to the informant the nature of the research and the value of knowing about the different problems of richer and poorer families. Ask the informant to give two examples of differences between richer and poorer families to be sure the concepts of wealth are shared. Also check the informant and researcher are using the same definitions for a household.

4. Group activity. List all the households in the village. Best for the chairperson and several others to do this (key informants can be included) – they call out the names as the researcher writes a list. Spend some time on this, as it is important to try to get as complete a list of the households as possible. All should be aware of the ‘boundaries’ of the particular research location.

5. Each household name should then be written on a small card and the cards shuffled. If the informant cannot read the names on the cards, they are read to him and the informant is asked to place each card in one of a series of piles before him or her, corresponding to the previously agreed understanding of different wealth categories in the village. More than three categories may be used as this does not matter at this stage.

William Darwall/Integrated Wetland Assessment project

*Fish being sold in Stung Treng Market*

6. Verification. When finished pick up each card and read the names asking the informant again to be sure (s)he thinks they are in the right pile. (S)he is free to move them into a different pile.

7. Ideally no pile should have more than 50% of the households. If one does, the respondents may need to rethink the criteria they are using to define wealth.

8. Additional household information. The interviewer should then go through the cards in each pile and ask whether the respondent feels each household has become more wealthy or poorer over the last five years, or if they think the wealth of the household has not really changed. Responses can be recorded against the list of names on the data sheet. The informant can then be asked to give one or two reasons for the apparent change. This may be sensitive information.

9. After sorting has been verified discuss the nature of the differences between the different wealth ranks. Do not ask about specific households as this might be sensitive information. Usually it is easiest to begin with the richest group. Ask questions like, "*What do the people in this group have in common?*"

10. After completing the wealth ranking, wealth groups should be re-distributed into three income-wealth categories, with advice from the key informants. The three categories should be: the poor, the middle or better-off, and the rich or well-off. In most cases, this regrouping should be straightforward (the rich and the poor stay the same, and other groups end up in the middle). However, if the exercise produces a lot of groups, some thought may need to be given to how these match the poor, middle, rich distinction; and some help from informants may be needed in order to re-classify households in this way.

These three categories then form the basis from which the ten households to be surveyed are randomly chosen. NB the number of households assigned by the wealth ranking to each category must be recorded before the sample is taken, for otherwise this information will be lost when the cards are mixed up or thrown away.

## L9 Village livelihood timeline and status

The principal method to be used here is that of the village group meeting, which in this case should be a group that represents a reasonable cross-section of the community. Facilitators should be sensitive to the tendency for a few people to dominate group discussions, and should try to elicit responses from the less forthcoming members of the group. The discussion should aim to discover activity patterns of the village and how they have been changing over the past 10 years, including things that have got worse or better, and some general points on environmental change. Questions asked here could also be asked of selected individuals across different social groups in the village, as a way of confirming understandings. Questions specific to wetland resource use and conservation are given later (Chapter L11). Points to cover in discussion include:

- What are the main sources of income in the village now? Is this the same as five years ago? The same as 10 years ago? Are those sources of income as important now as they were five and 10 years ago?
- What new activities are commonplace now that were rare or did not exist before? Activities that have started in the last 10 years? The last five years? How important are these new activities now for the incomes of people in the village? What

activities have stopped?

- What do villagers consider to have got worse in the last five years? Last 10 years? For those whose standard of living has deteriorated, what are the main things that have caused their lives or livelihoods to go down in the last five or 10 years?
- What do villagers consider to have improved in the last five years? Last 10 years? For those whose standard of living has increased, what are the main things that have got better in the last five or 10 years?
- What have been the main agricultural problems in the village over the past five or 10 years? What has been happening with maize? Other food crops? Livestock? Milk? Both production and marketing problems can be discussed here.
- What has happened to people's access to natural resources over the past 10 years? Access to land for cultivation? Fragmentation of holdings? Distance of holdings from homestead? Access to forests and forest products? Timber? Woodfuel? Water for agricultural and household purposes? Hay for livestock?
- What has been the impact of health issues (e.g. malaria, TB, water-borne diseases) on the village in the view of members of the group? Are many households affected? What are the main effects on people's ability to gain a reasonable living? How has the village responded to children who are orphaned due to this illness? (Note – questions on illness, particularly around AIDS-related illness and death, need to be handled with sensitivity; trained health professionals should be consulted before making any assessment.)
- How has the status of women changed in this village over the past five or 10 years? Are there more women that are heads of households than before? Are there activities that women do now that they did not usually do before? What livelihood activities are women still not permitted to do in this community?

### L9.1 Output

Information elicited should be written up in a summary report, and can also be summarised in a matrix format as illustrated in Table 4 in Chapter 4.8.

## L10 Institutional review

The same methods can be used here as for the preceding Chapter, possibly even the same group of people can be used provided that this does not result in 'respondent fatigue'. Of special importance here are the factors that inhibit rather than encourage people from taking advantage of livelihood opportunities or creating new opportunities for themselves.

- Are there particular activities in the village that require special permission or a licence in order to be allowed to do that thing? [Make a list of such activities]
- For these activities, what person, or organization or institution grants permission or issues licences? [Link this to the relevant activity]
- What is the cost of getting permission, or obtaining a licence to start-up this activity? Probe here both for official and 'unofficial' costs (e.g. gift payments to traditional authorities or to local officials)
- Are there particular activities that individuals in the group would like to do, but are unable to do because of the costs that are imposed on starting up the activity?
- Are there any restrictions on moving produce (e.g. non-timber forest products, fish, crops or livestock) from the village to the town for sale?
- If so, what are these restrictions? Are payments required to any person or institution in order to move goods from one place to another?
- Amongst the village organisations and institutions which ones are the most helpful for improving people's standard of living? [Rank list in order of priority as given by people in the group]
- What is it that these organisations do that help people to gain a better living?
- Are there people in the village who are excluded for some reason from the benefits that these organisations can provide? If so which group or groups of people?
- Amongst the village organisations and institutions which ones are least helpful, or even block, people from doing things to improve their standard of living? [Make ranked list of unhelpful organisations and institutions]
- What is it that these organisations do which hold people back from gaining a better living?
- Are there people in the village who are particularly disadvantaged by the way these organisations or institutions work? If so, which group or groups of people?

## L11 Specific wetland use discussion

Most wetland resources are common property and as an activity, gathering, hunting and fishing pose special problems for investigation, due to the cyclical and seasonal nature of many resources, their varying location at different times and the difficulties of establishing rights of access and ownership. Fisherfolk, for example, tend to be more mobile than settled farmers and are sometimes a different ethnic group from the resident agriculturalists in wetland-area villages. Owners of boats and gears may be different from users of those same assets, and wage (or catch-share) labour arrangements may be prevalent. Qualitative data research can be divided into four main categories:

- General discussion about wetland resource use, in a broadly representative village group meeting
- Discussion about regulations, access and management with members of fishing, hunting and gathering households

Gita Kasthala/Darwin Integrated Wetland Assessment Project

*Village meeting in Mtanza-Msona to discuss wetland resource use*

(focus group meetings), and key informants, resident in the village

- If relevant, discussion with migrant fishermen or hunters who are temporarily sited at or nearby to the village
- Mapping of migratory movements made by fishermen and other mobile hunter-gatherers

### L11.1 Category A: general discussion about wetland resources use

Some main questions in a general village discussion about wetland resource use are:

(a) What do the community consider to be *wetland*?

(b) Overall importance of direct uses of non-farm wetland products for survival in this community? Is this just a minority occupation? Do most households have members that fish, hunt or gather wetland products, or are there some families that specialize while others do not engage in these activities at all? Obtain count of households that do and households that do not make substantive use of wetland products in this village

(c) How big an area is exploited by people based in the village? Do village-based fishers and hunters move around and often fish or hunt elsewhere? [Create maps showing these with GPS coordinates]

(d) Where are the main sites that village-based fishermen and hunters go for fishing? [A map may be helpful here – linked to habitat mapping; create maps showing these with GPS coordinates]

(e) How has the importance of fishing, hunting and gathering changed compared to five years ago? Ten years ago?

(f) Is it still possible in this village for people who were not fishing or hunting before to take up fishing and hunting now? Are fishing and hunting seen as a good way to strengthen livelihoods? What are the barriers for people who want to take up fishing and other common property resource-based activities?

(g) What are the seasonal characteristics of fishing, hunting and gathering as occupations? What are the peak months for catches and harvests, and the lowest months during the year? Draw up a calendar showing seasonal changes in these activities; have there been any changes in the seasonal pattern of resource availability compared to five years ago? Ten years ago? (Reasons for these fluctuations? Weather, drying constraints (e.g. rain), fish and wildlife movements/ availability/depletion etc)

(h) Aside from regular annual patterns of fishing and wetland product harvest, are there cyclical changes that occur across years e.g. very good years for fishing occurring every three years or every five years? What is the recollection of the community about years (over the past 10-15 years) that have been very good or very bad years for fishing (reasons/ understanding of fluctuations – biological stocks, weather, markets, costs?)

### L11.2 Category B: access regulation and constraints

Some main questions for discussion with a focus group of wetland product-using households are as follows:

(i) What are the chief regulations about wetland resource access that the village understands to apply to their activities? Do people comply with these regulations?

(j) How are the regulations policed? What is the penalty for non-compliance? Is this an individual penalty or one imposed on the community?

(k) Does the village have its own (community management) system for regulating seasonal, spatial or personal access to natural resources and permitted harvesting equipment (e.g. guns, fishing gears), and how does this work?

(l) Have either formal or village regulations changed over the past five years? Past 10 years? And if, so how have they changed?

(m) Are there conflicts between the way the village authorities would like to manage access to resources, and the rules that are imposed from outside by government departments?

(n) Do the rules (whether village-based or imposed from outside) mean that some individuals have permanent rights to use natural resources while others are always excluded?

(o) Have outsiders been coming in to use wetland resources over the past five years? If so, what effect have they had on the state of the resources (abundance, distribution, ease of harvest)? What effect do new resource users have on the way that resources are managed here?

After discussing these questions in a village group situation, they should be followed up by discussions with key informants to check on the understanding of different people about matters of regulation and access. For example, individuals who are in authority in the village, selected people who specialize in the various natural resource sectors (for example fishing, hunting, charcoal-making), and selected people who do not engage in these activities in order to find out why they do not if they are located in proximity to these resources.

### L11.3 Category C: external resource users

This category comprises migrant fishermen and other migrant resource users who are located at or nearby to the resident villages. Questions to be asked of this group are:

(p) Where are you from? (place of permanent residence)

(q) Which resources are you using? What is the main resource that you come here to use?

(r) Duration of stay in the wetland? Other places you carry out these activities? Always go to the same places? Where are these places? Do you come every year? Or do you come only when you hear that there are good fish stocks (for example) here? [This set of questions should allow a map of places on the lake, river or coastline that are favoured by this group of resource users to be drawn, together with info on the time they spend at each location]

(s) Why do you come to this village in particular? What are the advantages of being located here? [List reasons given by the group, and follow up particularly on relationships between the migrants and the resident community e.g. exchanges, trading arrangements etc.]

(t) Do you need permission from the village authorities to be here? How do you get this permission?

(u) Is it easier or more difficult to get permission to fish/hunt/log/gather at this site compared to five years ago? Ten years ago?

(v) What rules and regulations (e.g. rules about when you are allowed to fish, or about net size etc.) apply to your activities? Are these good rules? What do you see as the good or bad points about these rules?

(w) In your place of permanent residence what is the main activity of your family (e.g. farming etc.)? How important is fishing/hunting/gathering for you (i.e. for your livelihood) overall? (e.g. very minor, about a quarter, half etc.)

(x) In general has access to natural resources in the wetland got more difficult? Or less difficult? Over the past five years? The past 10 years? What are the reasons for access getting worse or better?

### L11.4 Category D: mapping movements

This is the mapping exercise alluded to in Chapter L7 above, and is about discovering the movements that wetland resource users make to different parts of the lake in order to sustain their catches and harvests. This does not require 'formal' research methods, but will require visiting villages and temporary fishing or hunting camps, at intervals, along the banks of a river or lake, to find out where people are from, and to ask them about the main places that they use resources. Seasonal information about fishing, hunting and gathering locations should be included. Questions asked are where are you from? How long are you here? What other sites do you fish/hunt/gather/burn? In which seasons do you move between these places? For villages visited for PRA or sample survey purposes, this can obviously be done at the same time as the PRA. See Section on Mapping (Chapter 6) for further information on the types of spatial data that should be collected.

## L12 Key informant interview

Some people encountered during the research process will evidently have either a better understanding of some of the issues, be more eloquent in explaining, or both. These individuals should be indentified and interviewed separately, either alone or in a group with other 'key informants' in order to probe deeper into the issues, and to test initial insights emerging.

It will be important to interview key informants from marginalised and poor groups, specific occupational groups using the wetland, women, traders and so on.

## L13 Household sample survey

Many of the questions in the sample survey (see Figure 51 in appendix) are to do with people's work and incomes. Income is a sensitive matter, which is sometimes difficult to discuss with people, and enumerators should make very clear to respondents that this information is for research use only and no one else will know about it. Sample selection should include some 'spare' households in case of non-cooperation by one or more chosen households. Enumerators should try to develop a good relationship with the family, and should be prepared to make repeat visits to clarify points that do not seem to make sense or to obtain more complete information.

Enumerators should also be sensitive to gender relations, and where it seems evident that clearer results would emerge by interviewing a particular woman or man separately, then this should be done in order to improve the accuracy of the data (both women and men may conceal details of particular activities and income flows from each other). Some further points about the conduct of the sample survey are:

(a) Aside from gender-sensitive income data, interviews should be conducted with several members of the household present, so that individuals can remind each other of information that requires recall up to one year back
(b) Where information is required of a household member who is absent (e.g. someone out earning wages), a return visit must be done to complete this information
(c) The attempt should be made to collect gender-sensitive income data from the individual concerned – this is likely to apply especially to specialist income-generating activities such as fish drying, beer brewing (Figure 51, Form E) or work outside the home (Figure 51, Form F); one way of achieving this may be to have both a female and male enumerator visit the household, which may make separate discussions with individuals easier to do
(d) After initial completion, the survey forms should be checked carefully for the consistency and accuracy of the information they contain. The proposed range of sample sizes is relatively small, so attention to detail is important. Answers which do not make sense, or which contradict each other in different parts of the questionnaire, should be checked by revisit to the household
(e) Enumerators should have a supervisor, who signs off on the front page of the questionnaire only when completely satisfied with the quality of the data on the form. If there are problems with the replies, a return visit to the household should be made to try and rectify them
(f) In general most of the survey can be completed with a single visit to the household, provided this has been fixed in advance so that the relevant members of the household are there to be interviewed
(g) Note, however, that Form F (Figure 51) must be completed for <u>each individual</u> who has obtained non-farm or non-wetland-based income during the past year, including casual wage work, permanent wage or salary work, self-employment in a non-farm or non-wetland activity like driving a rickshaw, working in a government office, or pension income resulting from former full-time employment

### Further reading


Allison, E.H., and Ellis, F. 2001. The livelihoods approach and management of small-scale fisheries. *Marine Policy* **25**: 377-88.

Allison, E.H. 2005. *The fisheries sector, livelihoods and poverty reduction in eastern and southern Africa*. In: Ellis, F. and Freeman, H.A. (Eds.) 2005. *Rural Livelihoods and poverty reduction policies*. Routledge, London, UK.

Baumgartner, R. & Hogger, R., 2004. *In Search of Sustainable Livelihood Systems: Managing Resources and Change*, Sage Publications Pvt. Ltd.

Dorwood, A., Poole, N., Morrison, J., Kydd, J., and Urey, I.. 2003. Markets, institutions and technology: missing links in livelihoods analysis. *Development Policy and Review* **21**: 319-32.

Ellis, F. 1998. Household strategies and rural livelihood diversification. *J. of Dev. Studies* **35**: 1-38.

Grandin, B.E. 1988. *Wealth Ranking in Smallholder Communities: A Field Manual*. Intermediate Technology Publications, London, UK.

Scoones, I., 2009. Livelihood perspectives and rural development. *Journal of Peasant Studies*, 36(1). Available at: http://community.eldis.org/.59b9a649/15/cmd.233/enclosure..59c20af7

Springate-Baginski, O. & Blaikie, P., 2007. *Forests, People and Power: The Political Ecology of Reform in South Asia*, London: Earthscan.

Stirrat, R.L. 2004. Yet another ‘magic bullet’: the case of social capital. *Aquatic Resources. Culture and Development* **1**: 25-33.


The methodologies presented here are similar to those used during the LADDER survey conducted by the Overseas Development Group, University of East Anglia. Their web-site contains detailed information about the methods and data obtained, including the database (downloadable) that they used to store the data.

See their website:
www1.uea.ac.uk/cm/home/schools/ssf/dev/odg/research/currentprojects/LADDER
and the database link:
www1.uea.ac.uk/cm/home/schools/ssf/dev/odg/research/currentprojects/LADDER/Data

[1] The use of relatively small sample-sizes for household surveys recognises that household survey data is time-consuming to collect and validate, and that such surveys can generate vast quantities of data which are then seldom properly validated and analysed. These drawbacks are well recognised in the major UNDP and World Bank household surveys conducted as part of national Poverty Reduction Strategy Programmes. This approach seeks to complement, rather than replicate these large-scale survey and monitoring exercises.

[2] Some argue that this framework would benefit from the addition of further categories of capital – political and cultural (Sirrat, 2004).

[3] What is known as the vulnerability context in the livelihood framework is conceptually similar to what is termed ‘risk exposure’ in the literature on vulnerability.

[4] Diversification need not mean diversifying out of fishing entirely; it includes promoting alternative activities that may supplement fishing and reduce dependency on fish stocks.



# Chapter 5

## Economic valuation tools

*Lucy Emerton*

Putting a value on the ecosystem services which wetlands provide to human communities can ensure that they are better acknowledged and accounted for in decision-making. This section introduces the basic concepts and thinking behind valuation, and offers guidance in selecting and applying valuation methods.



*Gita Kasthala/Darwin Integrated Wetland Assessment project*

## Economic valuation tools

*This section presents the economic valuation tools. It includes:*

- ✔ *An introduction to the ecosystem services approach*
- ✔ *An overview to wetland valuation, and a range of methods through which valuation can be made*
- ✔ *A review of research design techniques and requirements, with practical examples*
- ✔ *Analysis of wetland valuation data*

*The subject area is extremely complex and rapidly evolving. In the space available here we can provide only an introduction, and we strongly recommend further reading, which is provided at the end of the section. We also recommend careful selection of a team leader already proficient in these methods.*

## E1 Why value wetland goods and services?

### E1.1 The problem of under-valuation

An inherent tension exists between economic development and wetland conservation, a tension due to divergent economic and social priorities. This in turn relates to making choices about how, where and why to invest, produce, and consume; and balancing the trade-offs that will inevitably arise in the impacts of development activities on conservation goals, and vice versa.

Economic measures and indicators can inform these choices about how to use and allocate funds, resources and land. They can also have a strong influence on how development and conservation trade-offs are conceptualised and decisions are made. Yet the economic calculations that underpin wetland development decisions have conventionally tended to be flawed, and fundamentally incomplete, because they typically omit an important set of costs and benefits — the values associated with ecosystem goods and services.

For the most part, calculations of the returns to different investments or to alternative land and resource uses do not factor in wetland values. Although conventional analysis decrees that the 'best' or most efficient allocation of resources is one that maximizes economic returns, measures of the returns to different land, resource and investment options have for the most part failed to deal adequately with wetland costs and benefits. Most cost-benefit analyses, investment appraisals and other economic calculations are therefore misleading in their conclusions as to the relative costs, benefits and returns to different uses of land, resources and investment funds.

From an economic viewpoint, wetland ecosystems remain some of the world's most under-valued resources. Decision-makers and land-use planners have long perceived there to be little economic benefit to conserving wetlands, and few economic costs attached

Eddie Allison / Darwin Integrated Wetland Assessment Project

*Mat manufacture using wetland resources in Mtanza-Msona* to their degradation and loss. In particular, the non-marketed goods and services associated with wetlands (most notably local use of wetland resources, and the ecosystem functions that they yield) are typically excluded from consideration when decisions are made about managing and using land, water, funds and other resources in wetland areas. This does not just underestimate the importance of wetlands as a stock of natural capital and flow of economic services, it also marginalises the (often poor) groups who depend on these values.

As a result, decisions have tended to be made on the basis of only partial information, thereby favouring short-term (and often unsustainable) development imperatives or leading to conservation and development choices that fail to optimise economic benefits. At the worst, in the absence of information about ecosystem values, substantial misallocation of resources has occurred and gone unrecognised (James 1991). As a result, immense economic costs have often been incurred by the coastal populations who depend on ecosystem goods and services.

Given a tendency to under-valuation, the management of wetlands has been biased all over the globe towards modifying, converting, over-exploiting and degrading them, in the interests of other seemingly more 'productive' or 'profitable' land and resource management options. Wetland under-valuation has also been a persistent problem in environmental planning and practice. In all too many cases it has been difficult to justify conservation in development terms, or to make sure that the resulting activities are economically viable, socially equitable, or financially sustainable.

### E1.2 Factoring wetland values into decision-making

The problem is not that wetlands have no economic value, but rather that this value is poorly understood, rarely articulated, and as a result is frequently omitted from decision-making. Therefore taking a comprehensive ecosystem service approach would require a very extensive research exercise in order to gain:

- *Biophysical understanding of how and where the ecosystem services are generated*
- *Where and in what terms the benefits are realised*
- *What level of value the services provide*
- *How ecosystems are governed and the opportunities for compensating the providers of public goods*
- *In what ways service flows and values would be likely to change under different management and utilisation scenarios*

(Turner *et al.* 2008)

In this toolkit, we look at how to quantify the economic value of wetland goods and services. Wetland valuation involves determining people's preferences: how much they might be willing to pay for ecosystem goods and services, and how much better or worse off they would consider themselves to be as a result of changes in their supply.

By expressing these preferences, valuation aims to make ecosystem goods and services directly comparable with other sectors of the economy when investments are appraised, activities are planned, policies are formulated, or land and resource use decisions are made. When properly measured, the total economic value of ecosystem functions, services and resources frequently exceeds the economic gains from activities which are based on ecosystem conversion or degradation (Barbier 1994). Although a better understanding of the economic value of ecosystems does not necessarily favour their conservation and sustainable use, it at least permits them to be considered as economically productive systems, alongside other possible uses of land, resources, and funds.

## E2 Summary of steps in wetland valuation

This chapter describes the stages in carrying out wetland economic valuation, as part of an integrated economic-biodiversity and livelihood assessment. As illustrated in Figure 24, economic valuation follows a series of iterative steps that complement, and run parallel to, those carried out in biodiversity and livelihood assessment (see Chapters 3 and 4). The rest of this chapter traces through these steps, and describes how to carry out an economic assessment of wetland values.

## E3 Stage I: Setting the study scope and parameters

*Step 1: Defining the study goal and management focus*

However academically interesting it is to know the monetary value of a particular wetland good, service or site, wetland valuation is not an end in itself. It is a means to an end – better and more informed conservation and development decision-making. Economic valuation does not take place in isolation; it is prompted by a particular management or policy issue that needs to be addressed, or a particular decision that needs to be made about the use of funds, land or other resources.

The information that is generated by a valuation study aims to assist in understanding or dealing with this issue, or in making this decision. It is the management or policy issue which determines the scope, objective and parameters of the valuation study – what it will include, what it will exclude, which values will be considered, and to what ends.

The very first step in wetland valuation is therefore to define and understand the management context in which the study is taking place, and the management need and issue it addresses. This in turn determines the questions which have to be answered by the valuation study, and the information it needs to generate.

It is impossible to pre-determine what these questions will be as the specific management issue that is being addressed by the

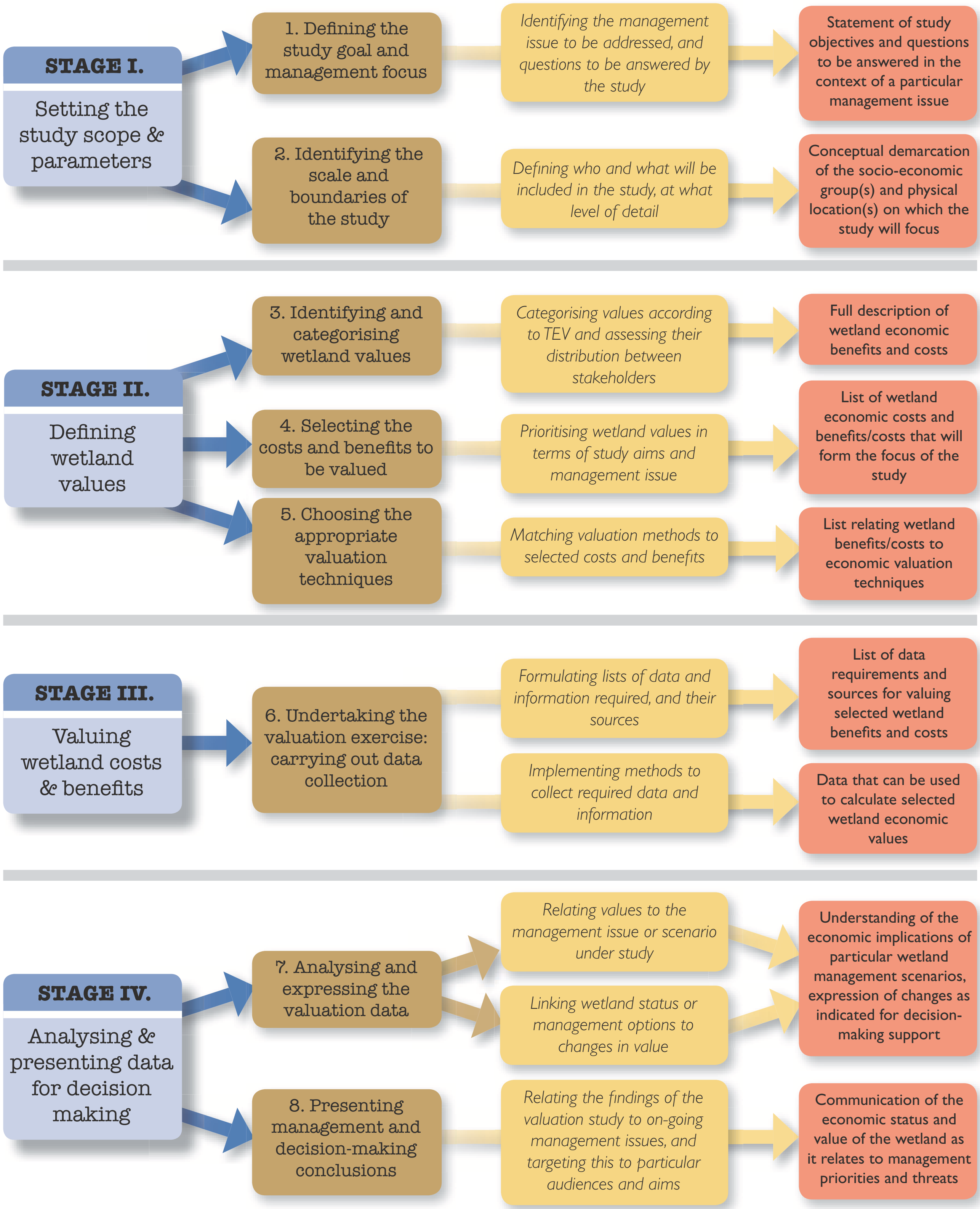



**Figure 24: Summary of stages and steps in wetland valuation**

valuation study will vary in different cases. There are however certain types of issues and trade-offs which are commonly faced by wetland managers, and for which valuation studies can provide important information to assist in decision-making. For example:

- Justifying or making a case for wetland conservation
- Identifying wetland financing needs and mechanisms
- Assessing the impacts of upstream developments on wetland status
- Choosing between particular wetland management regimes
- Assessing the profitability of different sustainable use options
- Looking at needs and niches for local benefit sharing

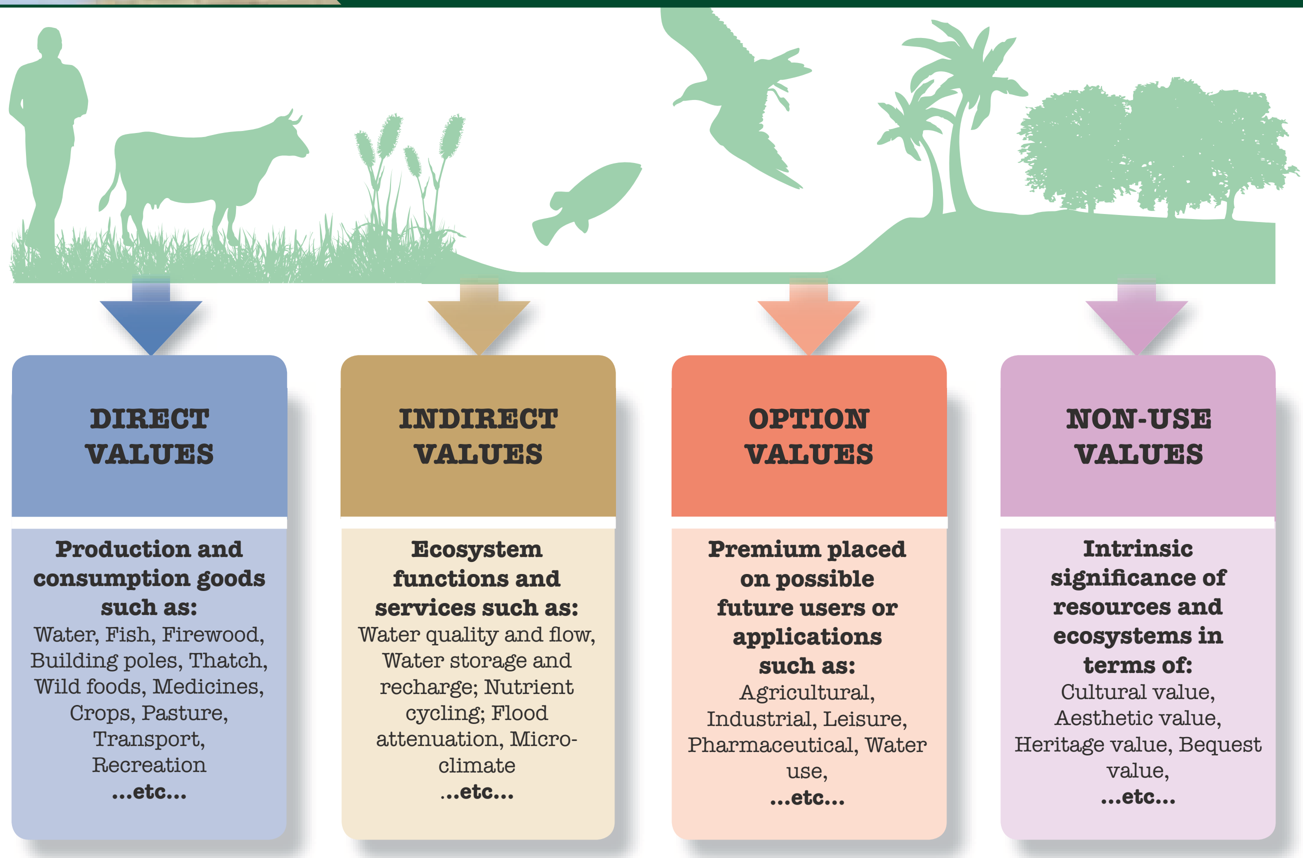



**Figure 25: The total economic value of wetlands from Emerton 2005**

- Setting fees for wetland use, and penalties or fines for illegal activities
- Estimating the relative profitability, or returns, to different investment, land and resource use options in and around wetlands

*Step 2: Identifying the scale and boundaries of the study*

In summary, this step involves defining who and what will be included in the study, at what level of detail. It should result in a conceptual demarcation of the socio-economic group(s) and physical location(s) on which the study will focus.

It is rarely necessary, or practical, for a valuation study to consider each and every value, stakeholder or unit of area associated with a given wetland. In line with the overall objective or management/policy focus, it is necessary to define the boundaries of the valuation study, and to demarcate the area it will actually work in. The second stage of a valuation study is therefore to identify the scale and boundaries within which the study will focus, including the geographic boundary of the site to be studied, its socio-economic boundary or user/beneficiary population, as well as the time period to be incorporated in the study.

## E4 Stage II: Defining wetland values

*Step 3: Identifying and categorising wetland values*

In summary, this step involves prioritizing wetland benefits and selecting those which will be valued in the study. It should result in a list of wetland economic costs and benefits that will form the focus of the study. Field checklists (Figures 52 and 53) for identifying, listing and selecting wetland costs and benefits to be valued are provided in the appendix.

Wetlands yield multiple goods and services, and also incur a range of economic costs. In any valuation study, it is important to define and categorise all the costs and benefits that have relevance to the given wetland under scrutiny, in order to present a broad overview of the economic stocks and flows that are associated with it.

*Benefits*

One reason for the persistent under-valuation of ecosystems is that, traditionally, concepts of economic value have been based on a very narrow definition of benefits. Economists have seen the value of natural ecosystems only in terms of the raw materials and physical products that they generate for human production and consumption, especially focusing on commercial activities and profits. These direct uses however represent only a small proportion of the total value of ecosystems, which generate economic benefits far in excess of just physical or marketed products. The concept of Total Economic Value (TEV) has now become one of the most widely-used frameworks for identifying and categorising ecosystem benefits (Barbier *et al.* 1997). Instead of focusing only on direct commercial values, it also encompasses the subsistence and non-market values, ecological functions and non-use benefits (Figure 25). As well as presenting a more complete picture of the economic importance of ecosystems, it clearly demonstrates the high and wide-ranging economic costs associated with their degradation, which extends beyond the loss of direct use values.

Looking at the TEV of an ecosystem essentially involves considering its full range of characteristics as an integrated system – its resource stocks or assets, flows of environmental services, and the attributes of the ecosystem as a whole (Barbier 1994). Broadly defined, the TEV of water ecosystems such as wetlands and catchment forests include:

- **Direct values:** raw materials and physical products which are used directly for production, consumption and sale such as those providing energy, shelter, foods, agricultural production, water supply, transport, and recreational facilities

- **Indirect values:** the ecological functions which maintain and protect natural and human systems through services such as maintenance of water quality and flow, flood control and storm protection, nutrient retention and micro-climate stabilisation, and the production and consumption activities they support

- **Option values:** the premium placed on maintaining a pool of species and genetic resources for future possible uses, some of which may not be known now, such as leisure, commercial, industrial, agricultural and pharmaceutical applications, and water-based developments

- **Existence values:** the intrinsic value of ecosystems and their component parts, regardless of their current or future use possibilities, such as cultural, aesthetic, heritage and bequest significance

The TEV of wetlands can also be usefully conceptualised in relation to the schema of ecosystem services provided by the MEA (2005). From an economic perspective, ecosystem services correspond to different elements of TEV, including direct values (provisioning services), indirect values (supporting and regulating services), cultural services (existence values), and their possible uses and applications in the future (option values) – as illustrated in Figure 26.

*Costs*

There is a tendency, especially in conservation-based assessments, to ignore the fact that wetlands generate a wide variety of costs, which impact on people's livelihoods and economic activities. As in the case for benefits, wetlands costs have tended to be defined narrowly in the past, focusing only on investment and recurrent costs incurred to the institutions

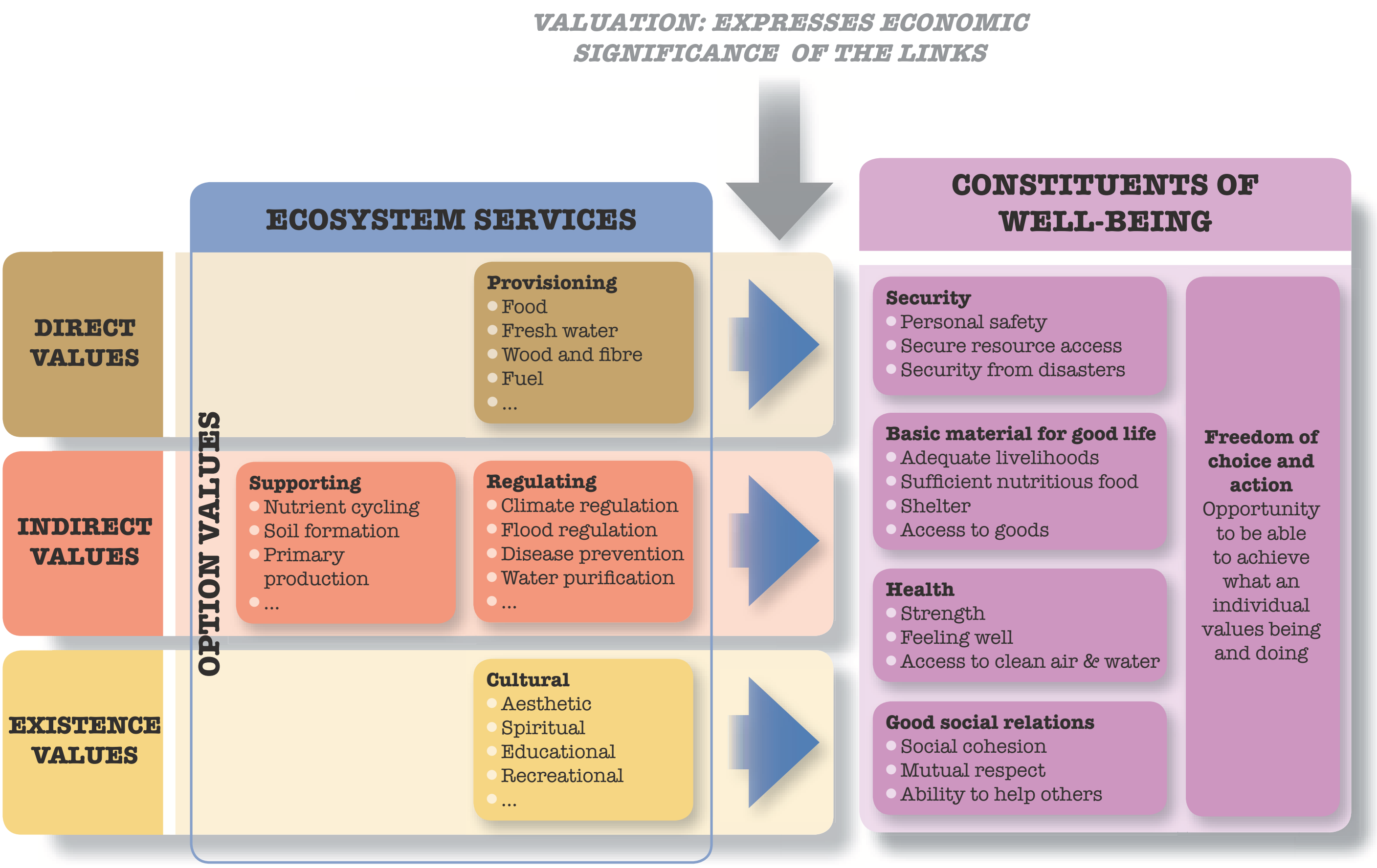



**Figure 26: Ecosystem services, human well-being and the total economic value of wetlands. Adapted from MEA (2005)**

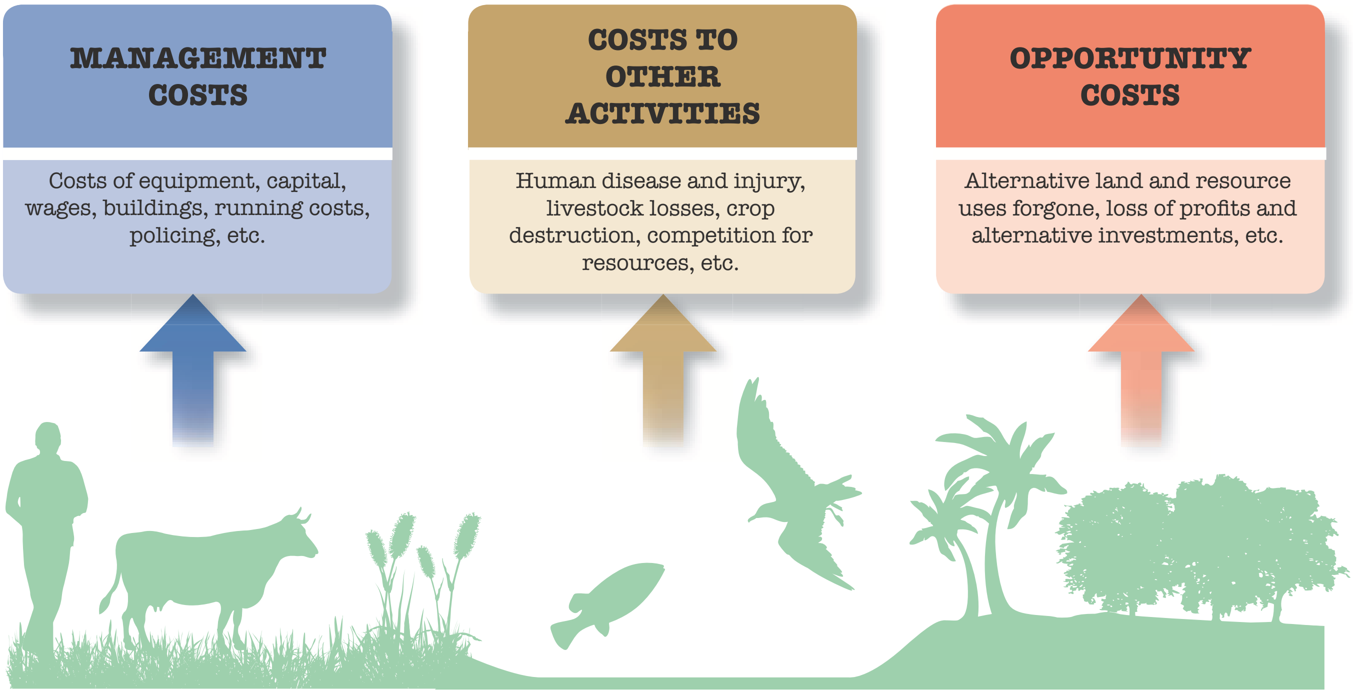



**Figure 27: The total economic cost of wetlands (from Emerton 1999)**

concerned with wetlands management. Wetlands give rise to costs because they preclude, diminish or interfere with other economic consumption and production activities. Valuation must take account of the full range of economic costs associated with wetlands as illustrated in Figure 27.

- **Management costs:** the direct physical expenditures on the equipment, infrastructure and human resources required to manage wetlands
- **Opportunity costs:** alternative uses of time, land, money or other resources required for wetland conservation which could have generated income and profits had they been used or allocated elsewhere
- **Costs to other activities:** damage and interference to human and economic activities caused by wetlands resources and species, including human and livestock disease and injury, crop pests and sources of competition over resources

All of these costs lead to economic losses because they require cash, necessitate expenditures, decrease income or reduce livelihood options. Valuation, in addition to making a monetary estimate of wetlands benefits, attempts to quantify the total economic costs associated with wetlands.

*Step 4: Selecting the costs and benefits to be valued*
There are limited data, time and other resources with which to carry out a valuation study. In most cases it is impossible to value each and every economic benefit and cost associated with a particular wetland. For this reason, it is necessary to decide on the coverage of the study – which benefits and costs it will value, and how. Once the major characteristics and values have been identified, they need to be prioritized in terms of their importance to the overall goal and objectives of the study (which, in turn, is determined by its management focus).

*Step 5: Choosing the appropriate wetland valuation techniques*
In summary, this step involves examining the economic methods and techniques that will be used to value selected wetland benefits/costs. It should result in a list relating wetland benefits/costs to economic valuation techniques. A field checklist for choosing wetland valuation techniques is provided in the appendix (Figure 54).

A wide variety of methods are now available with which to quantify wetland values. Each method has different data and analytical requirements, is more or less applicable to different types of wetland costs and benefits, and has varying suitability in different contexts and situations. For this reason, having defined and prioritized which costs and benefits the valuation study will focus on, it is necessary to decide which method(s) will be used to determine the value of each.

After identifying the values and the costs and ranking them, they need to be assigned a monetary value. There are a number of techniques that are used to do this, which can be categorized in a number of ways. One way of classifying wetland valuation methods is to distinguish between revealed preference methods (those which rely on observing people's behaviour to ascertain the value of wetland goods and services) and stated preference methods (those which directly ask people the value they place

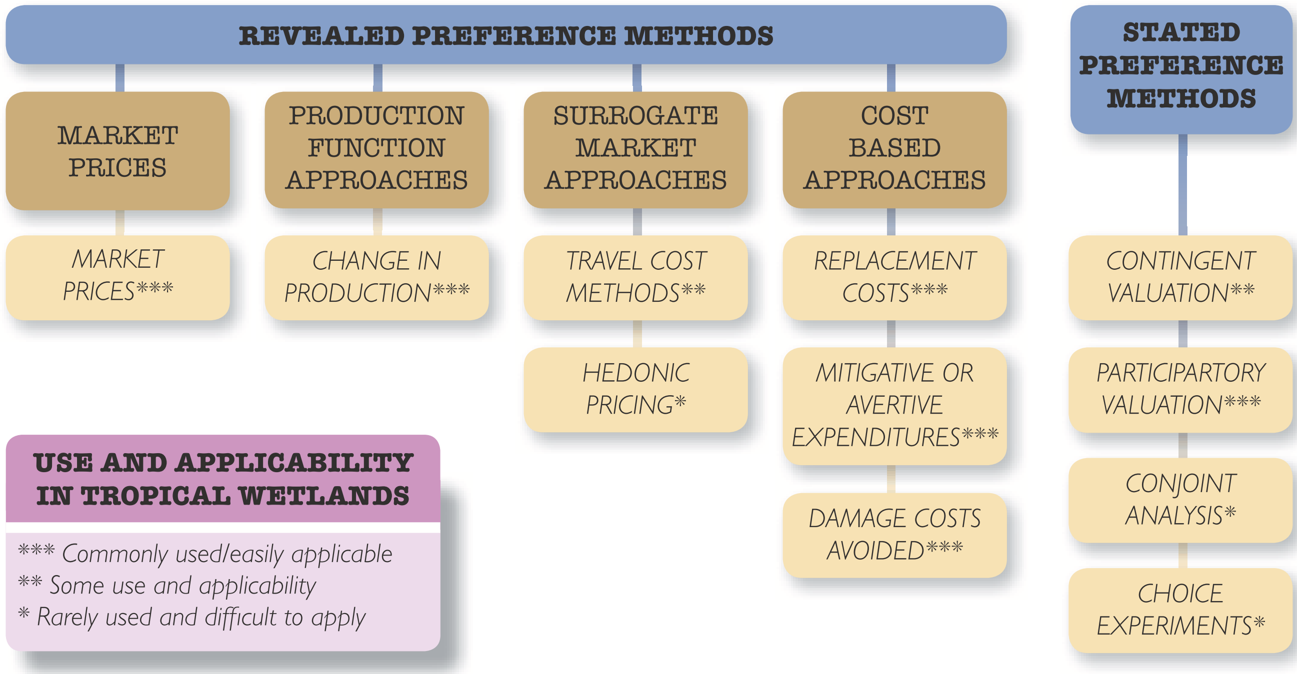



**Figure 28: Methods for wetland valuation (from Emerton and Bos 2004)**

on wetlands). These are illustrated in Figure 28, and described below.

- **Market prices:** this approach looks at the *market price* of ecosystem goods and services as they are bought or sold in the market

- **Production function approaches:** these approaches, including *effect on production*, attempt to relate changes in the output of a marketed good or service to a measurable change in the quality or quantity of ecosystem goods and services by establishing a biophysical or dose-response relationship between ecosystem quality, the provision of particular services, and related production

- **Surrogate market approaches:** these approaches, including *travel costs* and *hedonic pricing*, look at the ways in which the value of ecosystem goods and services are reflected indirectly in people's expenditures, or in the prices of other market goods and services

- **Cost-based approaches:** these approaches, including *replacement costs, mitigative or avertive expenditures* and *damage costs avoided*, look at the market trade-offs or costs avoided of maintaining ecosystems for their goods and services

- **Stated preference approaches:** rather than looking at the way in which people reveal their preferences for ecosystem goods and services through market production and consumption, these approaches ask consumers to state their preference directly. The most well-known technique is *contingent valuation*. *Participatory valuation* is gaining currency particularly in situations where wetland use is primarily for subsistence purposes, while less commonly-used stated preference valuation methods include *conjoint analysis* and *choice experiments*

All of these methods are elaborated in detail below, in Chapter E6. Different categories of method are more or less suitable for different kinds of wetland costs and benefits. Market price and surrogate market price techniques are most suitable for wetland direct values, while wetland indirect values are commonly measured using cost-based and production function approaches. Stated preference methods are, in principle, applicable to any category of wetland benefit, and provide some of the few available methods which can be used to estimate option and existence values.

## E5 Stage III: Valuing wetland costs and benefits

*Step 6: Undertaking the valuation exercise: carrying out data collection*

In summary, this step involves formulating a list of the data that must be collected to enable the economic valuation of wetland benefits. It should result in a list of data requirements for valuing selected wetland benefits and costs. A field checklist for identifying data needs and sources for the valuation exercise is provided in the appendix (Figure 55).

Having prioritised the wetland costs and benefits to be valued, and selected the most appropriate methods by which to do this, it is necessary to determine what data will be required to apply the chosen valuation methods and to identify how these data will be collected. It should be underlined that before commencing valuation fieldwork, it is important to have thought through what data will be required, and how it will be sourced. Typically, a valuation study will use various data collection techniques and information sources, including both primary and secondary data collection:

- **Literature review:** including a review of similar valuation studies carried out in other areas or countries, as well as of documents and reports that contain information on the wetland under study such as project reports, government statistics and records, scientific articles and publications

- **Expert consultation:** including with technical experts (such as sociologists, hydrologists, biologists and ecologists, and civil engineers) as well as with the various stakeholders who are involved in managing and using the wetland (such as government officials, NGOs, community leaders, local households, and wetland user groups)

- **'Traditional' socio-economic information gathering techniques:** such as questionnaires, interviews and statistical analysis

- **Participatory techniques:** such as focus group interviews, PRA and RRA techniques

Having identified the data sources and collection techniques, the next thing is to actually apply the selected valuation methods. A detailed description of each of the main valuation techniques is given below, which is primarily drawn from IUCN's toolkit for valuing water-based ecosystem services (Emerton and Bos 2004).

## E6 Stage III: Applying wetland valuation techniques

### E6.1 Market price techniques

*E6.1.1 Overview of the method*

The simplest, most straightforward and commonly-used method for valuing any good or service is to look at its market price: how much it costs to buy, or what it is worth to sell. In a well-operating and competitive[1] market these prices are determined by the relative demand for and supply of the good or service in question, reflect its true scarcity, and equate to its marginal value[2].

In theory, market price techniques are applicable to any ecosystem good or service that can be freely bought or sold. They are particularly useful for valuing the resources and

Jens Kipping

*A channel within the wetlands of the Okavango Delta, Botswana*

products that are harvested from water-dependent ecosystems, for example timber, fuel wood, fish, or non-timber forest products. In the example of the Zambezi Basin given in Box 7, the study estimated the value of wetland products including crops, livestock, fish and tourism using market prices.

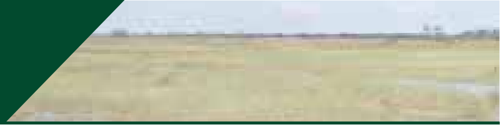
*E6.1.2 Data collection and analysis requirements*

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

1. Find out the quantity of the good used, produced or exchanged
2. Collect data on its market price
3. Multiply price by quantity to determine its value

These data are generally easy to collect and analyse. Market information, including historical trends, can usually be obtained from a wide variety of sources such as government statistics, income and expenditure surveys, or market research studies. In most cases it will be necessary to supplement these secondary sources with original data, for example through performing market checks or conducting some form of socio-economic survey.

When applying this technique it is important to ensure that the data collected covers an adequate period of time and sample of consumers and/or producers. Factors to bear in mind include the possibility that prices, consumption and production may vary between seasons, for different socio-economic groups, at different stages of the marketing or value-added chain, and in different locations.



*E6.1.3 Applicability, strengths and weaknesses*

The greatest advantage of this technique is that it is relatively easy to use as it relies on observing actual market behaviour. Few assumptions, little detailed modelling, and only simple statistical analysis are required to apply it.

A major disadvantage is the fact that many ecosystem goods and services do not have markets or are subject to markets which are highly distorted or irregular. In such cases, it is inappropriate to use market price techniques:

- **Ecosystem services such as catchment protection or nutrient retention are rarely available for purchase or sale**. Because they have many of the characteristics of public goods[3], it is in fact questionable whether the market can ever accurately allocate or price them

- **Many ecosystem goods and natural products are utilised at the subsistence level**. They are not traded in formal markets, and are consumed only within the household

- **There exist a wide variety of subsidies and market interventions which distort the price of natural products or ecosystem-dependent goods**. Examples include subsidies to water and electricity, centrally-set royalties and fees for products such as timber, and state-controlled prices for basic food and consumer items

- **Because markets for most ecosystem goods and services are not well-developed, they tend not to be competitive, and prices are a poor indicator of true social and economic values**. This may be the case where there is an additional social or environmental premium attached to natural goods and services, where there are only a small number of buyers and sellers, or where there is imperfect market information

- **In many cases, even where an ecosystem good has a market and a price, it is impossible to measure the quantities produced or consumed**. Especially at the subsistence level, natural resource consumption and sale is often highly seasonal or irregular. For example, particular products are only available at particular times of the year, are used under special conditions, or are collected and used on an opportunistic basis. Ecosystem goods are also often collected and consumed as part of a bundle of items or have high levels of substitution[4] or complementarity[5] with other goods. For example, they are used only when other products are unavailable or unaffordable, or they form occasional inputs into the production of other goods

- **Even where an ecosystem good or service has a market, and quantities bought or sold can be measured, prices do not tell us how important this good or service is to society, nor how much some buyers would actually be willing to pay.**

In such cases it is usually necessary to use alternative valuation techniques, such as those described in Box 7.

### E6.2 Effect on production techniques

*E6.2.1 Overview of the method*

Even when ecosystem goods and services do not themselves have a market price, other marketed products often rely on them as basic inputs. For example: downstream hydropower and irrigation depend on upper catchment protection services; fisheries depend on clean water supplies; and many sources of industrial production utilise natural products as raw materials. In these cases it is possible to assess the value of ecosystem goods and services by looking at their contribution to other sources of production, and to assess the effects of a change in the quality or quantity of ecosystem goods and services on

**BOX 7: USING MARKET PRICE TECHNIQUES TO VALUE FRESHWATER WETLANDS IN THE ZAMBEZI BASIN, SOUTHERN AFRICA**

The Zambezi River runs through Angola, Zambia, Botswana, Namibia, Zimbabwe, Malawi and Mozambique in Southern Africa. It is associated with a large number of wetlands, which yield a wide range of economically valuable goods and services. Wetland-dependent products and services include flood recession agriculture, fish, wildlife, grazing, forest resources, natural products and medicines, and ecotourism.

A study was carried out to estimate the value of the Zambezi's wetland goods using market price techniques. First, an inventory of the products and services was made for each wetland. Market prices were then used to calculate the value derived from each wetland. Crops and livestock were valued at their production value, and fish catches were valued according to their local sale price. Tourism earnings and utilisation charges were used to calculate the value of wildlife, and the market price of wetland products was applied to natural resource use. Donor contributions were assumed to reflect biodiversity conservation values.

Inputs and other production costs were deducted from these figures, so as to yield the marginal value of wetland resources. Total use values were extrapolated through making assumptions about the extent and intensity of wetland land and resource use. This yielded a marginal value of USD145 million a year for the 10 major wetlands in the Zambezi Basin, or an average of USD48 per hectare.

From Seyam *et al*. 2001

these broader outputs and profits.

Effect on production techniques can thus be used to value ecosystem goods and services that clearly form a part of other, marketed, sources of production. For example, watershed protection and water quality services, or natural resources that are used as raw materials. In the example in Box 8, the value of flood attenuation benefits is estimated through its contribution to crop production.

*E6.2.2 Data collection and analysis requirements*

There are three main steps to collect and analyse the data required for effect on production techniques to value ecosystem goods and services:

1. Determine the contribution of ecosystem goods and services to the related source of production, and specify the relationship between changes in the quality or quantity of a particular ecosystem good or service and output
2. Relate a specified change in the provision of the ecosystem good or service to a physical change in the output or availability of the related product
3. Estimate the market value of the change in production

Effect on production techniques rely on a simple logic, and it is relatively easy to collect and analyse the market information that is required to value changes in production of ecosystem-dependent products (see above, market price techniques).

The most difficult aspect of this method is determining and quantifying the biophysical or dose-response relationship that links changes in the supply or quality of ecosystem goods and services with other sources of production. For example, detailed data are required to relate catchment deforestation to a particular rate of soil erosion, consequent siltation of a hydropower dam and reduced power outputs, or to assess exactly the impacts of the loss of wetland habitat and water purification services on local fisheries production. To be able to specify these kinds of relationships with confidence usually involves wide consultation with other experts, and may require situation-specific laboratory or field research, controlled experiments, detailed modelling and statistical regression.

*E6.2.3 Applicability, strengths and weaknesses*

Effect on production techniques are commonly used, and have applicability to a wide range of ecosystem goods and services. Their weakness relates to the difficulties that are often involved in collecting sufficient data to be able to accurately predict the biophysical or dose-response relationships upon which the technique is based. Such relationships are often unclear, unproven, or hard to demonstrate in quantified terms. Simplifying assumptions is often required to apply the production function approach.

An additional concern is the large number of possible influences on product markets and prices. Some of these should be excluded when using effect on production techniques. In some cases changes in the provision of an ecosystem good or service may lead not just to a change in related production, but also to a change in the price of its outputs. That product may become scarcer, or more costly to produce. In other cases consumers and producers may switch to other products or technologies in response to ecosystem change or to a scarcity of ecosystem goods and services. Furthermore, general trends and exogenous factors unrelated to ecosystem goods and services may influence the market price of related production and consumption items. They must be isolated and eliminated from analysis.

**BOX 8: USING EFFECT ON PRODUCTION TECHNIQUES TO VALUE FOREST FLOOD ATTENUATION BENEFITS IN EASTERN MADAGASCAR**

This study looked at the value of Mantadia National Park in conserving the upland forests that form the watershed for the Vohitra River in Eastern Madagascar. It employed effect on production techniques to do so. The productivity analysis measured the forest's watershed benefits in terms of increased economic welfare for farmers. These benefits result from reduced flooding as a consequence of reduced deforestation, which is in turn associated with the establishment of the national park and buffer zone.

The study used a three stage model to examine the relationship between economic value and the biophysical dimensions of the protected area. First, a relationship between land use changes and the extent of downstream flooding was established. Remote sensing was used to construct a deforestation history of the study area, and to ascertain an annual deforestation rate. Records of monthly river discharge were analysed for flood frequency and time trend, and the effects of land conversion on flooding were quantified.

A second stage was to ascertain the impacts of increased flooding on crop production. Flood damage to crops was estimated taking into account a range of parameters such as area of inundation, flood depth, duration, seasonality and frequency. Analysis focused on paddy rice cultivation, a high value and locally important form of agricultural production which is tied closely to flooding.

The final stage in the valuation study was to adopt a productivity analysis approach to evaluate flood damage in terms of lost producer surplus. The economic impact of changes in ecosystem quality was established using the net market value of paddy damaged by flooding. This found that a net present value for forest watershed protection benefits of USD126,700 resulting from the establishment of Mantadia National Park.

From Kramer *et al.* 1997

## E6.3 Travel cost techniques

*E6.3.1 Overview of the method*

Ecosystems often hold a high value as recreational resources or leisure destinations. Even when there is no direct charge made to enjoy these benefits, people still spend time and money to visit ecosystems. These travel costs can be taken as an expression of the recreational value of ecosystems. We can use this technique at the whole ecosystem level, taking into account all of its attributes and components in combination, or for specific goods or services such as rare wildlife, opportunities for extractive utilisation of products such as fishing or resource collection, or for activities such as hiking or boating that are related to its services. In the example given in Box 9, improved freshwater ecosystem quality was estimated through looking at visitor travel costs.

*E6.3.2 Data collection and analysis requirements*

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

1. Ascertain the total area from which recreational visitors come to visit an ecosystem, and divide this into zones within which travel costs are approximately equal
2. Within each zone, sample visitors to collect information about the costs incurred in visiting the ecosystem, motives for the trip, frequency of visits, site attributes and socio-economic variables (such as the visitor's place of origin, income, age, education and so on)
3. Obtain the visitation rates for each zone, and use this information to estimate the total number of visitor days per head of the local population
4. Estimate travel costs, including both direct expenses (such as fuel and fares, food, equipment, accommodation) and time spent on the trip
5. Carry out a statistical regression to test the relationship between visitation rates and other explanatory factors such as travel cost and socio-economic variables
6. Construct a demand curve relating number of visits to travel cost, model visitation rates at different prices, and calculate visitor consumer surplus[6]

Travel cost techniques depend on a relatively large data set. Quite complex statistical analysis and modelling are required in order to construct visitor demand curves. Basic data are usually collected via visitor interviews and questionnaires, which make special efforts to cover different seasons or times of the year, and to ensure that various types of visitors from different locations are represented.

*E6.3.3 Applicability, strengths and weaknesses*

The travel cost method is mainly limited to calculating recreational values, although it has in some cases been applied to the consumptive use of ecosystem goods.

Kong Kim Sreng/Darwin Integrated Wetland Assessment project

*A lift-net fishery on the Mekong River near Stung Treng*

Its main weakness is its dependence on large and detailed data sets, and relatively complex analytical techniques. Travel cost surveys are typically expensive and time-consuming to carry out. An additional source of complication is that several factors make it difficult to isolate the value of a particular ecosystem in relation to travel costs, and these must be taken into account in order to avoid over-estimating ecosystem values. Visitors frequently have several motives or destinations on a single trip, some of which are unrelated to the ecosystem being studied. They also usually enjoy multiple aspects and attributes of a single ecosystem. In some cases travel, not the destination *per se*, may be an end in itself.

**BOX 9: USING TRAVEL COST TECHNIQUES TO VALUE THE IMPACTS OF IMPROVED ENVIRONMENTAL QUALITY ON FRESHWATER RECREATION IN THE US**

The Conservation Reserve Programme (CRP) in the United States aims to mitigate the environmental effects of agriculture. A study was carried out to see how non-market valuation models could help in targeting conservation programmes such as the CRP. One component of this study focused on the impacts of improved environmental quality on freshwater recreation.

This study was based on data generated by surveys that had been carried out to ascertain the value of water-based recreation, fishing, hunting and wildlife. These surveys sampled 1,500 respondents in four sub-State regions who were asked to recall the number of visits made over the last year to wetlands, lakes and rivers where water was an important reason for their trip. The cost of these trips was imputed using the travel cost method.

The influence of CRP programmes on improved environmental quality and on consumer welfare was then modelled. The study found that the combined benefit of all freshwater-based recreation in the US was worth slightly over USD37 billion a year. The contribution of CRP efforts to environmental quality, as reflected in recreational travel values, was estimated at just over USD35 million, or about USD2.57 per hectare.

From Feather et al. 1999

### E6.4 Hedonic pricing techniques

*E6.4.1 Overview of the method*

Even if they do not have a market price themselves, the presence, absence or quality of ecosystem goods and services influences the price that people pay for, or accept for providing, other goods and services. Hedonic pricing techniques look at the difference in prices that can be ascribed to the existence or level of ecosystem goods and services. Most commonly this method examines differences in property prices and wage rates between two locations, which have different environmental qualities or landscape values. In the example given in Box 10, the value of urban wetlands was estimated through looking at impacts on property prices.

*E6.4.2 Data collection and analysis requirements*

There are five main steps involved in collecting and analysing the data required to use hedonic pricing techniques to value ecosystem goods and services:

1. Decide on the indicator to be used to measure the quality or quantity of an ecosystem good or service associated with a particular job or property
2. Specify the functional relationship between wages or property prices and all of the relevant attributes that are associated with them, including ecosystem goods and services
3. Collect data on wages or property prices in different situations and areas which have varying quality and quantity of ecosystem goods and services
4. Use multiple regression analysis to obtain a correlation between wages or property prices and the ecosystem good or service
5. Derive a demand curve for the ecosystem good or service

Hedonic pricing techniques require the collection of a large amount of data, which must be subject to detailed and complex analysis. Data are usually gathered through market observation, questionnaires and interviews, which aim to represent a wide variety of situations and time periods.

*E6.4.3 Applicability, strengths and weaknesses*

Although hedonic pricing techniques can, in theory, be applied to any good or service they are most commonly used within the context of wage and property markets.

In practice, there remain very 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.

**BOX 10: USING HEDONIC PRICING TECHNIQUES TO VALUE URBAN WETLANDS IN THE US**

This study aimed to value wetland environmental amenities in the Portland, Oregon 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, neighbourhood 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, neighbourhood attributes, and amenity value of nearby wetlands and other environmental resources. The second stage analysis consisted of constructing a willingness-to-pay function for the size of the nearest wetland to a residence. Results showed that wetland proximity and size exerted a significant influence on property values, especially for open water and larger wetlands.

From Mahan 1997

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.

### E6.5 Replacement cost techniques

*E6.5.1 Overview of the method*

It is sometimes possible to replace or replicate a particular ecosystem good or service with artificial or man-made products, infrastructure or technologies. For example, constructed reservoirs can replace natural lakes, sewage treatment plants can replace wetland wastewater treatment services, and many natural products have artificial alternatives. The cost of replacing an ecosystem good or service with such an alternative or substitute can be taken as an indicator of its value in terms of expenditures saved. In the example in Box 11, the value of wetland water quality services was estimated through looking at the costs of replacing these services by artificial means.

*E6.5.2 Data collection and analysis requirements*

There are three main steps involved in collecting and analysing

David Allen/IUCN

*Sand collection from the Sanaga River in Cameroon for building construction*

the data required to use replacement cost techniques to value ecosystem goods and services:

1. Ascertain the benefits that are associated with a given ecosystem good or service, how it is used and by whom, and the magnitude and extent of these benefits
2. Identify the most likely alternative source of product, infrastructure or technology that would provide an equivalent level of benefits to an equivalent population
3. Calculate the costs of introducing and distributing, or installing and running, the replacement to the ecosystem good or service

Data collection is relatively straightforward, and usually relies on secondary information about the benefits associated with a particular ecosystem good or service and alternatives that are available to replace it. In most cases this can be ascertained through expert consultation and professional estimates, supplemented with direct observation.

*E6.5.3 Applicability, strengths and weaknesses*

Replacement cost techniques are particularly useful for valuing ecosystem services, and have the great advantage that they are simple to apply and analyse. They are particularly useful where only limited time or financial resources are available for a valuation study, or where it is not possible to carry out detailed surveys and fieldwork.

The main weakness of this technique is that it is often difficult to find perfect replacements or substitutes for ecosystem goods and services that would provide an equivalent level of benefits to the same population. In some cases this results in ecosystem under-valuation, as artificial alternatives generate a lower quantity or quality of goods and services. Yet this technique may also lead to the over-valuation of ecosystem benefits, as in some instances the replacement product, infrastructure or technology may be associated with secondary benefits or additional positive impacts. The reality of the replacement cost technique is also sometimes questionable: we may question whether, in the absence of a well-functioning ecosystem, such expenditures would actually be made or considered worthwhile.

**BOX 11: USING REPLACEMENT COST TECHNIQUES TO VALUE WETLAND WATER QUALITY SERVICES IN NAKIVUBO SWAMP, UGANDA**

This study used replacement cost techniques to value the wastewater treatment services provided by Nakivubo Swamp, Uganda. Covering an area of some 5.5 $km^2$ and a catchment of over 40 $km^2$, the wetland runs from the central industrial district of Kampala, Uganda's capital city, passing through dense residential settlements before entering Lake Victoria at Murchison Bay.

One of the most important values associated with Nakivubo wetland is the role that it plays in assuring urban water quality in Kampala. Both the outflow of the only sewage treatment plant in the city, and — far more importantly, because over 90% of Kampala's population have no access to a piped sewage supply — the main drainage channel for the city, enter the top end of the wetland. Nakivubo functions as a buffer through which most of the city's industrial and urban wastewater passes before entering nearby Lake Victoria, and physically, chemically and biologically removes nutrients and pollution from these wastewaters. These services are important – the purified water flowing out of the wetland enters Lake Victoria only about three kilometres from the intake to Ggaba Water Works, which supplies all of the city's piped water supplies.

The study looked at the cost of replacing wetland wastewater processing services with artificial technologies. Replacement costs included two components: connecting Nakivubo channel to an upgraded sewage treatment plant which could cope with additional wastewater loads, and constructing elevated pit latrines to process sewage from nearby slum settlements. Data were collected from the National Water and Sewerage Corporation, from civil engineering companies, and from a donor-funded water supply and sanitation project that had been operating in a nearby urban wetland area. It also took into account the fact that some level of intervention would be required to manage Nakivubo more efficiently for water treatment, mainly through extending and reticulating the wastewater channels that flow into the swamp. These costs were deducted when wetland benefits were valued. The study found that the infrastructure required to achieve a similar level of wastewater treatment to that provided by the wetland would incur costs of up to USD2 million a year in terms of extending sewerage and treatment facilities.

From Emerton *et al.* 1999

### E6.6 Mitigative or avertive expenditure techniques

*E6.6.1 Overview of the method*

When an economically valuable ecosystem good or service is lost, or there is a decline in its quantity or quality, this almost always has a negative effect. It may become necessary to take steps to mitigate or avert these negative effects so as to avoid economic losses. For example: the loss of upstream catchment protection can make it necessary to desilt reservoirs and dams: the loss of wetland treatment services may require the upgrading of water purification facilities; and the loss of ecosystem flood control may require the construction of flood control barriers. These mitigative or avertive expenditures can be taken as indicators of the value of maintaining ecosystem goods and services in terms of costs avoided. In the example in Box 12, the value of wetland flood attenuation services was estimated through looking at the expenditures that would be required to mitigate or avert the effects of the loss of these services.

*E6.6.2 Data collection and analysis requirements*

There are four main steps involved in collecting and analysing the data required to use mitigative or avertive expenditure techniques to value ecosystem goods and services:

1. Identify the negative effects or hazards that would arise from the loss of a particular ecosystem good or service
2. Locate the area and population which would be affected by the loss of the ecosystem good and service, and determine a cut-off point beyond which the effect will not be analysed
3. Obtain information on people's responses, and measures taken to mitigate or avert the negative effects of the loss of the ecosystem good or service
4. Cost the mitigative or avertive expenditures

Data collection and analysis is relatively straightforward, and usually relies on a combination of interviews, surveys, direct observation and expert consultation.

*E6.6.3 Applicability, strengths and weaknesses*

Mitigative or avertive expenditure techniques are particularly useful for valuing ecosystem services. In common with other cost-based valuation methods, a major strength is their ease of implementation and analysis, and their relatively small data requirements.

As is the case with the replacement cost technique, the mitigative or avertive measures that are employed in response to the loss of ecosystem goods and services do not always provide an equivalent level of benefits. In some cases it is also questionable whether in fact such expenditures should be made or can be seen as being worth making. An additional important factor to bear in mind when applying this technique is that people's perceptions of the effects of ecosystem loss, and what would be required to mitigate or avert these effects, may not always match those of 'expert' opinion.

**BOX 12: USING MITIGATIVE OR AVERTIVE EXPENDITURE TECHNIQUES TO VALUE WETLAND FLOOD ATTENUATION IN SRI LANKA**

This study used avertive expenditure techniques to value the flood attenuation services of Muthurajawela Marsh in Sri Lanka. Muthurajawela is a coastal peat bog which covers an area of some 3,100 hectares, running alongside the Indian Ocean between 10-30 km north of Colombo, Sri Lanka's capital city. One of its most important functions is its role in local flood control.

The study first involved investigating the biophysical characteristics of the marsh, and their relationship to local flooding patterns. Data were obtained from hydrological surveys, which estimated the maximum water storage capacity of the marsh at 11 million cubic metres, with a maximum discharge of 12.5 cubic metres per second and a retention period of more than 10 days. Analysis of historical rainfall and stream flow data found that during the rainy season large volumes of water enter the wetland system, from rainfall, through run-off from surrounding higher grounds and via floodwaters from the Dandugam Oya, Kala Oya and Kelani Ganga Rivers. Muthurajawela buffers these floodwaters and discharges them slowly into the sea.

The value of these services was calculated by looking at the flood control measures that would be necessary to mitigate or avert the effects of wetland loss. Consultation with civil engineers showed that this would involve constructing a drainage system and pumping station, deepening and widening the channels of water courses flowing between the marsh area and the sea, installing infrastructure to divert floodwaters into a retention area, and pumping water out to sea. Cost estimates for this type of flood control measure were available for Mudu Ela, a nearby wetland that has recently been converted to a housing scheme. Here infrastructure had been installed to ensure that a total of 443 acres of land remains drained, in order to reclaim an area of 360 acres. Extrapolating the capital and maintenance costs from Mudu Ela to Muthurajawela gave an annual value for flood attenuation of more than USD5 million, or USD1,750 per hectare of wetland area.

From Emerton and Kekulandala 2002

### E6.7 Damage cost avoided techniques

*E6.7.1 Overview of the method*

Ecosystem services frequently protect other economically valuable assets. For example, the loss of catchment protection services may result in increased downstream siltation and flooding, which leads to the destruction of infrastructure, settlements and agriculture. Such damage costs can be taken to represent the economic value of ecosystems in terms of expenditures avoided. In the example in Box 13, the value of wetland flood attenuation was estimated through looking at costs of damage avoided by conserving ecosystems.

*E6.7.2 Data collection and analysis requirements*

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

1. Identify the protective services of the ecosystem, in terms of the degree of protection afforded and the on- and off-site damages that would occur as a result of loss of this protection
2. For the specific change in ecosystem service provision that is being considered, locate the infrastructure, output or human population that would be affected by this damage, and determine a cut-off point beyond which effects will not be analysed
3. Obtain information on the likelihood and frequency of damaging events occurring under different scenarios of ecosystem loss, the spread of their impacts and the magnitude of damage caused
4. Cost these damages and ascribe the contribution of the ecosystem service towards minimising or avoiding them

Data collection is for the most part straightforward, usually relying on a combination of analysis of historical records, direct observation, interviews, and professional estimates. Predicting and quantifying the likelihood and impacts of damage events under different ecosystem scenarios is however usually a more complex exercise, and may require detailed data and modelling.

*E6.7.3 Strengths and weaknesses of the method*

Damage cost avoided techniques are particularly useful for valuing ecosystem services. There is often confusion between the application of damage costs avoided and production function approaches to valuation. Here it is important to underline that whereas this technique deals with damage avoided, such as from pollution and natural hazards (which are typically external effects), change in production techniques usually relates to changes in some input such as water (typically internalised).

A potential weakness is that in most cases estimates of damages remain hypothetical. They are based on predicting what might occur under a situation where ecosystem services decline or are lost. Even when valuation is based on real data from situations where such events and damages have occurred, it is often difficult to relate these damages to changes in ecosystem status, or to be sure that identical impacts would occur if particular ecosystem services declined.

### E6.8 Contingent valuation techniques

*E6.8.1 Overview of the method*

Absence of prices or markets for ecosystem goods and services, of close replacements or substitutes, or of links to other production or consumption processes, does not mean that they have no value to people. Contingent valuation techniques infer the value that people place on ecosystem goods and services by asking them directly what is their willingness to pay (WTP) for them or their willingness to accept compensation (WTA) for their loss, under the hypothetical situation that they could be available for purchase.

Contingent valuation methods might, for example, ask how much people would be willing to see their water bills increase in order

**BOX 13: USING DAMAGE COST AVOIDED TECHNIQUES TO VALUE THE ROLE OF FLOOD ATTENUATION IN THE LOWER SHIRE WETLANDS, MALAWI AND MOZAMBIQUE AND BAROTSE FLOODPLAIN, ZAMBIA**

The Lower Shire Wetlands in Malawi and Mozambique and the Barotse Floodplain in Zambia cover a combined area of approximately 1.5 million hectares. They generate a number of economically important goods and services, one of which is flood attenuation. The wetlands play an appreciable role in minimising flood peaks and reducing flow velocity, because they store water and even out its release over time. At the onset of the rainy season, or in times of peak river flow, their large surface areas to depth and volume ratios mean that they are able to absorb and spread out water over a large area. The emptying of floodplains may take four times as long as the period between initial and peak season. The Barotse floodplain, for example, is capable of storing over 17.2 X 109 $m^3$ of water at peak floods, and may delay the downstream flooding peak by some three to five weeks.

The economic value of flood attenuation was assigned by looking at the extent to which the wetlands minimise downstream flooding and thereby reduce damage to infrastructure, land and associated settlement and production opportunities. The valuation study involved assessing the frequency of floods, their severity of impact, and the economic damages they gave rise to. Affected areas were identified by land use and settlement maps which showed where human populations and production activities were concentrated, district-level census and production statistics. Historical records provided estimates of flooding frequency and impacts, and the production and infrastructure damages that had arisen as a result of floods.

Taking account of the costs of temporary relocation of people, replacement of damaged roads and rail infrastructure, loss of farm fields and livestock and settlements destroyed, the study found a flood attenuation value for the two wetlands areas with a present value of over USD3 million.

From Turpie *et al.* 1999

to uphold quality standards, what they would pay as a voluntary fee to manage an upstream catchment in order to maintain water supplies, how much they would contribute to a fund for the conservation of a beautiful landscape or rare species, or the extent to which they would be willing to share in the costs of maintaining important ecosystem water services. In the example given in Box 14, household willingness to pay for conservation was taken as an estimate of the value of coastal wetlands.

*E6.8.2 Data collection and analysis requirements*

There are five main steps involved in collecting and analysing the data required to use contingent valuation techniques to value ecosystem goods and services:

1. Ask respondents their WTP or WTA for a particular ecosystem good or service
2. Draw up a frequency distribution relating the size of different WTP/WTA statements to the number of people making them
3. Cross-tabulate WTP/WTA responses with respondents' socio-economic characteristics and other relevant factors
4. Use multivariate statistical techniques to correlate responses with respondent's socio-economic attributes
5. Gross up sample results to obtain the value likely to be placed on the ecosystem good or service by the whole population, or the entire group of users

This valuation technique requires complex data collection and sophisticated statistical analysis and modelling, which are described in detail elsewhere (see Carson and Mitchell 1989).

Most contingent valuation studies are conducted via interviews or postal surveys with individuals, but sometimes interviews are conducted with groups. A variety of methods are used in order to elicit people's statement or bids of their WTP/WTA for particular ecosystem goods or services in relation to specified changes in their quantity or quality. The two main variants of contingent valuation are: dichotomous choice surveys, which present an upper and lower estimate between which respondents have to choose; and open-ended surveys, which let respondents determine their own bids. More sophisticated techniques are also sometimes used, such as engaging in trade-off games or using take-it-or-leave it experiments. The Delphi technique uses expert opinion rather than approaching consumers directly.

*E6.8.3 Applicability, strengths and weaknesses*

A major strength of contingent valuation techniques is that, because they do not rely on actual markets or observed behaviour, they can in theory be applied to any situation, good or service. They remain one of the only methods that can be applied to option and existence values, and are widely used to determine the value of ecosystem services. Contingent valuation techniques are often used in combination with other valuation methods, in order to supplement or cross-check their results.

One of the biggest disadvantages of contingent valuation is the large and costly surveys, complex data sets, and sophisticated analysis techniques that it requires. Another constraint arises from the fact that it relies on a hypothetical scenario which may not reflect reality or be convincing to respondents.

Contingent valuation techniques require people to state their preferences for ecosystem goods and services. They are therefore susceptible to various sources of bias, which may influence their results. The most common forms of bias are strategic, design, instrument, and starting point bias. Strategic bias occurs when respondents believe that they can influence a real course of events by how they answer WTP/WTA questions. Respondents may for instance think that a survey's hypothetical scenario of the imposition of a water charge or ecosystem fee is actually in preparation. Design bias relates to the way in which information is put across in the survey instrument. For example, a survey may provide inadequate information about the hypothetical scenario, or respondents are misled by its description. Instrument bias arises when respondents react strongly against the proposed payment methods. Respondents may for instance resent new taxes or increased bills. Starting point bias occurs when the starting point for eliciting bids skews the possible range of answers, because it is too high, too low, or varies significantly from respondents' WTP/WTA. With careful survey design, most of these sources of bias can however be reduced or eliminated.

**_BOX 14: USING CONTINGENT VALUATION TECHNIQUES TO VALUE COASTAL WETLANDS IN KOREA_**

This study used contingent valuation techniques to estimate the non-extractive benefits of conserving coastal wetlands around the Youngsan River in Korea. It focused primarily on the landscape, recreational, amenity and existence values.

The study involved a survey of more than 1,000 local residents. It elicited willingness to pay for a conservation programme designed to maintain coastal wetlands rather than develop them for alternative uses, measured through additional household taxes. Questionnaires ascertained respondents' attitudes and perceptions of coastal wetlands, their willingness to pay a minimum or maximum tax increase, and collected information about socio-economic variables such as age, education, income, marital status and expenditures on recreation.

Correlating these variables with respondent willingness to pay enabled the study to construct a demand curve for coastal wetlands. Overall, respondents stated that they would be willing to pay almost USD40 per household per month to ensure that coastal wetlands were conserved, suggesting an annual aggregate conservation value of more than USD176 million.

From Pyo 2002

### E6.9 Participatory valuation techniques

*E6.9.1 Overview of the method*

It is often difficult to use conventional environmental valuation techniques within largely subsistence-based economies, or to generate realistic estimates of local wetland use. Participatory valuation responds to some of the constraints and problems associated with using conventional valuation techniques, including:

- Many wetland goods have no substitute or market price, or it is unrealistic to use these as a proxy for their value in situations where the majority of the population do not have access to markets or substitutes
- Cash measures and market prices may have little relevance in a subsistence economy where cash is not the main medium of exchange or indicator of local value
- People frequently become suspicious when faced with a scenario where they must state a monetary willingness to pay/accept compensation for a natural product, if they suspect that they will be actually subjected to some kind of payment, tax or compensation. They will often under-quote the amount of money they would be willing to pay for wetlands goods if they fear that such charges may actually be made in the future, and over-quote the compensation they require if they think there may be a possibility of actually receiving payments
- Wetland resource collection and access are frequently illegal in protected areas. People are reluctant to speak openly about their wetland use activities because they fear arrest. Some activities also have ritual or cultural significance, and knowledge is considered the preserve of specialist groups. Whereas households are reticent in the face of direct questioning, indirect techniques are a good means of stimulating discussion and gathering information

Participatory valuation aims to find a bridge between local economic systems and cash values, and elicit information about wetland use and values at the subsistence, non-market level. It allows people to define wetland values within the context of their own perceptions, needs and priorities rather than according to externally-imposed categories or market prices. It is particularly suitable for valuing occasional, subsistence-based or illegal wetland uses, and for relating wetland values to broader household livelihoods. See Box 15 for an example of participatory wetland resource valuation.

*E6.9.2 Data collection and analysis requirements*

There are seven main steps to collect and analyse the data required for participatory valuation techniques to value ecosystem goods and services:

1. Establishing the categories of wetland product, and types of activities, that are carried out in a particular locality
2. Defining a numeraire or yardstick for valuation which is not cash. This is usually a commodity or item that forms an important part of the local socio-economy, has wide significance as an item of local value and exchange, and can easily be translated into a cash amount
3. Using picture cards to refer to each wetland product or activity that is used, and to the selected numeraire
4. Performing a ranking exercise on the picture cards, to ascertain the relative importance of different products
5. Establishing values by distributing a set number of counters between different picture cards, including the numeraire
6. Using the number of counters allocated to each card, translating wetland products into numeraire equivalents and converting this to cash amounts based on the price/market value of the numeraire
7. Discounting the resulting figures to give annual wetland use values

*E6.9.3 Applicability, strengths and weaknesses*

Participatory valuation techniques have most applicability to subsistence economies, particularly those which are relatively remote and where the majority of the population have a high livelihood dependence on wetland products. They are particularly useful in situations where wetland goods are used for subsistence purposes only, or where wetland use is illegal or for some other reason a sensitive topic.

One factor to bear in mind is that even where markets for wetland products exist, participatory valuation rarely yields the same value estimates as market prices. This is because it is based on local perceptions of value, which may well not coincide with market-driven prices. Different people will value products differently, as values will reflect their relative importance to them in their daily lives, according to their personal preferences and responsibilities. Participatory valuation often yields far higher estimates of wetland value than other methods, because it incorporates a wide range of perceptions of value and is not confined to market prices alone.

Selection of the numeraire must be undertaken carefully, and a single measure used consistently across the community being studied. It is often challenging to identify a measure which has relevance and value for all concerned, and can be accurately reflected via a monetary value. It should be emphasised that the results of participatory valuation *must* be converted to an equivalent annual amount (or whatever time period that wetland values are being calculated for). This depends on the effective lifespan of the numeraire that has been selected.

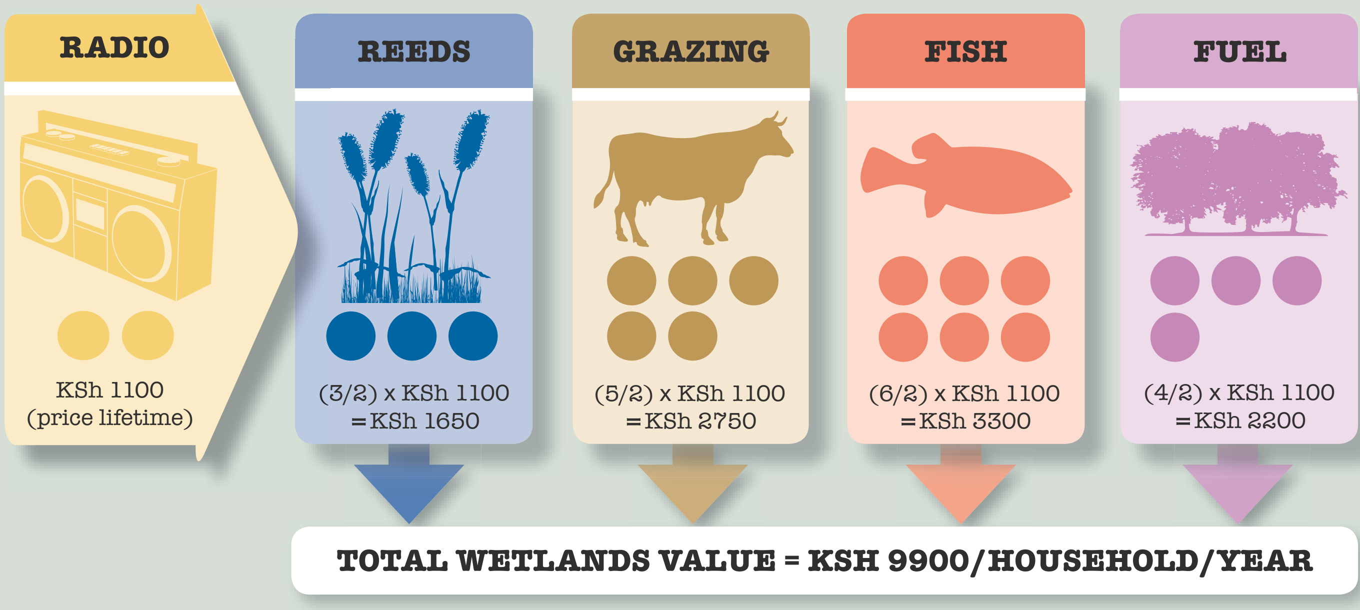
### E6.10 Other stated preference techniques: conjoint analysis and choice experiments

Other stated preference valuation methods include conjoint analysis and choice experiments. Due to their complexity in terms of data needs and analysis, and because there exist very few examples of their application to ecosystem water services (see, for

### *BOX 15: USING PARTICIPATORY VALUATION TO VALUE WETLAND UTILISATION IN SACRED LAKE, KENYA*

Wetland resources form an important part of domestic subsistence and local livelihoods around Sacred Lake in Mount Kenya Forest. The bulk of wetland products are used within the household only, and are never bought or sold. Wetland utilisation is also highly variable at different times of the year. Many wetland uses are illegal so people are reluctant to speak openly about their activities because they fear arrest. Some wetland activities also have ritual or cultural significance, and knowledge is considered the preserve of specialist groups.

For all these reasons it was necessary to use an indirect technique for valuation which would allow people to define wetland values within the context of their own perceptions, needs and priorities rather than according to cash amounts. Whereas households proved reticent in the face of direct questioning, drawing and manipulating pictures of different wetland activities was found to be a good means of stimulating discussion. These pictures were used to value wetlands utilisation.




Because cash measures had little relevance in a subsistence economy such as that around Sacred Lake, it was necessary to find a numeraire for valuation which formed part of the local socio-economy, had wide significance as an item of value, and could be translated easily into a monetary amount.

Households chose a radio as the most appropriate measure of local value. Picture cards depicting wetland activities were laid out together with a picture of a radio. Each household then distributed 20 beans as counters between these different activities and the numeraire card. It was thus possible to measure the perceived value of wetland products in terms of radio equivalents, and translate each wetland product into a cash amount based on the market value of a radio, giving a total annual value for wetland utilisation of approximately USD200 per household.

From Emerton 1998

example, DGA and UAC 2000, Griner and Farber 1996, Kuriyama 2002, Morrison *et al.* 1998), these methods are not described in detail here.

Conjoint analysis was originally developed in the fields of marketing and psychology, in order to measure individuals' preferences for different characteristics or attributes of a multi-choice attribute problem. In contrast to contingent valuation, conjoint analysis does not explicitly require individuals to state their willingness to pay for environmental quality. Rather, conjoint asks individuals to consider status quo and alternative states of the world. It describes a specific hypothetical scenario and various environmental goods and services between which they have to make a choice. The method elicits information from the respondent on preferences between various alternatives of environmental goods and services, at different prices or costs to the individual.

Choice experiments techniques present a series of alternative resource or ecosystem use options, each of which are defined by various attributes including price. Choice of the preferred option from each set of options indicates the value placed on ecosystem attributes. As is the case for contingent valuation, data collection and analysis for choice experiments is relatively complex. Usually conducted by means of questionnaires and interviews, choice experiments ask respondents to evaluate a series of 'sets', each containing different bundles of ecosystem goods and services. Usually, each alternative is defined by a number of attributes. For example, for a specific ecosystem this might include attributes such as species mix, ecosystem status, landscape, size of area, and price or cost. These attributes are varied across the different alternatives, and respondents are asked to choose their most preferred alternative. Aggregate choice frequencies are modelled to infer the relative impact of each attribute on choice, and the marginal value of each attribute for a given option is calculated using statistical methods.

## E7 Stage IV: Analysing and presenting the data for decision-making

Calculating the economic value of wetlands is not an end in itself. Rather, it is a means of providing information which can be used to make better and more informed choices about how resources are managed, used and allocated. In order for the results of the valuation study to influence real-world policy and practice, it is of critical importance that time and thought is given to analysing the data that has been gathered, and presenting it in a form that captures the attention of decision-makers, and is convincing to them.

*Step 7: Analysing and expressing the valuation data*
In summary, this step involves relating values to the management issue or scenario under study and expressing changes in wetland status as indicators for decision-making support. It should result in quantified estimates of wetland benefits and costs, understanding of the economic implications of particular wetland management scenarios, and expression of changes in wetland status as indicators for decision-making support.

Decision-makers, whether in conservation or development sectors, are primarily concerned with choosing between different uses of land, funds and other resources, for example: whether to manage a wetland under strict protection or to allow for some form of sustainable use; whether or not to build a dam, irrigation scheme or housing estate; which infrastructure design option to invest in; or whether to zone a wetland for conservation or to convert it to settlement or agriculture (assessing damage to a wetland). To analyse the results of a valuation study thus we need to be able to express ecosystem values as measures that make sense to decision-makers when they weigh up the different funding, land and resource management choices that wetland decisions involve.

Conducting a valuation study provides us with data about the economic value of particular wetland goods and services. However, what is important for decision-making is the ability to understand and express how making choices between alternative uses of land, water, resources or investment funds will influence these values. For example, how much additional flood-related costs would be incurred if a wetland were degraded, and what downstream production losses would arise from additional silt loads? Or, what additional investments in water treatment and purification would be required if a particular wetland were reclaimed? Or, what potential actually exists for raising revenues from urban dwellers to maintain water quality in a particular river or lake?

In order to answer these questions, and to integrate wetlands values into these decision-making processes, it is necessary to be able to analyse data so as to trace the economic implications of changes in the stock of wetland resources, flows of wetland services, or attributes of wetland systems that result from following a particular course of action, and factor them into measures of its economic desirability. In other words, we need to know what the economic impacts of particular decisions will be in terms of wetland costs and benefits.

### E7.1 Building up a bio-economic model

Various studies have demonstrated the utility of applying a simple bio-economic model in order to generate information for wetland decision-making (Creemers and van den Bergh 1998, Colavito 2002, Bennett and Whitten 2002). This type of model presents a useful tool for relating wetland values to decision-making, and involves a number of steps which translate baseline data on ecosystem values into information that can be used to assess the economic impacts of decisions on wetlands:

- **Establish ecological and socio-economic background and parameters:** identifying, defining and understanding the status of the wetland and its links to hydrological goods and services, their benefits and beneficiaries, and the way in which various social, institutional and management aspects affect it
- **Calculate baseline economic values from which to measure ecosystem changes:** carrying out the partial or total valuation study
- **Link physical changes in ecosystem status and integrity to changes in these economic values:** tracing the effects of different decisions on the provision of wetland goods and services, and determining the impacts of these changes on economic values
- **Express the results as indicators or measures that can be integrated into broader economic appraisal or analysis processes:** expressing the results of value changes as quantitative indicators or measures that can be integrated into wider decision-support frameworks

The next two sub-sections look at two of the most commonly used techniques for expressing wetland values in decision-making: cost-benefit analysis and multi-criteria analysis.

### E7.2 Cost-benefit analysis

Cost-benefit analysis (CBA) remains the most commonly-used decision-making framework for using the results of a wetland valuation study in order to assess and compare economic and financial trade-offs. It is the standard tool for appraising and evaluating programmes, projects and policies and one that is a required part of many government and donor decision-making procedures. CBA is a decision tool that judges alternative courses of action by comparing their costs and benefits. It assesses profitability or desirability according to net present benefits – the total annual benefits minus total annual costs for each year of analysis or project lifetime, expressed as a single measure of value in today's terms.

In order to bring a project's benefits and costs over time to their present value, each is discounted. Discounting is essentially the inverse of applying a compound interest rate, and gives values relatively less weight the further into the future they accrue. It accounts for the fact that people generally prefer to enjoy benefits now and costs later, and that any funds tied up in a project could be used productively to generate returns or profits elsewhere. In most cases, the discount rate is therefore based on the opportunity cost of capital – the prevailing rate of return on investments elsewhere in the economy.

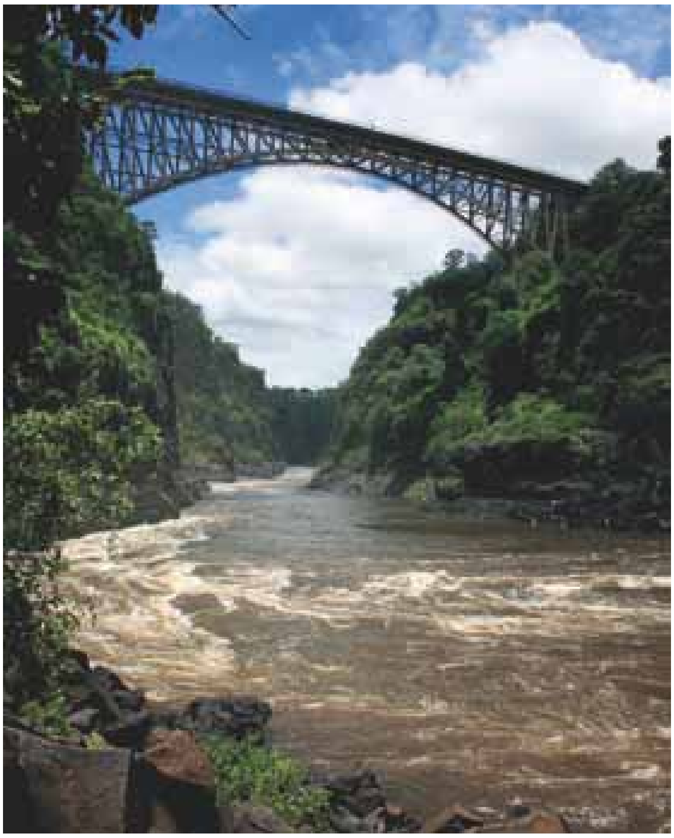
CBA presents three basic measures of worth, which allow different projects, programmes or policies to be assessed and compared with each other:

- **Net Present Value (NPV)** is the sum of discounted net benefits (i.e. benefits minus costs), and shows whether a project generates more benefits than it incurs costs
- **Benefit Cost Ratio (BCR)** is the ratio between discounted total benefits and costs, and shows the extent to which project benefits exceed costs
- **Internal Rate of Return (IRR)** is the discount rate at which a project's NPV becomes zero

In general, a project can be considered to be worthwhile if its NPV is positive and its BCR is greater than one and if its IRR exceeds the discount rate. A positive NPV and a BCR greater than one means the project generates benefits that are greater than its costs. An IRR above the discount rate means that the project generates returns in excess of those which could be expected from alternative investments.

There are basically two types of Cost-Benefit Analyses: financial and economic. Financial CBAs look only at the private returns accruing to a particular individual or group. They calculate costs and benefits at market prices, reflecting the actual cash profits and expenditures that people face. A financial CBA might for example measure and compare the relative profitability of different dam design options for a hydropower company, the returns to improved water and sanitation facilities for urban consumers, or the highest earning mix of irrigated crops for a farmer. Here, wetland values will primarily be incorporated into CBA calculations as they influence private costs and benefits, affect investments and are expressed through market prices.

Jens Kipping



*The Zambezi River below Victoria Falls*

In contrast, economic CBAs examine the effects of projects, programmes and policies on society as a whole. They consider all costs and benefits, for all affected groups. Sometimes weights are assigned to prioritise particular groups, benefits or costs that are considered to be of particular importance in economic terms. As such, economic CBAs are mainly carried out by public sector and donor agencies, who are concerned with broad development impacts. For example, an economic CBA would consider the total costs and benefits of different hydropower design options, such as relocation costs and loss of production incurred by reservoir flooding, income from increased employment in the power sector, and benefits associated with improved earning opportunities arising from electrification. An economic CBA of different irrigated crop mixes might include consideration of the premium attached to foreign exchange earnings from export crops, improved food security benefits, and revenues in agro-processing and value-added industries.

Because economic CBAs assess the desirability of a given course of action from the perspective of society as a whole, they usually adjust financial costs and benefits to account for the various imperfections and distortions in the market. They recognise that market prices are not a good indicator of the true social and economic value of goods and services. This means that wetland values should form an integral component of economic CBAs.

### E7.3 Other economic decision-support tools

CBA remains the most widely-used tool for the financial and economic appraisal of projects, programmes and policies. Other, less commonly-used, value-based measures of profitability or economic/financial desirability include:

- **Cost-effectiveness analysis:** this decision-support tool judges the minimum cost way of attaining a particular objective. It is useful where a project has no measurable benefits, or where a particular goal has already been set (for example maintaining a certain water quality level). It involves calculating all the costs of attaining the given objective, discounting them, and pointing to the option with the lowest NPV
- **Risk-benefit analysis:** this decision-support tool focuses on the prevention of events carrying serious risks (for example investing in flood prevention). It assesses the costs of inaction as the likelihood of the specified risk occurring. The benefit of inaction is the saving in the cost of preventive measures. This is useful where risk is a major consideration in projects, and can be captured via monetary values
- **Decision analysis:** this decision-support tool weights the expected values of a given course of action (in other words, the sum of possible values weighted by their probability of occurring) by attitudes to risk, to give expected utilities. It draws up and assesses decision makers' preferences, judgements and trade-offs in order to obtain weights that are attached to outcomes carrying different levels of risk
- **Multi-criteria analysis:** multi-criteria analysis provides one of the most useful and increasingly common tools for integrating different types of monetary and non-monetary decision criteria. It has been developed to deal with situations where decisions must be made taking into account multiple objectives, which cannot be reduced to a single dimension. Multi-criteria analysis is usually clustered into three dimensions: the ecological, the economic and the social. Within each of these dimensions certain criteria are set, so that decision-makers can weigh the importance of one element in association with the others. Here, monetary values and CBA measures can be incorporated as one of the criteria to be considered, and weighed against the others in decision-making

*Step 8: Presenting management and decision-making conclusions*
In summary, this step involves relating the findings of the valuation study to ongoing management issues, and targeting this to particular audiences and aims. It should result in a convincing report on the economic status and value of the wetland as it relates to management priorities and threats.

However good the results of a valuation study are, they will have little impact on decision-making if nobody sees, reads or is persuaded by them. There is an art to presenting information, and communicating it effectively. In many cases, the technical experts who carry out the valuation study itself may not be the best placed to do this – there is often a need for professional communicators and a properly-designed communications strategy.

Information about wetland values will be easiest to communicate when decision-makers find it useful, and it helps them to address or better understand a particular situation or problem. Many people are involved in shaping decision-making, and communication of the results of valuation studies must usually take place at many levels of scale. Making the results of valuation convincing to these different groups requires different types of communications strategies, different messages and different ways of presenting information.

In a perfect world where all decisions were made for the good of society, merely making valuation information available might be enough to ensure that water decisions took fair account of ecosystems. Unfortunately this is not usually the case. There exist multiple, and often competing, interests in wetlands. Fostering cooperation and balancing these competing interests is critical when the results and recommendations of wetland valuation studies are presented. Here, it is important to be tactical and work with the different constituencies who actually have the political will, and power, to influence wetlands. Just as wetland valuation aims to articulate particular costs and benefits that have traditionally been ignored in decision-making, it also represents the interests of many of the groups who have often been excluded from these decisions.

### Further reading

Turner, R.K, Georgiou, S., and Fisher, B. 2008. *Valuing Ecosystem Services: The case of multi-functional wetlands*. Earthscan, London, UK.

Barbier, E.B., Acreman M.C. and Knowler, D. 1997. *Economic valuation of wetlands: a guide for policy makers and planners*. Ramsar Convention Bureau, Gland, Switzerland

[1] A market can be said to be competitive when there are a large number of buyers and sellers, there are no restrictions on market entry, buyers and sellers have no advantage over each other, and everyone is fully informed about the price of goods.

[2] Marginal value is the change in value resulting from one more unit produced or consumed.

[3] A public good is characterized by the non-excludability of its benefits – each unit can be consumed by everyone, and does not reduce the amount left for others. Many ecosystem services are pure or partial public goods – for example scenic beauty (a pure public good), or water quality (which has many of the characteristics of a public good). In contrast a private good is one from which others can be excluded, where each unit is consumed by only one individual. Most natural resources are private goods.

[4] A substitute good or service is one which is used in place of another – for example kerosene instead of firewood, or bottled water instead of tap water.

[5] A complementary good is one which is used in conjunction with another – for example between other products and fishing activities such as the collection of reeds for fishing baskets or firewood for fish smoking.

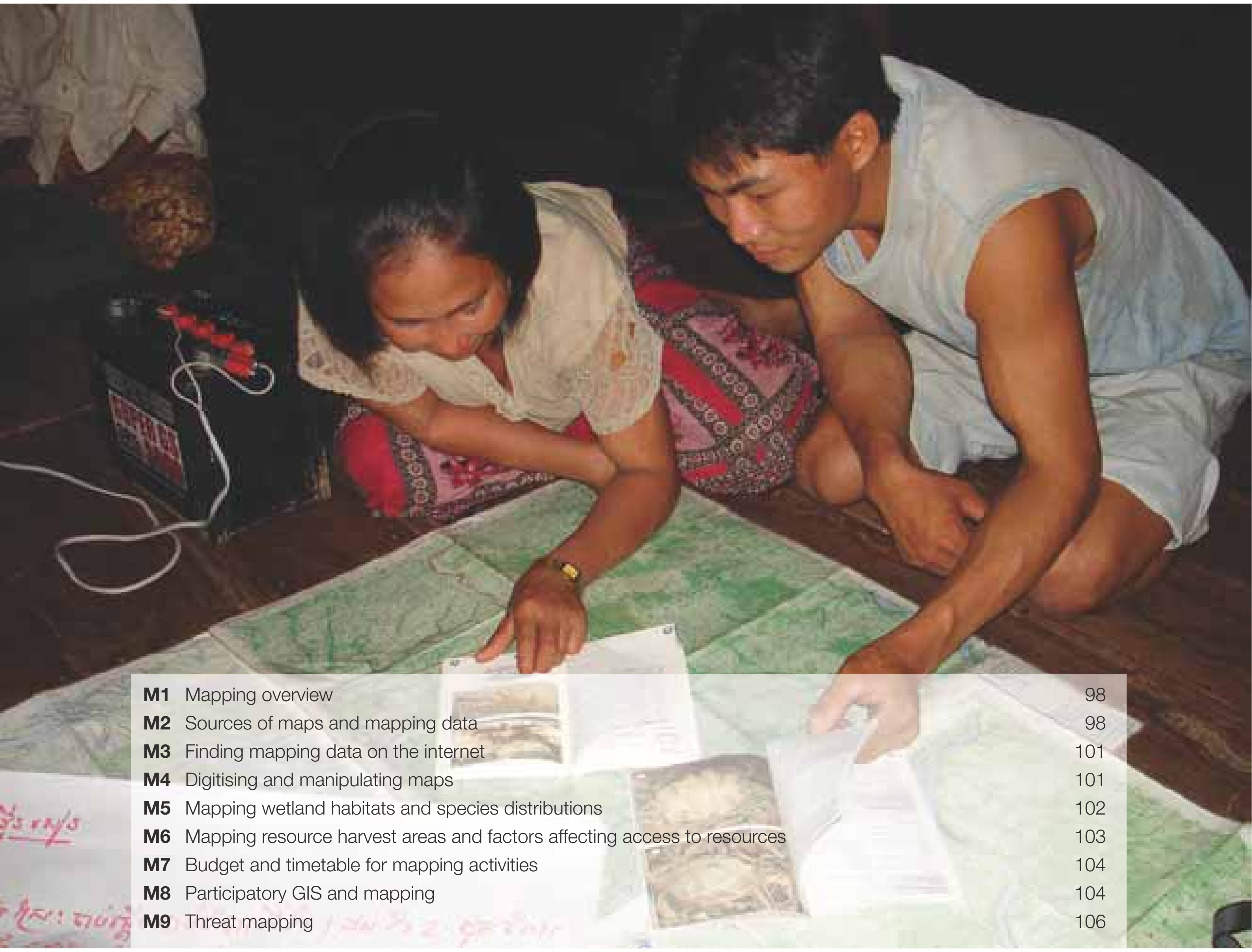
[6] Consumer surplus is the difference between the value of a good and its price, in other words the benefit over and above what is paid that is obtained by a consumer who is willing to pay more for a good or service than is actually charged. When a benefit is obtained free, all of its value is consumer surplus.

# Chapter 6

## Mapping Tools

*Anna McIvor, David Allen, and William Darwall*

The spatial aspects of wetland management and use are critically important to understand. Mapping methods and tools are therefore essential to integrate into the assessment, and the presentation of findings. This chapter presents a range of methods and approaches and gives advice on how best to apply them.





*Kong Kim Sreng/Darwin Integrated Wetland Assessment Project*

## M1 Mapping Overview

Maps are an ideal way to present information about a wetland site. They present information in a way that is easy to understand; they are attractive, quick to take in, and bring different types of information together. They can be an ideal way of presenting integrated information to stakeholders.

In this toolkit there is a strong emphasis on collecting georeferenced data in order to produce useful, insightful maps. Some common mapping terms are defined in Box 16. The georeferenced biodiversity, livelihoods, and economics data can be overlaid on a base map to highlight areas of interest, such as conflict between use and conservation, or areas of high value. The maps should be clear, concise and easily accessible to decision-makers and other stakeholders. They may in themselves become useful tools to elicit further information on conservation and development issues within the area, as local people discuss the validity of the information shown.

The most convenient and powerful way to store, analyse and present map and location data is in a Geographical Information System (or GIS – see Box 16 below).

**BOX 16: COMMON MAPPING TERMS AND DEFINITIONS**

**Digitise:** Converting a map from a picture (either on paper or in electronic format) into a format which can be viewed using mapping software. The different features of the map are represented by different layers which can be viewed independently and recombined with layers generated from other maps.

**GIS:** Geographical Information System – a way of storing, analysing and presenting data that is linked to a location. There are many different GIS software packages available, some of which are free 'open source'.

**Georeference:** To define data in physical space. When using GIS it is important that all data have a common referencing system so that sources and outputs can be combined. Georeferencing ensures, for instance, that GPS points show up at the correct coordinates on another source file, such as an aerial photograph.

**GPS:** Global Positioning System. A GPS unit receives information from satellites around the globe. From this, a GPS can calculate its geographic location anywhere in the world.

**Projection:** The grid system used to display the globe on a flat surface. A change in projection can have a dramatic effect on the appearance of the resultant image.

### M1.1 Types of geographical data required

Species data are traditionally mapped using point locations where species are found, which may be mapped to a grid or just used as point localities. However, in order to be able to overlay species data with resource use data, we need to have complete coverage of an area with respect to species' presence. It is impossible to sample every point within an area, so we recommend an approach where the habitat types are mapped, species are sampled within the different habitat types, and then the species found within each habitat type are assumed to be distributed throughout that habitat type. This requires that all species' sightings are georeferenced, and that habitat types are mapped using existing maps, aerial photos or satellite imagery, or by georeferencing the boundaries on foot or by boat.

Livelihood and economic data, the spatial aspects of resource harvesting, and the factors affecting people's access to resources can also be mapped. Areas to be mapped include resource harvest areas, institutional boundaries, natural boundaries and other (man-made) boundaries which may limit people's access to resources. Additionally, travel times to different areas can be shown on maps, and these may be useful in understanding resource use patterns. Researchers need to enquire about where resources are harvested from and why in order to collect these types of information. Participatory mapping exercises may be a useful tool for doing this, followed by georeferencing of areas or boundaries with the help of local people using a GPS.

It is important that the boundaries of areas, and not a point location in the middle of the area, are recorded for each habitat, resource harvest area, or institutional boundary. Point locations are insufficient to map sites, unless notes are made about the size of the site. For example, if the middle point is georeferenced and notes are made that the area (e.g. a deep pool in a river) is approximately round, with a diameter of 20 m, then that is sufficient to map the area. It is however preferable to georeference the boundary of a site where possible, taking GPS readings at key changes in direction or every few metres (if the site is irregularly shaped).

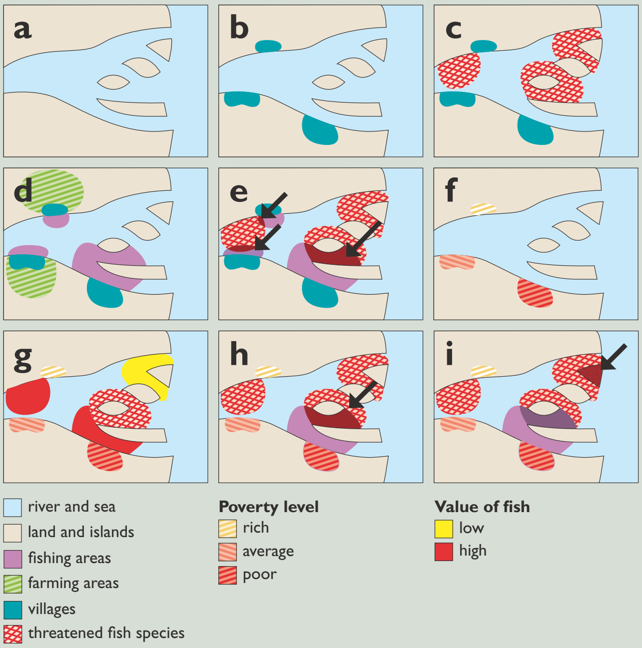
### M1.2 Mapping example

The types of maps that we envisage creating, using the methods described in this toolkit, are shown schematically in Box 17.

## M2 Sources of maps and mapping data

Maps and GIS data can increasingly be found on the internet, and time should be spent searching for these before starting to digitise your own maps (see M3). However, maps may not be available at an appropriate resolution for a project if working

**BOX 17: SCHEMATIC MAPS SHOWING BIODIVERSITY, LIVELIHOODS, AND ECONOMIC VALUES IN A WETLAND**




a) a river, its delta and islands
b) the location of villages around the delta
c) the distributions of three species of fish which are considered at risk of extinction
d) the fishing and farming areas around the villages (while two villages rely on both fishing and farming, the village nearest the sea relies almost entirely on fishing for its livelihoods)
e) the overlaps between the fishing zones and distributions of threatened fish to show where humans are putting pressure on threatened fish species
f) the poverty levels of the villages (the village most reliant on fishing is also the poorest village)
g) the economic value of the three threatened fish species. While one species is of low value (and is not fished), the other two species are of high economic value. The one fished by the poorest village has the highest economic value
h) the area of overlap where a threatened fish species of high economic value is providing an essential resource to the poorest community
i) such information could be used in decision-making. For example, if a tourist lodge is planned for one of the islands in the delta, the small northern-most island is recommended as the best location as this is the only island which does not border an area containing a threatened fish species of high economic value to the poorest people

in a relatively small area, or there may be issues of ownership and use. If existing digital maps are not available, the following sources may be useful as bases from which to digitise new maps (see an example in Figure 29).

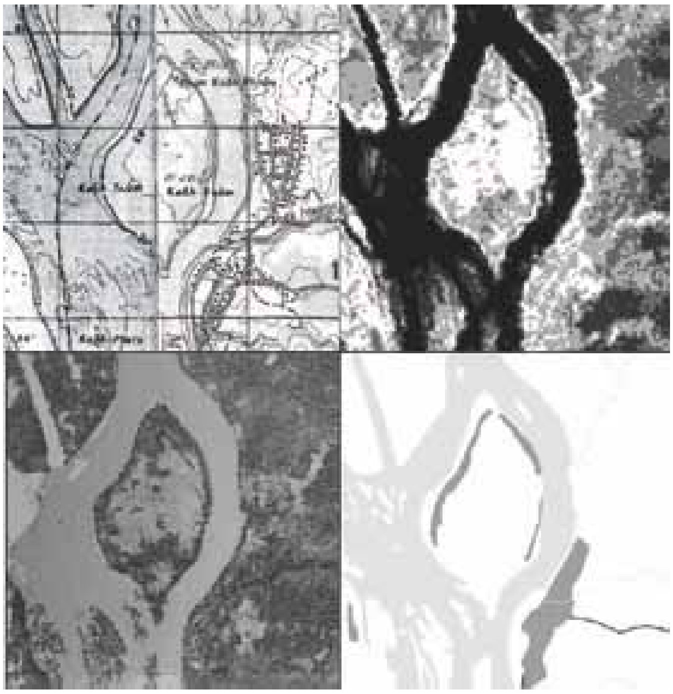


**Figure 29: An example of maps showing digitising techniques. The maps show, clockwise from top left: a 1972 topographic map (low water); a LandSat satellite image; a 2001 aerial photo, scale 1:40,000 (high water); and a digitised image, using the topographic map as its base, but digitising villages (dark grey) from the aerial photo (land is white, river is light grey)**

### M2.1 Topographic maps

Topographic maps (maps which present the cultural and natural features of an area) are often available from government and private mapping agencies, and resources are increasingly being made freely available. Topographic maps will show, depending on the scale, the larger rivers and lakes, and may indicate floodplains, marshes, seasonal pools and other wetland areas. They are particularly useful for making base maps, and additional features can be digitised from other sources and added as a GIS 'layer'. Care should be taken when digitising these maps to note the projection of the map, otherwise there will be problems later overlaying other map layers. Very old maps should be viewed with caution; although it is unlikely that the river and lake outlines will have changed significantly, this can happen. In areas where there are large annual fluctuations in water level, it is also a good idea to think about whether you want your map to show high (seasonal flooding) water levels, low water levels or stages in between.

### M2.2 Satellite images

Satellite images can be found free on the internet, or obtained from commercial or government sources, though the resolution of maps which are freely available is usually inadequate for mapping wetland habitats. Most free satellite images have

David Allen/Darwin Integrated Wetland Assessment

*The provision of GPS to key members of the community, with appropriate training, can be an invaluable way of collecting georeferenced data, especially if project resources are limited, and – more importantly – promote community involvement in the project. In this case, the Mtanza-Msona village fisheries officer mapped a range of locations including key fishing habitats and agricultural land*

already been geo-coded, but the extraction of information about the surface cover types requires specialist software, and so far wetland habitats have been poorly resolved. There are likely to be major advances in this area in the coming years, even to the point where some in-river habitats may be differentiated, such as riffles and deep pools. Satellite images may be useful to look for water bodies which are not currently included on the map, however, digitising these habitats is probably best done using either aerial photos or by georeferencing their boundaries in the field.

### M2.3 Aerial photos

For many areas aerial photos may already exist, and these may be available for a fee from government mapping agencies, university geography departments or NGOs. Google Earth now provides aerial images of the whole globe; coverage of rural areas is often at a low resolution, but may be adequate for making initial maps of an area (ensuring that the projection of the original images is recorded).

In order to use aerial photos, they must first be geo-processed, a process that includes orthorectification and geo-coding. Orthorectification is required to take account of distortion caused by the camera lens and the shape of the Earth. Geo-coding puts the image in the right place on the earth's surface, using Ground Control Points (GCPs) which are identifiable features in the photo whose exact latitude and longitude is known (the position of such features can be found using a GPS). Generally three GCPs are needed for each photo. Finally, aerial photos need to be fitted together (as a *mosaic*), ensuring that the edges line up to make an image of the whole area. The provider of aerial photos may have already completed these steps, but they should not be skipped otherwise the quality of maps made from such photos will be seriously compromised.

### M2.4 Georeferencing in the field

Georeferencing will be necessary for many wetland habitats of relevance to integrated assessments, as some of these may be small seasonal water bodies which are barely visible on satellite images and will only be seen in aerial photos if they were taken at the right time of year. Use a GPS to record the boundary coordinates of wetland features.

Similarly, species locations should be georeferenced with a GPS, as well as key livelihood activity locations, such as harvesting areas and markets, and seasonal, temporary, and permanent settlements.

*M2.4.1 GPS unit selection and operation*

A GPS unit picks up information from up to (for most GPS units) 12 or more satellites to calculate the position on the ground. Normal accuracy is approximately 7-15 m. Recent GPS models provide improved satellite signal location and accuracy, even under dense tree canopy and on steep terrain, both situations which usually prevent accurate GPS location. For most situations when surveying in wetlands, for example on floodplains and open rivers and lakes, only a simple GPS unit will be needed.

All GPS units used by the project should be set to the same coordinate system and datum. Ideally, the GPS unit should be set to match the projection, datum and coordinate system of the GIS map on which the data will be shown, although conversion later within the GIS is possible. Latitude/Longitude and UTM (Universal Transverse Mercator) are two coordinate systems that are commonly used.

Survey locations (coordinates) can either be recorded in full in the field and later transferred to a GIS, or (with many GPS units) the location can be stored on the GPS as a waypoint, and later downloaded directly onto a computer and into a GIS mapping programme. Care needs to be taken that waypoint data are not lost. Appropriate software and connecting cables will be needed, and the data downloaded on a regular basis from the GPS. The waypoint locations and names can then be exported into a spreadsheet and imported into a GIS.

## M3 Finding mapping data on the internet

Much mapping data and many GIS data layers are freely available on the internet, so a quick internet search may save you a lot of time.

For example, sources of mapping data include:-

- CGIAR Spatial Data Catalogue
  www.grida.no/prog/global/cgiar/dif/
- UNEP/GRID-Europe
  www.grid.unep.ch/
- FAO – Africover
  www.africover.org/
- GeoCommunity Data Catalogue
  data.geocomm.com/catalog/index.html
- WDPA: protected area mapping data
  www.wdpa.org/
- MapCruzin: free digital resources
  www.mapcruzin.com/download-free-maps.htm
- Open Forum on Participatory Geographic Information Systems and Technologies
  www.ppgis.net/

Some basic map layers (GIS shapefiles) are available directly from the IUCN Freshwater Biodiversity Unit (iwa_toolkit@iucn.org). Layers available include country and administrative borders, elevation models, and wetland features such as rivers.

## M4 Digitising and manipulating maps

If only paper maps, satellite images or aerial photos are available, it will be necessary to import them into a GIS by digitising (see M2). Features such as rivers, lakes, villages, and roads are then traced to create a digitised layer for each feature. These can then be viewed separately or together, and in conjunction with other data such as habitat types or harvest areas as required. The digitising process is illustrated in Box 18.

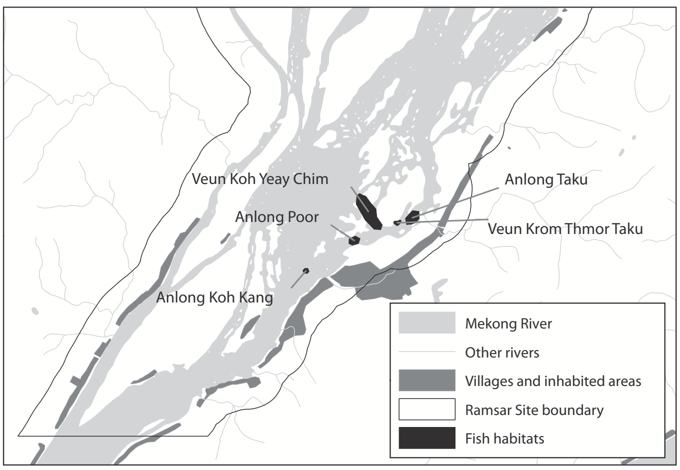
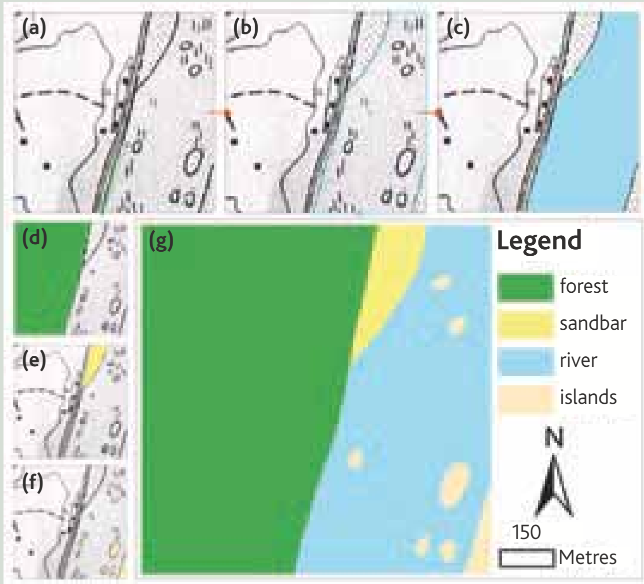



**Figure 30: An example of overlays of georeferenced data**

### BOX 18: DIGITISING MAPS




Starting with a scanned in topographic map, the river is traced over (a,b,c), followed by the forest, sandbar and islands (d,e,f). The four layers are combined to make a map of the area (g).

### M4.2 Geographic Information Systems

A variety of GIS software is available, ranging from commercial software such as ArcInfo, ArcGIS, and ArcView (all available from ESRI; www.esri.com) to free 'open source' software which may have much more limited capacities, but may nevertheless be adequate depending on a project's needs. There are many 'open source' GIS software packages available and an internet search will show recommended packages.

Many government agencies, university departments and some NGOs have GIS resources (both software and skilled personnel), and it may be possible to access these resources.

### M4.3 Using a GIS to create maps and integrate information

The power of maps lies in their ability to present a lot of information visually, allowing people to take in that information quickly. They also allow different types of information to be displayed together, effectively integrating that information. Figure 30 brings together information on fish habitats as georeferenced from a boat guided by local fishermen (the habitat areas are named on the map), with the locations of villages (digitised from an aerial photo), the boundary of a Ramsar Site (defined as a certain distance from the river by government) and the river outline with its islands (digitised using a 1972 topographic map).

## M5 Mapping wetland habitats and species distributions

If available maps of the area do not show wetland habitats in sufficient detail it may be necessary to map wetland habitats as part of the project. Maps will normally show streams, rivers, and lakes, but may not show seasonal pools, marshes, floodplains, in-river and in-lake habitats (such as deep pools, rocky shores, waterfalls, water holes and various other habitats) that may be important for local livelihoods or may contain unique freshwater species.

### M5.1 Prioritising wetland habitats to map

Before spending too long mapping and digitising every wetland feature in an area, it is worth considering how much time is available for mapping habitats and conducting species surveys. If time permits that only three or four different habitat types are sampled for species, then habitat mapping should focus on those habitat categories. These habitat categories should be broad enough to include the majority of wetland habitats that are present, such as main rivers, tributaries, and lakes, along with seasonal ponds, seasonal pools, and wet grasslands.

The choice of habitats to focus on also needs to take into account their importance to livelihoods. For example, if seasonal pools are essential to livelihoods, then they should be mapped and sampled for species, even though they may have to be mapped on foot as they probably will not show up on satellite images or even on aerial photos if they are small. Deep pools in rivers may serve a similarly important livelihood function.

Kong Kim Sreng/Darwin Integrated Wetland Assessment Project

*House of a low income family within the Stung Treng Ramsar Site wetlands*

### M5.2 Species mapping

If the aim is to produce species maps for the study area, then a sampling strategy needs to be chosen that will efficiently sample the area to produce such a map. We recommend:

1. Mapping the representative wetland habitats found in the area
2. Sampling for species in a subset of these habitats
3. Mapping the species found in each habitat type to all similar habitats found in the area

This will give *inferred* species distribution maps with complete coverage of the wetland area. This inferred mapping needs to be informed by knowledge of the wetlands within the project area as some potential habitats may be unsuitable for the species, for example due to pollution. The following figures demonstrate this approach.

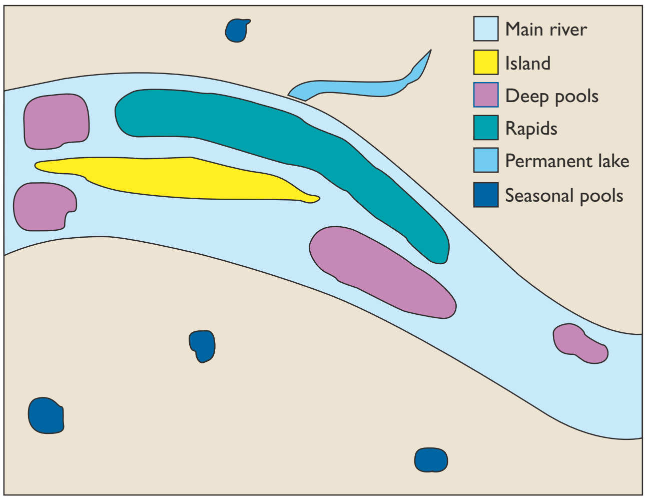



**Figure 31: River habitats**

In this area (Figure 31) there are a variety of wetland habitats including river margins, river mainstream, deep pools, rapids, permanent lakes, and seasonal pools. If the time available allows the team to visit 10 sites for biodiversity surveys, which sites should be chosen?

All habitat types should be visited at least once (six sites). Up to four habitat types can be sampled more than once. Which habitats are chosen for additional sampling might depend on their importance to local livelihoods, or on other factors, such as the likelihood of variation in species assemblages between patches of similar habitats, or seasonal or migrational variation in species' presence and abundance. For example, if the deep pools contribute significantly to the local fishery, then two more deep pools could be surveyed. If it is considered likely that the small seasonal pools will contain varied species assemblages, one seasonal pool from each side of the river could be sampled. Where more than one site of a particular habitat type can be sampled, the sites chosen should be of varying sizes, widely dispersed, and representative of other gradients present on the site (for example, if some seasonal pools were on the floodplain while others were more than 20 m above the river level, both types should be sampled). The accessibility to sampling sites should also be considered when choosing them. Therefore in this example the sampling sites chosen might be as shown in Figure 32.

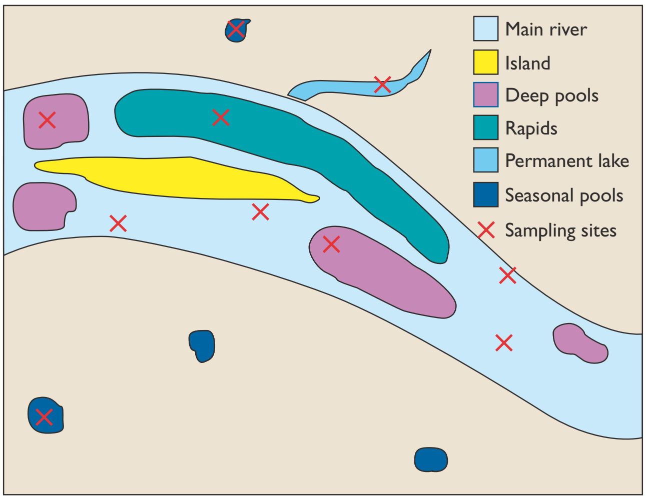



**Figure 32: Selection of sampling sites**

Following such sampling, each habitat will have a species list associated with it (species' lists from different patches of the same habitat type can be combined). Species maps can then be generated by mapping species onto the habitats where they were found. For example, if the 'spiny fish' was found in the deep pools, the main river channel, river margins and permanent lakes, then its distribution map would look like Figure 33.

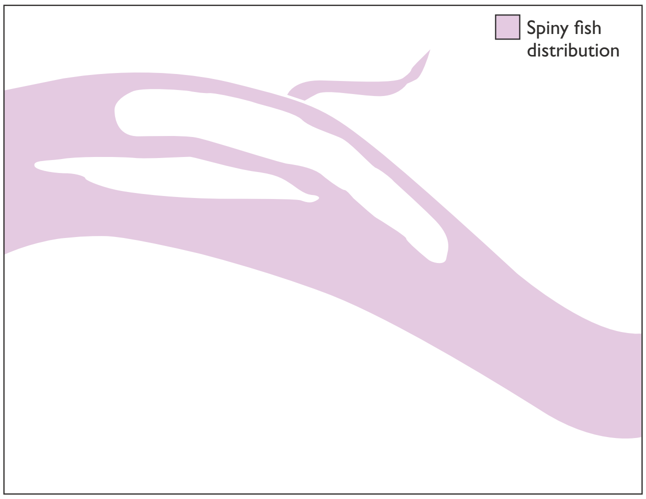



**Figure 33: Species habitat**

If only five sites could be surveyed, the main habitats could be reclassified as river habitats, lake habitats and seasonal pools. The survey points chosen might then be as shown in Figure 34; which in-river habitats are sampled could be related to those habitats most frequently used as harvest areas by local people.

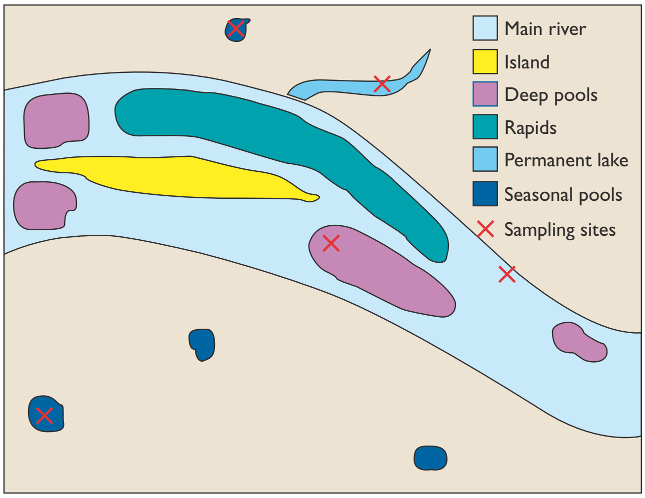



**Figure 34: Selection of sampling sites where constrained**

## M6 Mapping resource harvest areas and factors affecting access to resources

Whenever resource use is discussed, such as in focus group or key informant discussions, researchers should record information on where resources come from, as well as what the resources are (species name or specimen) and who uses them (e.g. household wealth, location of household, resident or migratory). Local people may be able to draw the locations on maps (e.g. using participatory mapping techniques, see M8); these can be digitised into a GIS, but better accuracy is obtained if the locations are subsequently georeferenced with a key informant or resource user, recording harvest areas and which species are harvested from which area. This is an ideal opportunity to discuss when harvests are made, how they vary throughout the year in quantity and quality, why different areas are used at different times, who harvests from the area and why. If local people are shown how to use the GPS, they may be able to georeference the harvesting areas.

Other features that can be mapped include:

- institutional boundaries, such as the edge of a protected areas or game and forest reserves, especially where they impact upon the use of wetland resources, and boundaries of ownership or right of use, such as village boundaries, family boundaries or sacred sites where harvesting is forbidden
- natural boundaries created by the geography (such as cliffs, chasms, rapids, waterfalls, mountain passes). The presence of wild animals such as lions or crocodiles, or disease vectors, can also create natural boundaries or restrict access to resources at certain times (e.g. some lakes may be preferred for fishing, water collection or washing because it is known that there are no crocodiles present)

- other artificial boundaries, such as areas where it is considered dangerous to go because of bandits, potential conflicts with other people, or areas with landmines

Such areas may be elicited by asking why certain resources are not harvested from locations which otherwise seem ideal, or by spending time discussing the geography of the area with local people, focusing on where the valuable resources are and what limits their harvest and use.

It may also be useful to note travel time to various important harvest locations. These can be shown on maps, and are likely to have a strong influence on frequency of harvests; for example, harvest areas further away may be important in times of need.

In summary, all spatial aspects of resource harvesting and the factors affecting people's access to resources should be documented and georeferenced where possible, in order that they can be shown on maps and integrated with data on species' presence (i.e. resource availability).

## M7 Budget and timetable for mapping activities

Maps, aerial photos, satellite images, the software to handle them and people trained in doing so can be expensive to obtain or hire, and this needs to be considered in the assessment budget. This is particularly important if no maps are available, in which case aerial photos or other mapping data may need to be obtained. The time and expertise needed to work with maps also needs to be considered (see Table 13). Staff trained in GIS technologies will be required, and staff time needs to be budgeted (creating new maps by digitising aerial photos is time-intensive).

## M8 Participatory GIS and mapping

*This section has been adapted from materials developed by Dr Oliver Springate-Baginski, University of East Anglia, UK (oliver.springate@uea.ac.uk).*

Participatory mapping, using either GIS or novel online mapping tools such as Google Earth, has developed in recent years as a merger between Participatory Learning and Action (PLA) approaches to natural resource management and development, and the development of easily accessible computer or web-based technologies.

Participatory mapping, promoting the participation of local communities in resource and access mapping, has the potential advantages of:

- rapidly and more cheaply collecting georeferenced data on community land boundaries, resources and harvesting areas
- encouraging the participation in, and ownership of, the project process and outputs by the community(s) within the project area
- potential to address some of the ethical issues of ownership and access to data that arise from project activities.

Here we look at just one approach, using GPS georeference data in combination with freely-available Google Earth technology to map community resources.

### M8.1 Participatory resource mapping using Google Earth

Although valuable, conventional GIS have until recently been relatively inaccessible for widespread use. The software is typically expensive and technically demanding for the user, requiring specialist skills, licensed software, access to expensive data, and time to produce basemaps.

**Table 13: Timetable of mapping activities**

| STAGE | ACTIVITIES |
|---|---|
| **Pre-project proposal** | Research existing maps and mapping data. If none are available, ensure that the project budget includes funds to purchase mapping resources and staff time to compile and digitise these. Other items to include in the budget are one or more GPS units, which will be needed to georeference and ground-truth maps, and delineate areas such as wetland habitats and resource use areas |
| **Pre-scoping mission** | Ensure that a suitable map showing main features of sites is available – such as rivers, lakes and as many other wetland habitats as possible, towns, villages, roads etc |
| **Scoping mission** | Ground-truth maps. Check if there are more wetland habitats that should be included on maps. Use GPS to delineate unmapped wetland habitats. Choose biodiversity sampling points to be representative of wetland habitats present |
| **Field assessment** | Georeference species records and important economics/livelihoods locations, such as resource use zones, boundaries of use areas (e.g. by ownership), markets etc |
| **Analysis and presentation** | Production of map layers showing areas of biodiversity and livelihood values (threatened species, utilized species, locations of poor households and harvesting areas for example); production of final maps |

To overcome some of these constraints, participatory GIS work during the 1990s began to explore how benefits of GIS use could be more widely accessed. In recent years the situation has been completely revolutionised by technical developments: the availability of low cost GPS devices; user-friendly and free mapping software (e.g. 'GPS Trackmaker'); and free web-based data (e.g. Google Earth). Together these tools have transformed the possibilities for linking GPS data collected from field locations to maps, and for analysing and expressing this graphically. As such they are being rapidly and widely adopted around the world for a growing range of development and resource monitoring-related uses. For example:

- land rights groups in Brazil and India are using them for land boundary definition
- production of village poster-maps using these methods is facilitating improved community resource management planning
- monitoring of fisheries locations (e.g. in the USA and the EU)
- production of spatial locations for biodiversity assessment data, along with tracking of species movements, is proving valuable, particularly for tracking species involved in conflict with human populations (e.g. elephants in South Asia and Southern Africa)

Companies such as Google are actively promoting the use of their products for these sorts of applications (for instance, a Google workshop promoting Google-based biodiversity mapping methods was held at the World Conservation Union Congress in 2008).

The potential of these new tools and methods is twofold:

1. To improve understanding of development issues and to empower people with information about their circumstances is far-reaching, particularly with reference to natural resource management
2. To improve research methods and data collection in several ways

Methods discussed here have emerged from recent research on implementation of the Forest Rights Act 2006 in India where it is being used to research and document forest land claims.

*M8.1.1 Aims*

Using GPS georeferenced location data in conjunction with mapping (e.g. Google Earth; see http://earth.google.co.uk/outreach/index.html and http://earth.google.com) allows production of high quality and relatively accurate pictorial maps for very little effort. These can be used:

1. To facilitate discussions in villages (ideally printed on large scale poster size paper to facilitate group participation)
2. To represent the village land situation in reports (i.e. its *de jure* rights status and *de facto* use)

There are a number of similar web-based mapping tools, of which Google Earth is just one. Once demonstrated, villagers can use GPS units to collect georeferenced data which can then be mapped using Google Earth. The resulting maps or aerial photograph views can either be printed out on paper or shown to villagers on laptop computers.

*M8.1.2 Preparation*

A modern computer, printer, and fast internet connection are useful, but not essential, in the field as maps can be prepared and printed elsewhere or displayed on laptops.

1. Calibrate the GPS unit (this is essential; see the literature for your GPS unit)
2. Install GPS 'Trackmaker' software, and if available, the relevant base-map (not essential) from www.gpstm.com
3. Install Google Earth software (from http://earth.google.com)

*M8.1.3 Process*

1. Georeference the villages, boundaries and resources. Take readings for field edges, village boundaries and so on
2. Upload the locations onto the GPS Trackmaker programme on your computer:
   - Go to the GPS interface in Trackmaker
   - Turn on the GPS unit and connect to computer. Press '**Request from GPS**' function. When complete press '**Exit**' and disconnect the GPS
   - The waypoints should now be displayed on the GPS Trackmaker basemap of the region
   - Save them as a new file
   - Select the group using the cursor to create a box around the ones you want to view

**Figure 35: Selecting the GPS locations in Trackmaker**

3. Press the **'3D View in Google Earth'** function on the top row of buttons – this should open Google Earth and display the way-points

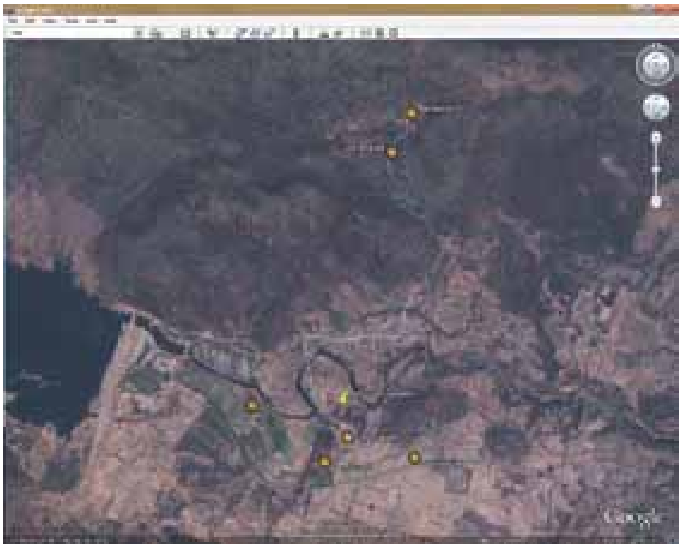


**Figure 36: Viewing the GPS points in Google Earth**

4. You can copy your screen and paste into word-processing documents or image software
5. You can also draw 'polygons' in Google Earth to demarcate areas under different uses, such as fishing areas or traditional access areas (instructions: http://earth.google.com/userguide/v4/ug_drawing.html). Areas of polygons can be measured in Google Earth (but only with the paid-for professional version), or the data can be exported from Google Earth (as .kmc or .kml files) and displayed in a GIS


**Figure 37: Drawing polygons around features (from Kumar *et al*. 2009)**

### M8.2 Uses

The 'photo-maps' can be printed out or displayed on laptop computers to use in village discussions. To produce large paper copies of the photo-maps, you can either use a special large format printer, or many normal A4 printers have drivers that allow you to print onto multiple pages, so that you can stick them together as a mosaic.

The paper maps are readily accessible by villagers and can be used to show local communities the location of their resources or proposed conservation management zones, for example, and to obtain feedback and comment, potentially allowing villagers a voice in the decision-making process.

### M8.3 Key resources

*M8.3.1 Readings*

Corbett, J., Rambaldi, G., Kyem, P., Weiner, D., Olson, R., Muchemi, J., McCall, M. *and* Chambers, R. 2006. Mapping for Change: The emergence of a new practice. *Participatory Learning and Action Notes* 54:13-19. IIED, London, UK. *Available at: http://www.iapad.org/publications/ppgis/ch01_overview_pp13-19.pdf*

Kumar, K., Behera, S., Sarangi, S. and Springate-Baginski, O. 2009. *Historical Injustice: Forest Tenure Deprivation and Poverty in Orissa.* UEA DEV Working Paper, University of East Anglia, UK.

*M8.3.2 Online resources*

These are just a small sample of the many online GIS, GPS and participative mapping resources that are available.

- Integrated Approaches to Participatory Development (IAPAD)
  www.iapad.org
- United Nations Office for the Coordination of Humanitarian Affairs
  www.humanitarianinfo.org/IMToolbox/web/03_Map.html
- Open Forum on Participatory Geographic Information Systems and Technologies
  http://www.ppgis.net

## M9 Threat mapping

Where the management question chosen as the focus for a study relates to a specific threat, such as the building of a dam or the establishment of a prawn farm, threat mapping can be a useful tool because it can show what important functions or values may be lost if the threat occurs and over what geographic extent the impacts will be seen.

There are two ways of mapping threats. If the source of the threat is localised, such as a new dam, then it is possible to map the threat itself (i.e. the position of the proposed dam). However some threats are not easily defined geographically in this way, such as climate change.

An alternative way of mapping threats is to map the likely effect of the threat on some item of value or a physical characteristic of the wetland. For example, a proposed dam would alter the flood regime downstream, so it might be possible to map areas

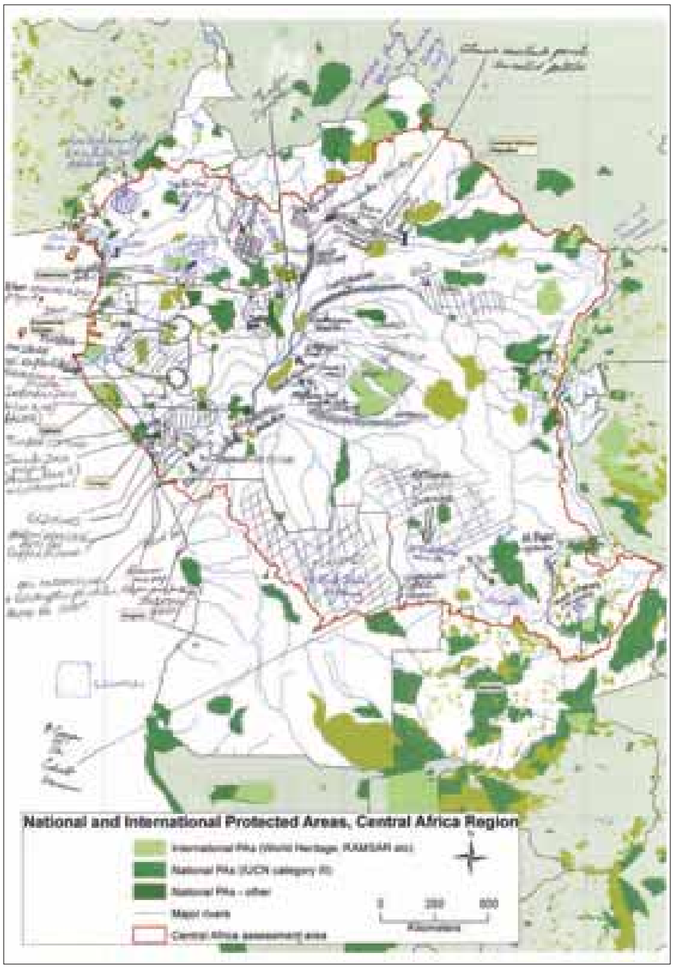



**Figure 38: An example of a threat map produced by workshop participants as part of a Central Africa freshwater biodiversity assessment project (see www.iucn.org/species/freshwater). Such a map can be rapidly produced during the literature review stage of an integrated wetland assessment using expert opinion**

that will be flooded less frequently or for a shorter time, or to map areas where it was previously possible to grow rice but where that will not be possible if the dam is built, or to map communities that will lose a significant proportion of their income.

### M9.1 Threat mapping process

The following questions are a guide to the process of threat mapping:

1. What is the 'item of value'? (for example, a particular species, all wetlands, income from wetlands)
2. Where is the 'item of value'? [Draw a map of it]
3. What threats are there to the 'item of value'? (e.g. climate change, drainage, migrant harvesters)
4. Where does the 'item of value' overlap with the threats (i.e. where is it threatened)? [Draw maps of different threats, and possibly number of threats summed by area]
5. How vulnerable is the 'item of value' to the threats? (i.e. How much impact leads to how much response – can you quantify the relationship?)
6. Therefore what is likely to happen to the 'item of value'? (If at time $t$=0, there is x amount of the 'item of value', what proportion of x is likely to be left at time $t$=1?)

These questions lead you through making a series of maps, starting with issues for which good data are available, and then moving towards issues about which we are less sure. For example:

a. A map of the distribution of the 'item of value' (e.g. a species' distribution map, a species' richness map, a map of tropical dry forest) [*KNOWN]*
b. A map of the importance/value of the 'item' (e.g. a map of wetlands of high economic value to livelihoods) [*KNOWN]*
c. A map of where the threat is expected to act (e.g. increased temperature, change in precipitation due to climate change, human population pressure, number of invasive species, reduction in river flow) [*PARTIALLY KNOWN*]
d. A map of where the pressure from the threat will be strongest, as it is usually graded and may act widely at a low level e.g. areas of highest temperature change, largest reductions in flow, highest levels of poverty, fastest rates of deforestation [*UNCERTAIN*]
e. A map of how the value of the 'item' will respond to the pressure (e.g. likely areas where a species or habitat will be lost from, areas where income from fishing is likely to decrease by >X %) [*SPECULATION*]
f. A map of important areas for conservation, defined as areas of high value and high threat (e.g. species-rich areas downstream of dams, communities whose livelihoods are highly dependent on non-timber forest products that are within a logging concession)

Issues to consider include that there may be a time lag between the occurrence of the pressure/threat and its effect on the item of value, which may not be possible to take into account or quantify.

In order to speculate about the possible effects of a pressure or threat (and factors such as time lags), it may be possible to look in the literature for historical examples from other areas and extrapolate to the case in hand (see Box 19). If this is not possible (such as with climate change, for example), an alternative approach is to get a group of experts together and ask them to qualitatively rank what they think is most likely to happen. This generates anecdotal data of how things might react to a pressure and how much time lag there might be.

Any threat or pressure can be mapped providing some data are available as to how likely it is to affect an 'item of value', where there is data on the distribution of that item.

Kong Kim Sreng/Darwin Integrated Wetland Assessment Project

*Using maps to assess the impact of proposed conservation management plans to local livelihoods in Stung Treng Ramsar Site, Cambodia*

### M9.2 Examples of threat-mapping

- Mountain Watch mapped issues affecting mountain regions, including the ecological and social values of mountain ecosystems and the current and potential pressures facing mountain environments and people. Pressures mapped included seismic hazards, armed conflict, fire, climate change, land cover change, agricultural suitability, and infrastructure
- Miles *et al*. (2006) mapped various pressures affecting tropical dry forests including climate change, forest fragmentation, fire, conversion to agriculture, and human population
- the Globio Project (*Global Methodology for Mapping Human Impacts on the Biosphere*; www.globio.info) used distance to infrastructure to estimate likely human expansions in different ecosystems and regions, which can be mapped
- the *Fall of the Water* project mapped the likely cumulative impacts of climate change, infrastructure development, land use, forestry, and nitrogen pollution on the abundance of biodiversity in central Asia

**BOX 19: HOW MIGHT WE MAP THE THREATS FROM A PROPOSED DAM?**

We could look at the effects of similar-sized dams on other similar rivers, as thousands of dams have been erected, and for at least some of them, data are available on how the hydrology and biota changed. This would give us an idea of the likely response to the dam, which we could then plot onto the downstream area.

For example, if similar dams in the United States have caused a lowering in water temperature of 5°C for 3 km downstream, we can show that on our maps as a likely outcome. If we know that 40% of the biota is intolerant of temperature changes greater than 1°C, we can plot these areas as losing 40% of the biota (in all likelihood). We could also look at changes in hydrological variability, maximum and minimum discharges and apply these to what we know about species' requirements in order to predict which and how many species are likely to be affected.

### M9.3 Key resources

*Global Methodology for Mapping Human Impacts on the Biosphere*. Available at: www.globio.info

Kumar, Kundan, Sricharan Behera, Soumen Sarangi and Oliver Springate-Baginski 2009 *'Historical Injustice': Forest Tenure Deprivation and Poverty in Orissa* (UEA DEV Working Paper) http://www.uea.ac.uk/dev/publications/wp

Miles, L., Newton, A.C., DeFries, R., Ravilious, C., Blyth, S., Kapos, V. and Gordon, J. 2006. A global overview of the conservation status of tropical dry forests. *J. Biogeography 33: 491-505.*

Nellemann, C. 2005. *The fall of the water Emerging threats to the water resources and biodiversity at the roof of the world to Asia's lowland from land-use changes associated with large-scale settlement and piecemeal development.* UNEP GRID-Arendal, Norway and IUCN, Switzerland. Available at: www.unep.org/PDF/himalreport.pdf

# Section III

## Integrated Wetland Assessment Case Studies

This Toolkit was developed through two pilot studies, which are presented in this section. The studies were undertaken with partners and communities in Cambodia and Tanzania. They demonstrate the processes used to enable integrated data collection and analysis, and the ways in which the information can be presented to influence the decision making processes that impact wetland livelihoods and biodiversity.

*Kong Kim Sreng/Darwin Integrated Wetland Assessment Project*

# Section III

## Introduction

*This section reviews the implementation of integrated assessments for two wetland sites (see Figure 39) undertaken through the* Strengthening pro-poor wetland conservation using integrated biodiversity and livelihoods assessment *project with funding from the Darwin Initiative, as part of the development of the toolkit:*

- ✔ *Mtanza-Msona village in Tanzania*
- ✔ *Stung Treng Ramsar Site in Cambodia*

*These locations were carefully chosen based on a number of selection criteria. A cross-regional focus, incorporating both Africa and Asia, provided the opportunity to facilitate and promote horizontal learning and interchange. Both countries contain wetlands of high national and global importance which also play a critical role in livelihoods, and are also countries where the incidence of rural poverty is high. They share many common issues and problems regarding wetland management and sustainable livelihoods development, which in turn require similar methodologies, approaches and management responses. At the same time the two sites, which both represent areas of globally significant biodiversity that have already been prioritised by government, together cover a representative and varied range of socio-economic, ecological, biodiversity, and threat circumstances, thereby providing a good opportunity for replicating and sharing the approaches and lessons learned during the course of the project with a wider audience.*

*In some cases a wetland assessment such as that described here will be the first assessment of the area. In this instance, researchers will have the freedom to design an integrated assessment from the beginning, identifying what information is needed and which tools are most appropriate to collect that information. Although Mtanza-Msona village had previously been the subject of considerable study (especially through the Rufiji Environmental Management Project, REMP), this was the approach used when planning the assessment in Mtanza-Msona.*

*In other cases, there may be a variety of ongoing assessment projects, which an assessment using this toolkit will need to work alongside. In these circumstances, it may not be possible to apply these protocols from the beginning, and integration may have to take place later in the assessment process, when some surveys and studies have already been undertaken, using different procedures for different study components. This was the situation in the Stung Treng Ramsar Site, which forms the second case study documented here, for which there were a number of ongoing and completed assessments using their own established methodologies.*

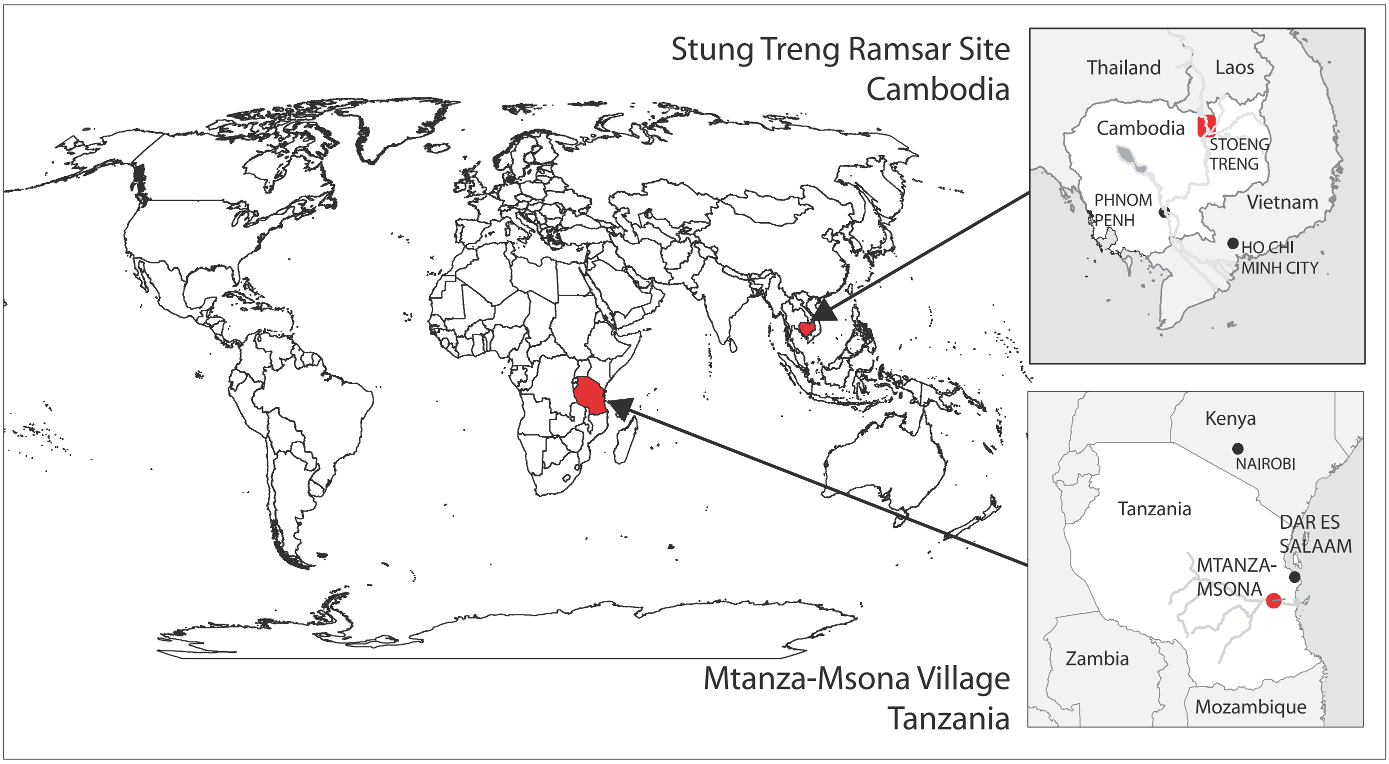



**Figure 39: Location of case study assessment sites for the *Strengthening pro-poor wetland conservation using integrated biodiversity and livelihoods assessment project***



# Chapter 7

## Mtanza-Msona Case Study, Tanzania

*Gita Kasthala, Aloyce Hepelwa, Hamoud Hamiss, Emmanuel Kwayu, Lucy Emerton, Oliver Springate-Baginski, Anna McIvor, David Allen and William Darwall*

Mtanza-Msona in Tanzania is a village located in wetlands and forests of high conservation value on the Rufiji river. Local livelihoods here depend heavily on wetland use to complement agriculture. The application of the integrated assessment method here highlighted the importance of wetland use, and the opportunities to involve local people in inclusive conservation processes.



*Eddie Allison/Darwin Integrated Wetland Assessment Project*

## T1 Background and site selection

### T1.1 Overview

Wetlands in Tanzania, like many places in the world, have diverse, interrelated environmental and human values that are often poorly reflected in conservation and development planning. Efforts to achieve sustainable, effective, and equitable wetlands conservation and management can be enhanced by a thorough understanding of relationships between their biodiversity, economic, and livelihoods dimensions. This, in turn, requires that wetland assessments consider these dimensions in an integrated way. While there are techniques to assess wetland biological, economic and livelihood values and trends separately, there are a lack of available methods to assess the dynamics between them, or to express this information in a way that straightforwardly contributes to realworld conservation and development planning.

IUCN Tanzania, with inputs from consultants from Tanzania and the IUCN Freshwater Biodiversity Unit, undertook an extensive, integrated assessment of the biodiversity, livelihood and economic value of wetlands in Mtanza-Msona Village (Rufiji District, Tanzania, see Figure 40). The assessment aimed to: inventory the socio-economic conditions and wetland species and habitats within the village; to investigate what, how, when, why and by whom wetland resources are used; and to identify the implications of this use on wetland conservation status and the status of the local economy and livelihoods. The assessment was also intended to test the overall approach, and in so doing, contribute to the larger international *Strengthening pro-poor wetland conservation using integrated biodiversity and livelihood assessment* project funded by the UK Darwin Initiative.

The inclusion of Mtanza-Msona as a field site provided an opportunity for the assessment to input directly to earlier wetland management processes. Between 1998 and 2003, REMP (implemented by the Government of Tanzania and IUCN) had the goal of promoting the long-term conservation and sustainable use of wetland resources and of improving and securing local livelihoods in the Rufiji Floodplain and Delta.

Under REMP, the Regional Natural Resources Department, District Natural Resources Officers and Village Environment Committees had developed a series of District and Village Environmental Management Plans for pilot villages, including Mtanza-Msona. The integrated assessment being carried out

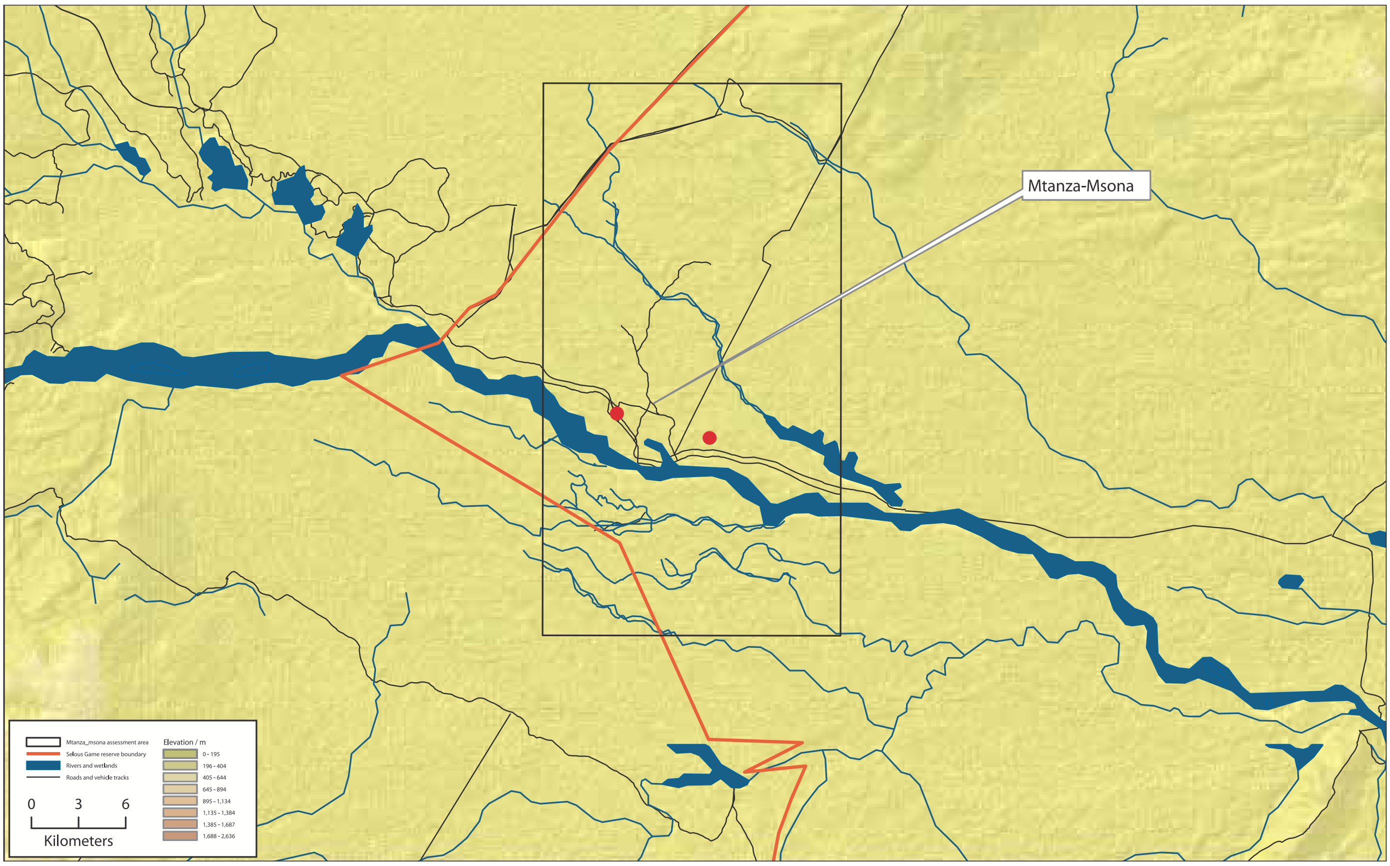



**Figure 40: Location of Mtanza-Msona. One of the case study assessment sites for the integrated wetland assessment project. The black rectangle around the village of Mtanza-Msona shows the extent of the assessment area, overlapping with the Selous Game Reserve boundary (red line) to the northwest and southwest, and the Stiegler Gorge to the west. The Rufiji River delta is to the east**

under the current project aimed to generate management information about the links between wetland biodiversity, livelihoods and economic values which can assist in the implementation of the Village Environmental Management Plan (VEMP) for Mtanza-Msona (see Hogan and Mwambeso 2004).

A number of activities were undertaken alongside the integrated field assessment, in partnership with the national institutions collaborating in the research (Rufiji District Council, and the Economic Research Bureau, Institute of Resource Assessment and Department of Geography of the University of Dar es Salaam). These included holding training courses on integrated wetland assessment and analysis, production of English and Kiswahili versions of awareness and information briefs, and running national policy roundtables and local dialogues.

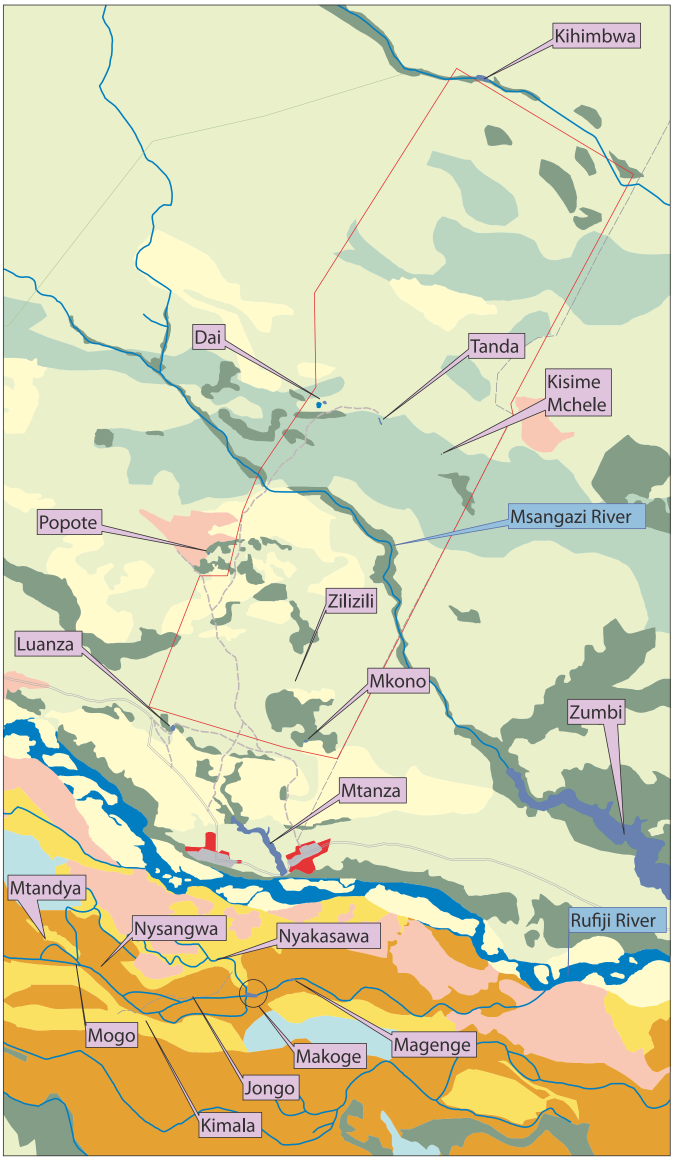



**Figure 41: The location of Mtanza-Msona, one of the case study assessment sites for the integrated wetland assessment project. The black rectangle around the village of Mtanza-Msona shows the extent of the assessment area, overlapping with the Selous Game Reserve boundary (red line) to the northwest and southwest. The Rufiji River delta is to the east and the Stiegler Gorge to the west**

### T1.2 Site description

The field assessment was carried out on Mtanza-Msona Village, Rufiji District. It focused on the wetlands (permanent and seasonal rivers, streams, lakes, swamps and floodplains) found within the village boundaries, including associated forest and grassland areas. The village lands occupy an area of over 30 km from north to south, and over 10 km from east to west. It shares boundaries with Kisarawe district to the north, the Selous Game Reserve to the south-west and north-west, Nyaminywili village to the east and Mibuyusaba village to the west, with a total estimated area of between 550-600 $km^2$. Mtanza-Msona is situated in the western floodplain area of Rufiji District on one of the 13 permanent lakes (Lake Mtanza) which are associated with the Rufiji, Tanzania's longest river. It is one of 98 registered villages in the district.

The village has a total population of 1,927 people in 428 households, and the village has four hamlets (sub-villages) namely Bizi, Msiga, Mtanza, and Mturuma. The age group profile shows that 46% of the population is over 18 years old, 36% between five and 17, and 18% under five years of age. The distribution by gender also shows that there are more women (58%) than men, 75% of households are male headed and the average household size is four. The largest tribe in Mtanza-Msona are the Ndengereko (also known as Waruhingo). Others tribes include the Matumbi, Pogoro, Hehe, Ngindo and the Zaramo.

## T2 Management focus of the assessment

The management objective of the study was to generate information which can support the ongoing implementation of the VEMP and advocate for broader support for this process from government and donors, and to generate data that can be used to inform the planning and implementation of on-the-ground wetland conservation activities in the village. Due to a range of socio-economic conditions, including widespread poverty and food insecurity, poor access to markets, and weak infrastructure, villagers in Mtanza-Msona lack adequate means to address the external threats to wetland resources or to improve the benefits they derive from wetlands. The VEMP aims to secure and enhance wetland benefits for the local population, and to support pro-poor sustainable development processes through wetland conservation. The assessment aimed to inventory the general socio-economic conditions and wetland species and habitats that exist within the village, to investigate what, how, when, why and by whom wetland resources are used, and to identify the implications of this use on wetland conservation status and the status of the local economy and livelihoods.

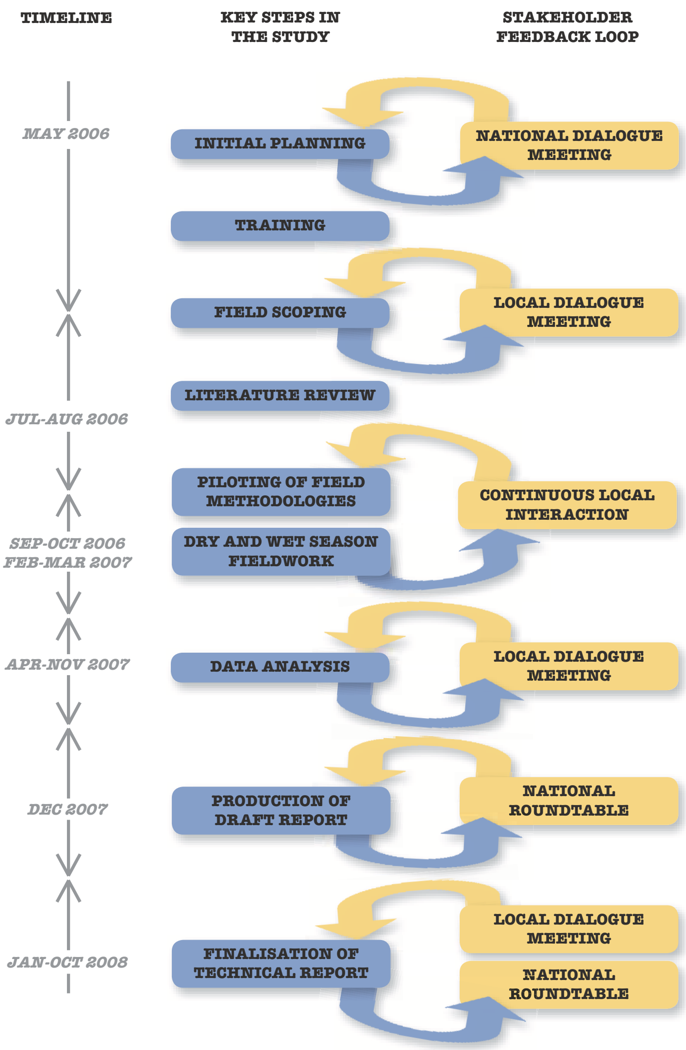



**Figure 42: Steps and stages in carrying out the Mtanza-Msona integrated wetland assessment, including stakeholder feedback**

Gita Kasthala / Darwin Integrated Wetland Assessment Project

*Preliminary survey of the Rufiji River with a member of the Mtanza-Msona community*

Two further potential issues were initially suggested by the assessment team for investigation through the integrated wetland assessment. Firstly, the presence of the nearby Selous Game Reserve gives rise to conflicts over the ownership and use of land and resources. Particular issues of concern to Mtanza-Msona residents include the large numbers of wild animals which come into the village (especially during the dry season) causing significant crop damage and risk of injury and death to villagers, and the perceived exclusion of the local community from opportunities to gain from tourism in the Selous. Secondly, there have long been plans to develop the hydropower potential of the Rufiji River at the Stiegler Gorge, upstream of Mtanza-Msona. Initially proposed in the 1970s, the plans for the proposed dam are being revived given ongoing energy shortages and fuel price increases within Tanzania. If developed, the dam could have a range of downstream impacts on the Mtanza-Msona wetlands and their dependent livelihoods, including disruption of fish migrations, and changes to silt deposition and the annual flooding regime.

## T3 Assessment timeline

For the Mtanza-Msona study, a core field team of four people (three national consultants and a project coordinator from IUCN Tanzania) and a broader reference group of 12 people were formed to plan and carry out the field survey, including biologists, ecologists, rural sociologists, and economists. An initial planning meeting brought the integrated study team together with additional experts from other research institutions and national/local government agencies (including from Rufiji District) in May 2006. At this point, training was carried out in both the integrated assessment framework and in methods for biodiversity, economics and livelihoods data collection. A series of steps, stages, and milestones were formulated to deliver on the study, with particular attention being given to mechanisms for incorporating stakeholder inputs and feedback, at both local and national levels, throughout the process. A short scoping mission (two days) to Mtanza-Msona ensured that the plan developed was practical in the field context, and secured feedback from local stakeholders (Figure 42).

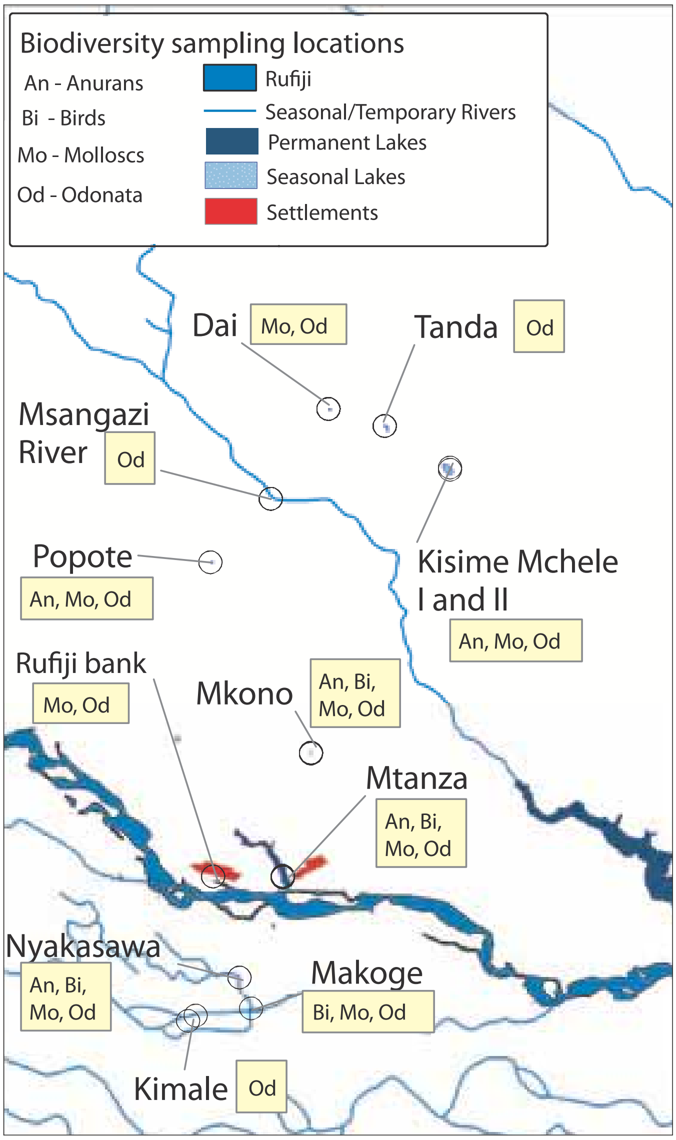
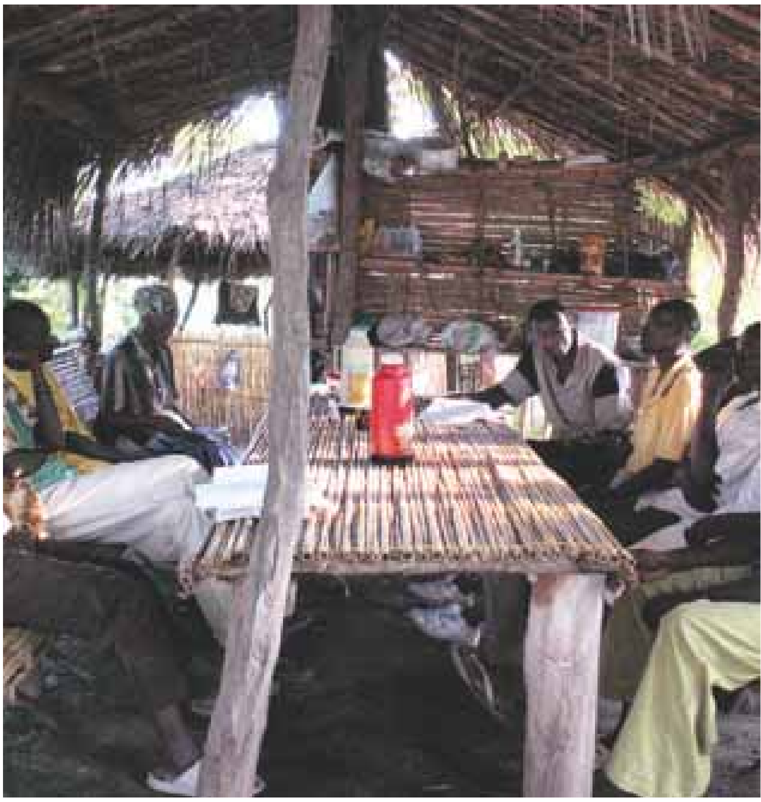



**Figure 43: Biodiversity sampling locations for Odonata, herpetofauna, molluscs and birds within the Mtanza-Msona wetland project area. These locations were identified through focus group interviews with fishers, as well as key informant interviews (for example, with the Village Fisheries Officer)**



*David Allen/Darwin Integrated Wetland Assessment Project*

*A fisher focus group discussion in Mtanza-Msona*

Between July and August 2006, a literature review was carried out of both published and 'grey' literature relating to Mtanza-Msona, and the data collection methodologies were pilot-tested in the field. The main field assessment was carried out in two stages: during the dry season (September-October 2006) and the wet season (February-March 2007). A total of 14 wetland sites were surveyed and three focus group discussions were held for the biodiversity assessment (flora and fauna), 112 households were interviewed and 12 focus group discussions were held for both livelihood and economic valuation exercises. An important element of the fieldwork was that data collection was carried out simultaneously by the full multi-disciplinary team. Integration was promoted through biodiversity, economics and livelihoods experts each being involved in collecting information relating to all three thematic areas, and daily planning and information review meetings were held and attended by the entire team (described in more detail in the next section of this chapter). Resources, habitats, species records, households, and community facilities were extensively georeferenced using a GPS to enable mapping and analysis. Over this period, ongoing interaction with local government authorities and villagers ensured a continuous stakeholder feedback loop as the survey was carried out.

With the field survey work completed, data analysis and report drafting took place between April and November 2007. A feedback meeting was held in July 2007 in Mtanza-Msona, involving a broad range of local stakeholders, in order to share preliminary findings and solicit feedback and verification. With the production of the final draft report in December 2007, a national dialogue meeting was held to share findings and seek feedback from conservation and development policy-makers and planners from government and NGOs, as well as from Rufiji District administration. The report was finalised, incorporating inputs from these workshops, with GIS maps produced by the IUCN Freshwater Biodiversity Unit (based on a map produced by Dr Stéphanie Duvail), and a final round of national and local dialogues were held at the end of 2008 to disseminate and share the technical report with stakeholders, and to discuss opportunities for adoption and adaptation of the integrated wetland assessment approach more widely within Tanzania.

## T4 Project outcomes

### T4.1 Key findings

- **All households in Mtanza-Msona use a variety of wetland resources to support their day-to-day livelihoods.** Every household engages in at least one wetland activity, and an average of seven activities. Wetland resources form a major source of domestic energy, shelter, medicines, and food for most people (Table 14)
- **Wetland resources are of substantial economic value to households and the village as a whole.** The majority of wetlands harvest and use activities are worth at least TSh25,000 (USD22) a year for each person engaging in them, with fishing, honey collection, building poles, firewood, and timber harvesting for sale being the most lucrative (average annual values exceeding TSh100,000 or USD87). The total annual value of wetland resource use is TSh226 million or just over USD196,000 (TSh528,353 or USD458 per household, TSh123,571 or USD107 per capita) though this estimate increases substantially when considering real values, including broader linkages and multiplier effects
- **Differentiation in the type and level of wetland activities across richer and poorer households demonstrate that, *inter alia*, the poorest households carry out a wider range of wetland activities, in part to spread risk and maximise available opportunities.** The participation of the poorest in wetland activities is however most often focused on meeting basic needs, and on relatively lower-value activities. Richer households tend to engage in both subsistence activities and activities for income-generation (e.g. pottery, wild honey harvesting, fishing, timber felling, and charcoal production), because they can afford the labour, time and equipment to do so
- **The village area wetlands support a high level of species diversity, with very limited conservation and active management.** There are, to local people's credit, village-implemented fisheries controls (closed seasons on Lake Mtanza and Lake Makoge, and limits on fishing gear and practices allowed) and forest conservation zoning
- **Village area wetland habitats and species face 'off-site' and 'on-site' threats.** The main 'off-site' threats include upstream alteration of water flow cycles, such as through construction of dams and water extraction for irrigation purposes, and the potential arrival of invasive alien species. The main 'on-site' threats include degradation/modification of wetlands for cultivation, over-exploitation of species (e.g. use of small-mesh size nets for lake/river fishing) and pollution

### T4.2 Project conclusions

**From the findings above, we can conclude that, *inter alia***

- Wetlands underpin the quality and security of people's livelihoods and improve their living circumstances, especially for the poor
- The vast majority of village economic activities depend directly or indirectly on wetland goods and services
- Several critical species require greater conservation measures to ensure their continued existence, and sustainable availability in support of local livelihoods

**Management implications include the following**

- More and stronger conservation management plans are needed for key species, together with effective community education and species protection implementation policies that seek the participation of villagers
- These management plans need to be coupled with policies and activities that directly benefit local people for conservation efforts, and that otherwise off-set the opportunity costs of restricted and modified resources use

**Table 14: The contribution of wetland products to fulfilling basic human needs in Mtanza-Msona**

| WETLAND ACTIVITY OR PRODUCT | MEDICINE | ENERGY | SHELTER | EQUIPMENT & TOOLS | CASH INCOME | FOOD |
|---|---|---|---|---|---|---|
| Fishing | | | | | ✔ | ✔ |
| Woodfuel | | ✔ | | | ✔ | |
| Timber | | | ✔ | ✔ | ✔ | |
| Grasses, reed and palms | | | ✔ | ✔ | ✔ | |
| Medicinal & aromatic plants | ✔ | | | | ✔ | |
| Wild food plants | | | | | ✔ | ✔ |
| Hunting & animal-based foods | | | | | ✔ | ✔ |
| Wild honey and beeswax | | | | ✔ | ✔ | ✔ |
| Clay | | | ✔ | ✔ | ✔ | |

Eddie Allison / Darwin Integrated Wetland Assessment Project

*Farmer on seasonally flooded farmland on the floodplain of the Rufiji River at Mtanza-Msona*

within the village area

- Conservation measures need to ensure equitable impacts, including through careful consideration of impacts on the poorest or most vulnerable groups in the village (who are also the most directly dependent on wetlands resources for basic needs and well-being)
- Conservation plans also need to operate at multiple levels to address both 'off-site' and 'on-site' threats, for example by using an Environmental Flows framework where the ecosystem approach is followed and the needs of people and the environment are equally considered
- More information should be collected on the environmental requirements of the wetland species, and their importance to village livelihoods and economies, to ensure that impacts of use and external actions can be fully assessed and considered in the evaluation of future developments

### T4.3 Project outputs

Information provided by the assessment, and the process itself, produced a number of benefits for Mtanza-Msona, and Tanzania more generally, in several ways.

- **Contribution to local conservation and development planning, including VEMP implementation**. The VEMP aims to secure and enhance wetland benefits for the local population, and to support pro-poor sustainable development processes through wetland conservation. Assessment outcomes further demonstrate the importance of the VEMP, and can contribute to its implementation by providing information about the nature and magnitude of the trade-offs and synergies between wetlands-linked biodiversity, livelihoods and economies
- **Increased capacity to defend local resources, and**

**thus livelihoods, from upstream development threats.** The Village government and people of Mtanza-Msona have limited capacity to express and defend the value of their local resources against harmful upstream developments, such as the proposed hydroelectric dam at Stiegler's Gorge. The information from the assessment — showing high, tangible, and diverse wetlands values — can contribute to local capacity to advocate against such upstream activities, and for continued rights to sustainable use of critical local resources

- **Enhanced capacity to capitalize on village resources.** For a number of reasons, including lack of market access, villagers in Mtanza-Msona also lack adequate means to sustainably develop and fully capitalize on village area resources. In discussing the assessment findings about the value of local resources, villagers generated several ideas about how these resources might be capitalized upon in more effective and sustainable ways, such as expanded ecotourism development. Some of these village-generated suggestions may now be taken up by other local and partner-supported activities
- **Opportunity to utilize integrated assessment tools in other wetlands.** Drawing on the lessons learned and interest generated by pilot activities in Mtanza-Msona, there are several developing opportunities to further adapt the assessment approach to the Tanzanian context, and to use the resulting adapted tools in local wetlands management and environmental planning activities in other locations in Tanzania. IUCN is collaborating with local, national, and international partners, including the Wetlands Unit, Wildlife Division of the Ministry of Natural Resources and Tourism and the National Wetlands Working Group (NWWG), to actively pursue these opportunities. Institutionalizing integrated assessment across Tanzanian wetlands can contribute to broader efforts undertaken through the Sustainable Wetlands Management Programme (SWMP) of IUCN, which emphasises decentralised natural resources management, and can serve as a model for similar approaches elsewhere.

*Project outputs*

Campese, J. 2009. *Tathmini ya thamani ya bioanuai, hali ya maisha na uchumi wa maeneo chepechepe katika kijiji cha Mtanza Msona, Tanzania*. Darwin Project local language summary #1. IUCN Tanzania Country Office, Dar es Salaam, Tanzania.

Campese, C. 2008. *A case study in integrated wetland assessment: wetlands biodiversity, livelihoods and economic value in Mtanza-Msona village, Tanzania*. IUCN Tanzania Country Office, Dar es Salaam, Tanzania.

Kasthala, G., Hepelwa, A., Hamiss, H., Kwayu, E., Emerton L., Springate-Baginski, O., Allen, D., and Darwall, D. 2008. *An integrated assessment of the biodiversity, livelihood, and economic value of wetlands in Mtanza-Msona Village, Tanzania.* Project technical report. IUCN Tanzania Country Office, Tanzania, and IUCN Species Programme, Cambridge, UK.

*Gita Kasthala/Darwin Integrated Wetland Assessment Project*

*Village meeting in Mtanza-Msona as part of the stakeholder dialogue process*

# Chapter 8

## Stung Treng Ramsar Site Case Study, Cambodia

*David Allen, William Darwall, Mark Dubois, Kong Kim Sreng, Alvin Lopez, Anna McIvor, Oliver Springate-Baginski, and Thuon Try*

The Stung Treng Ramsar Site is located on the Mekong in Cambodia, close to the Lao PDR border. The integrated assessment contributed to an ongoing conservation management planning process for the Site. The assessment showed that bringing livelihood analysis together with biodiversity assessment can lead to effective management solutions that sustain livelihoods whilst conserving biodiversity.



*William Darwall / Darwin Integrated Wetland Assessment Project*

## C1 Background and site selection

### C1.1 Introduction

The Stung Treng Ramsar Site in Cambodia was selected as the second of two pilot field sites for the project because it is an area of critical biodiversity significance with local reliance on wetland resources, in particular by the poorest members of the community. Designated as a Ramsar Site (a Wetland of International Importance) in 1999 for its ecological significance, the government of Cambodia has shown continued interest in improving management and wise use of resources within the Site. A management planning process was initiated as part of the Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP), a joint programme of IUCN, the Global Environment Facility and the Mekong River Commission, with government participation from Cambodia, Lao PDR, Thailand and Viet Nam. Part of this process involved biodiversity assessments and ecological characterization of the Ramsar Site, and this presented an ideal opportunity to undertake an integrated wetland assessment, with MWBP as a Darwin project partner, together with IUCN Cambodia. With the closure of MWBP in late 2006, IUCN Cambodia took on direct management of project activities, with backstopping from the regional IUCN office.

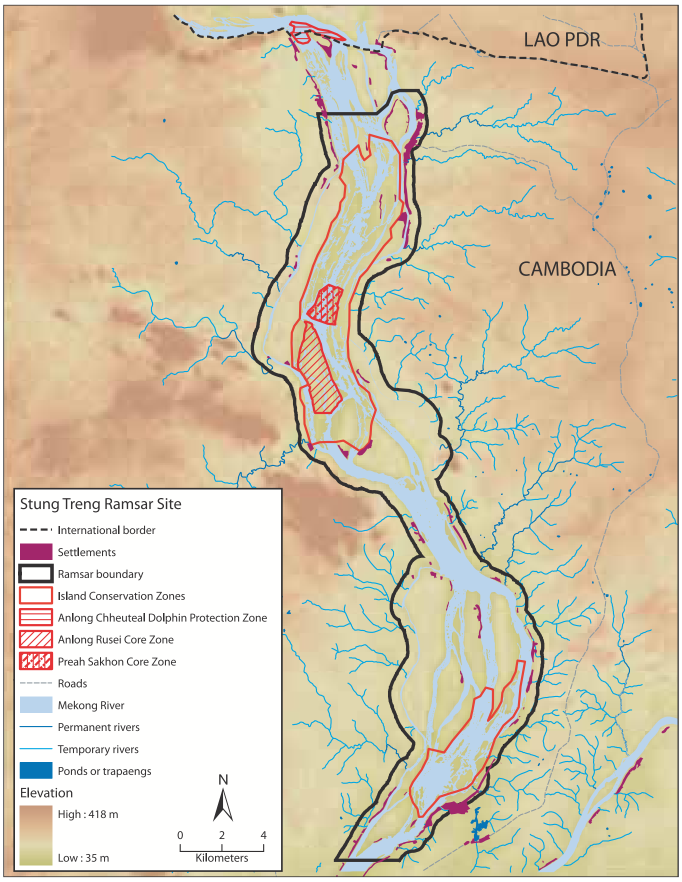



**Figure 44: The Stung Treng Ramsar Site including locations of the proposed Lower and Upper Island Conservation Zones, and the Preah Sakhon and Anlong Rusei Core Zones. The extensive settlement within the Ramsar Site can be seen (purple areas)**

Critical management issues affecting the ecological character of the Stung Treng Ramsar Site had already been identified in earlier MWBP work through a commissioned assessment of the biodiversity significance of the Ramsar Site (Timmins 2006). This report proposed a system of management zones targeting the key biodiversity areas within the site and restricting human use of the areas. This project employed the draft toolkit for IWA (Darwall *et al*. unpublished) to evaluate the implications of the proposed zoning on both biodiversity and livelihoods. A particular emphasis was placed on the Lower and Upper Island Core Zones (termed Lower and Upper Island Conservation Zones in the integrated assessment report), and especially the Anlong Rusei and Preah Sakhon Core Zones (termed 'Sanctuaries' in Timmins 2006).

In addition to assessment of the proposed management zones, this study also undertook a rapid assessment of the Anlong Chheuteal transboundary pool inhabited by the threatened Mekong River Irrawaddy Dolphin *Orcaella brevirostris*, the primary purpose being to determine the level of success of the 'total protection' measures, and their impact on the livelihoods of local communities.

### C1.2 Site description

Stung Treng Ramsar Site is one of only three Ramsar-designated wetland conservation areas within Cambodia, and covers a stretch of approximately 37 km of the Mekong River in Stung Treng Province, northern Cambodia.

The lower boundary of the Site is approximately 3-4 km upstream from Stung Treng town, extending upstream to within 2-3 km of the border with Lao PDR. The total area of the Site is estimated as 14,600 hectares. The official boundary of the Site has not as yet been defined and mapped (though recent signs erected at the Site utilize the boundary developed by this project), and boundary demarcation on the ground is not yet in place. For the purpose of this assessment, the boundary was treated as extending to a distance of 500 m from the dry season riverbanks (see Figure 45). A notional Site boundary is also held within the UNEP World Database of Protected Areas (WDPA). However, the source of this boundary is not certain; it extends to the Lao PDR-Cambodia international boundary, but does not cover the entirety of the transboundary dolphin pool.

Seasonal flooding inundates large areas of land beyond the dry season banks. This flooding is vital for the many species of fish that migrate both along the main channel of the Mekong

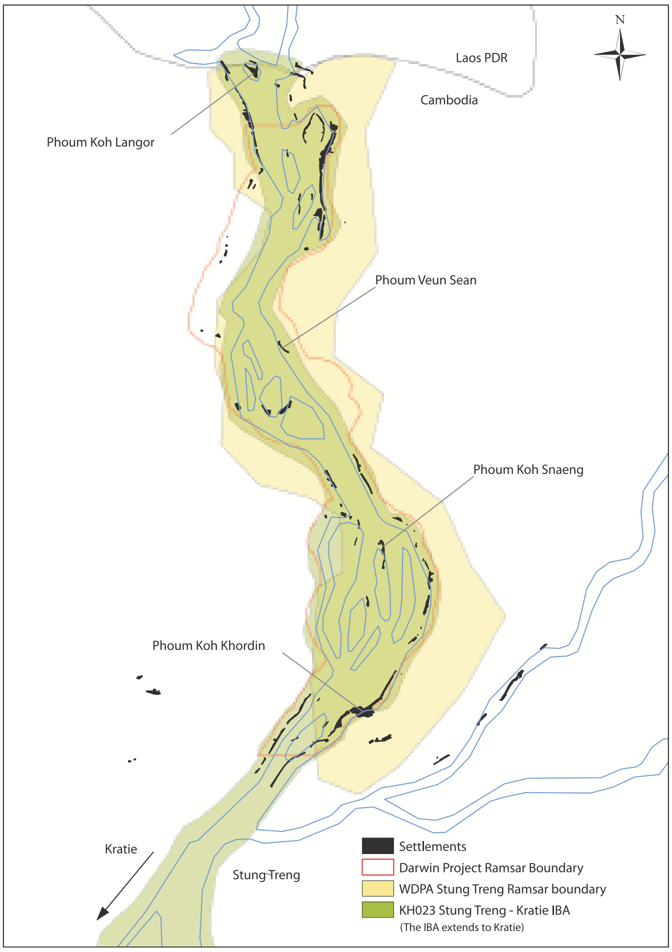



**Figure 45: The Stung Treng Ramsar Site boundaries. The map shows: (i) the Stung Ramsar boundary as defined by the Darwin project (red line); (ii) the WDPA Ramsar boundary (yellow shading); (iii) the Stung Treng – Kratie Important Bird Area (green shading) which extends from the Lao PDR border to Kratie. The majority of the Site is encompassed within this IBA**

River, and from the river channel to breed and feed in these shallower waters, and it brings important nutrients to the rice fields and the riverbanks that are used for farming. The Site is extremely important for fisheries and transport as there are few roads in the area.

The total population of Stung Treng province is estimated at 95,185 people, comprising 47,219 males and 47,966 females. The province consists of five districts (Stung Treng, Talaborithvat, Sesan, Siempang and Siembok district), 34 communes and 128 villages, of which there are approximately 21 officially within the Ramsar Site, with a total population of more than 10,000 people. In addition to the permanent settlements there are a number of pioneer settlements, populated by landless people from Stung Treng Province, elsewhere in Cambodia and beyond, and a range of temporary or semi-permanent camps. There is extensive ribbon development along the shore of both the main channel and the larger islands, as can be seen from recent aerial photographs. Migratory fishers establish longer-term camps on the larger islands, especially during the seasonal *trey riel* fish migration, and individual households or household members may establish temporary camps to allow them to fish and exploit other natural resources some distance from their homes.

The Site was officially designated on the basis of the Ramsar Criteria shown in Table 15.

## C2 Management focus of the assessment

The primary aim of the integrated wetland assessment was to evaluate the impact on livelihoods of conservation zoning proposals that had been developed for the Stung Treng Ramsar Site (Timmins 2006; see Figure 46): the Lower Island and Upper Island Conservation Zones (with the Upper Island Zone containing two proposed Core Zones); the Koh Khon Kham Gallery Forest Restoration Zone; O'Talas, various important deep pools and a complex mosaic of habitats. The Ramsar Site currently does not encompass the Anlong Chheuteal Dolphin Protection Zone.

The purpose of this assessment was to better understand resource use dynamics within the area and to review implications of designating the entire Upper Island area as a Conservation Zone. Both primary and secondary data were used for the analysis and discussion. The findings presented below provide

**Table 15: Designation Criteria for Ramsar Site 2KH003: Middle Stretches of Mekong River north of Stung Treng – Revised Ramsar Criteria (1999)**

| | |
|---|---|
| Criterion 1 | A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region. |
| Criterion 3 | A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region. |
| Criterion 4 | A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions. |

Source: www.wetlands.org/RSIS/_COP9Directory/ENG/Criteria.htm accessed on 11/02/2008

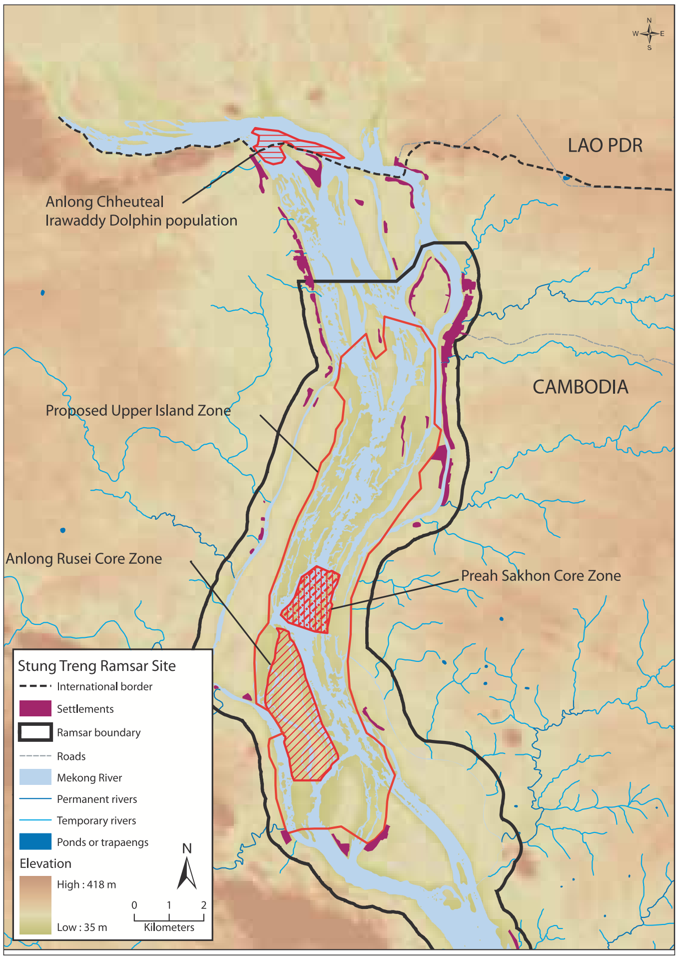



**Figure 46: Map showing the proposed Upper Island Conservation Zone in the northern part of the Stung Treng Ramsar Site, as well as the Anlong Rusei and Preah Sakhon Core Zones**

a summary overview of the biological importance of the proposed Upper Island Conservation Zone, the nature and extent of resource use, and a range of other economic issues that influence livelihood strategies, poverty and biodiversity, such as markets.

## C3 Assessment timeline

A workshop attended by project partners and key national and international advisors was held in Phnom Penh in February 2006 to initiate the project, followed by a scoping trip to the Ramsar Site to review the project timetable and establish relations with stakeholders in the assessment and Ramsar Site conservation planning process.

The study comprised a two-stage process whereby MWBP consultants undertook a review of existing literature and contributed survey data (especially the outputs of the *sala phoum* village-led fish resource assessment process, and biodiversity data from surveys undertaken by Kong Kim Sreng). IUCN Freshwater Biodiversity Unit produced base maps for the project area, and mapped the biodiversity data produced from the first stage of the project.

Following the closure of the MWBP in December 2006, a team of national and international consultants directly contracted by the Darwin project through IUCN undertook a brief integrated assessment to review the proposed conservation management zoning recommendations of Timmins (2006) in the Stung Treng Ramsar Site. The field assessment by the integrated team, the second stage of the project, was conducted over 11 days in January and February 2007. The team comprised four international consultants and IUCN Cambodia staff, with other Cambodia NGOs providing expertise and local knowledge. Following completion of fieldwork, the combined team undertook a two-day rapid analysis and writing workshop in Stung Treng, followed by a feedback workshop to key local stakeholders, including community leaders, local and national government staff, and other NGO workers.

The assessment team produced a draft report in March 2007 which went through a number of further drafts to incorporate further biodiversity data and maps (including a review of the Red List conservation status of species that had been identified) and economics data absent from the earlier draft. The final report was distributed at a workshop in Phnom Penh in November 2008 which attracted participants from national government, Ramsar authority staff and NGOs. A key need identified at the workshop was to ensure that the IWA Toolkit is produced in Khmer to ensure widespread awareness and adoption by relevant institutions. Other project materials, including Policy Briefs have been produced in both Khmer and English, and are available from www.iucn.org/species/freshwater.

## C4 Project outcomes

### C4.1 Main biodiversity findings

The Stung Treng Ramsar Site in the Lower Mekong supports a globally distinct type of seasonally-inundated riverine forest, not found above the Khone Falls in Lao PDR, nor further downstream. There are remnant areas of tall riparian forest, and significant reed beds. One of the main populations of Irrawaddy Dolphins in the Mekong breeds close to the Site in the Anlong Chheuteal transboundary deep pool. At least four globally-threatened birds species have been recorded, including the Green Peafowl, White-Shouldered Ibis, Spot-Billed Pelican, and the Lesser Adjutant, as well as a large number of globally Near Threatened and Regionally Threatened bird species; for some of these, the populations within the Ramsar Site represent a significant proportion of their overall population. The Critically Endangered Siamese Crocodile *Crocodylus siamensis* occurs within the Site in the proposed Anlong Rusei Core Zone.

At least 130 species of fish have been recorded by this survey, including three globally-threatened species. The number of fish species known to be present is likely to increase with further survey and there remain a number of unidentified specimens. Recent work revealed more than 207 fish species (including a number of unidentified species) in trade at Stung Treng market (Chavalit Vidthayanon, unpublished data). The conservation status of the vast majority of fish, dragonflies and damselflies, molluscs, and aquatic plants has not as yet been assessed and should be considered a priority due to the high economic and livelihoods value of many of the species, especially fish, within the Site. The high level of potential threat to aquatic species presented by the current plans for hydroelectric dam developments within the region, and the threatened status of many species, such as freshwater turtles, which are currently utilised within the Ramsar Site, further increases the urgency for completing a more detailed assessment.

*Kong Kim Sreng/Darwin Integrated Wetland Assessment Project*

*Village species mapping exercise during the biodiversity survey of the Stung Treng Ramsar Site*

The biodiversity of the Site was found to be vital to the livelihoods of local communities (both settled and migratory) and is economically important locally, nationally and regionally. Many species and products (including food, skins, and medicinal products) from the Site are traded to neighbouring countries. Assessing the full conservation impacts of this trade is beyond the scope of this report, but it is clear that a large number of regionally- or globally-threatened species that are traded are sourced from within the Ramsar Site. As Table 16 shows, a number of species of conservation concern are available in the markets close to the Site, and are likely to be traded across the border into Lao PDR.

At present the Ramsar Site is relatively unimpacted by local development although there has been significant clearance and degradation of the riverine gallery and semi-evergreen forest and bank-side perennial vegetation (Timmins 2006). The primary driver of the ongoing clearance of these habitats (often by deliberate fire) is for agricultural land. Logging is a minor threat in the area, probably because many of the commercially valuable trees have already been removed. The key future threat, especially to the aquatic habitats and their dependent species and livelihoods, is development of the basin's hydropower potential. Many dams have already been constructed and many more are currently in the feasibility or development stage, both on the mainstream of the Mekong and on its tributaries. Likely impacts, amongst many, include decreased dry season flows and decreased flooding events, changes in sedimentation rates and sedimentation of deep pools, and severe impacts on fish migrations. Alterations to the flooding regime, including the velocity and timing of flows, will impact upon the characteristic channel vegetation structure, giving rise to additional impacts to dependent species communities.

The increased growth of algae, possibly resulting from input of nutrients higher upstream, has emerged as a growing problem in recent years with dense mats of algae impacting upon fishing and transport activities. The impacts of the extensive algal cover to biodiversity remain unknown.

### C4.2 Main livelihoods and economic valuation findings

Livelihood practices in the Site do not in general appear to have significant adverse impacts on biodiversity in the area. Agriculture, fishing, and non-timber forest product collection can be sustainable if practices are regulated. However, a range of factors have led to a very weak governance and regulatory

**Table 16: A summary of (i) threatened, and (ii) Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) listed species traded in Stung Treng during a trial market survey in 2005**

| | STUNG TRENG–TOWN | VEUN KHAM BORDER CROSSING |
|---|---|---|
| (i) Globally-threatened species (IUCN Red List) | 15 | 3 |
| (ii) CITES-listed species (App.I-III) | 15 | 2 |

Note: The following locations were surveyed in Stung Treng town; Stung Treng market, 6 restaurants, 1 specialist wood market. Summarised from Boonratana *et al.* 2005.

environment in which traditional customary mechanisms have been undermined and new decentralised governance mechanisms have not yet become effective. These factors include the political turmoil of recent decades, centralised administration, and rapid societal changes, such as in- and out-migrations from rural areas. In this weak governance context some livelihood practices are having a negative impact on biodiversity. These include destructive fishing practices (particularly during the fish spawning season) and the collection of wildlife. Such practices are not however core to households' food security, and so could be addressed in a relatively straightforward manner; group discussions suggest the clear commitment of local people to improve these practices.

There are a range of growing pressures on the fishery resource within the region – a key pillar of many people's livelihood strategies. These include overfishing by both residents and non-resident fishers, and other factors such as land use change, hydrological flow changes caused by climate change and dams, and disruption of fish migrations. Further work is required to understand the complex interactions between these factors. Overfishing is closely linked both to the livelihood security of local households and also to profits of outside traders. Outsider traders are apparently receiving tacit patronage and protection of public servants and are thereby able to over-exploit the resource with impunity. The situation is a typical 'tragedy of the open access commons' scenario in which local households are unable to defend local resources from profit-maximising outside traders through traditional customary mechanisms, yet the new local government structures are not yet effective. Consequently no-one has an incentive to conserve and there is a 'race to the bottom' in which everyone seeks to privatise whatever they can of the resource before others do. Whilst in some communities traditional resource governance structures still function, in others they have collapsed. Further research could reveal the reasons for differing responses to change and provide lessons for strengthening community ownership of resources.

The increasing trend in population and immigration means that

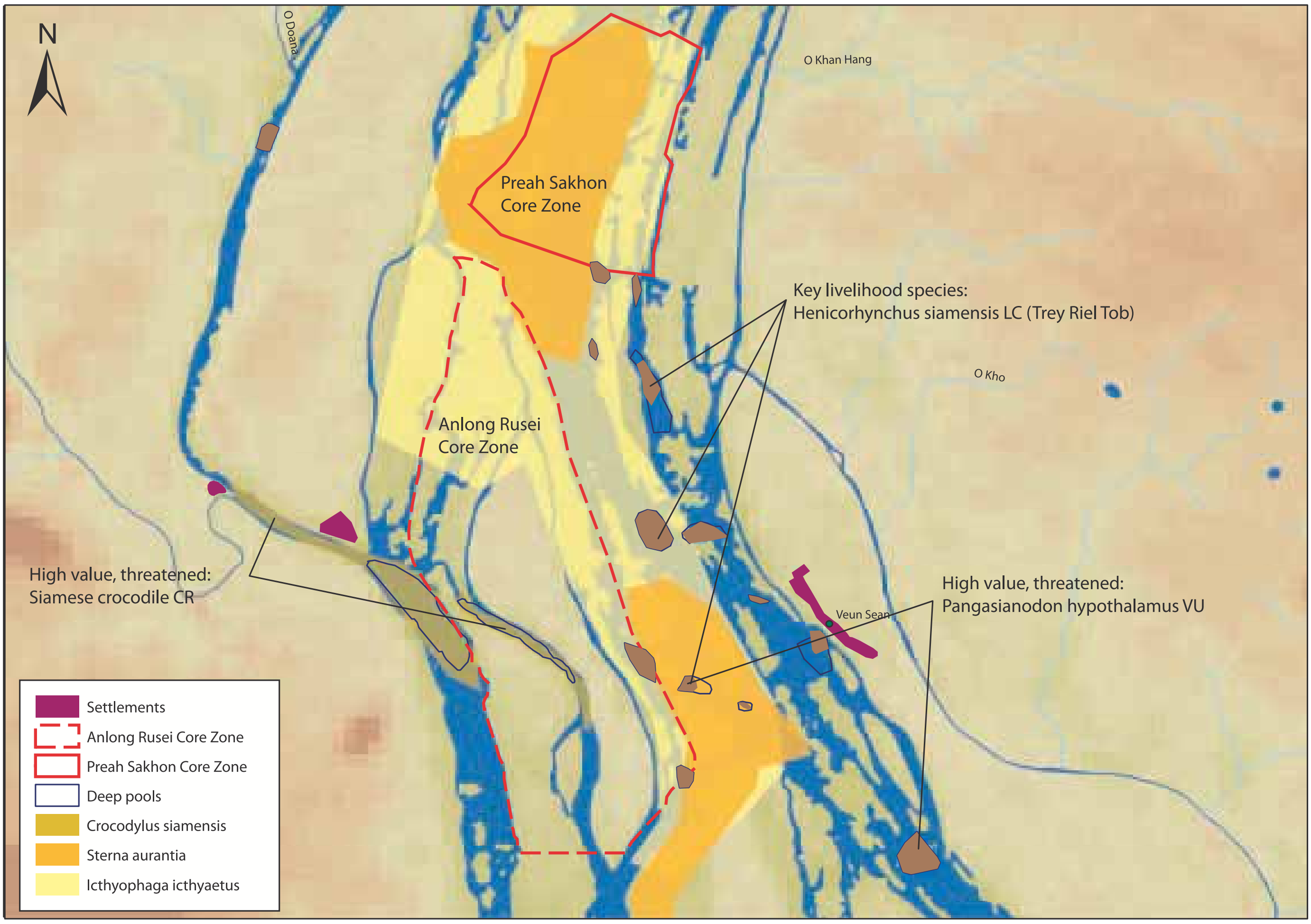



**Figure 47: An example of a GIS map used to illustrate the spatial overlap between biodiversity and areas important for local resource use and conservation within the Stung Treng Ramsar Site. The map shows the location of settlements (purple), deep pools (blue) which are key fishing locations (brown) for such high value species as Trey Riel Tob *Henicorhynchus siamensis*, high value and threatened fish species such as *Pangasianodon hypophthalmus*, and the habitat of the Critically Endangered Siamese Crocodile *Crocodylus siamensis***

there is likely to be an intensification of these issues and it is therefore urgent that they are addressed through strengthening local communities' powers and capacities.

### C4.3 Review of proposed conservation management zoning in Stung Treng Ramsar Site

The integrated assessment (Lopez *et al*. 2008) found alternative options for management that take into account the livelihood needs of local communities whilst also meeting biodiversity targets. The recommendations and management options for Preah Sakhon, a proposed core zone within the Stung Treng Ramsar Site, are presented here.

In 2006 ecological assessments in the Stung Treng Ramsar Site led to the proposal for the creation of a zoning plan for the site which includes a number of Core Zones where fishing and other activities of local communities would be banned. The recommendations were largely based from a biodiversity conservation perspective, concluding that there was currently minimal use of these exclusion zones by local people. The integrated research by the IUCN project, however, revealed extensive reliance by the local communities on natural resources from within the proposed Core Zones. This finding demonstrates the importance of conducting fully integrated multidisciplinary assessments where the focus is on provision of information relevant to both species conservation and socio-economic issues.

In early 2007, through the IUCN-Darwin project, an integrated assessment was conducted to evaluate the potential impacts of the proposed zoning on livelihoods, biodiversity, and local economies. The results revealed that the proposed zoning plans, if enforced, would adversely affect the poorest members of communities within the Ramsar Site, including migrant settlers, the landless, and those depending on income and food security from fishing. Taking biodiversity, livelihoods and economic perspectives into consideration, management options were explored and solutions were reached. It was found that seasonality is an important factor with regard to the timing of resource exploitation (mainly for fish) and the use of biodiversity refugia and nesting sites in the area.

At a presentation of the assessment findings in Stung Treng in February 2007, attended by district and national stakeholders, it was recommended that Preah Sakhon should be a semi-restricted zone with access permitted during the *trey riel* fishing period as there would be minimal impacts to other biodiversity at that time of year. A subsequent consultation meeting held in February 2008 with the General Department of Administration for Nature Conservation and Protection (GDANCP) noted that allowing people to enter the Preah Sakhon Core Zone would be in conflict with the criteria established by the Protected Area Law and might also set a precedent for other core zones where people have been prevented from entering and collecting resources. The general director of GDANCP therefore recommended that, if Preah Sakhon is an important habitat for both biodiversity and livelihoods, the area be alternatively designated as a Conservation Zone or Sustainable Use Zone. The Protected Area Law provides for access and resource collection within Conservation Zones and Sustainable Use Zones provided permission is granted by the protected area authority and/or there is supporting regulation and agreement between the local community and the protected area authority.

The greater challenge now is to determine whether existing regulations for protected area management are flexible enough to accept this solution for the protection of both biodiversity and livelihoods, and to ensure that the resources are made available to allow implementation of the management plan within the Stung Treng Ramsar Site.

### C4.4 Key assessment findings

- Preah Sakhon is one of the few remaining biodiversity hotspots within the Ramsar Site that is subject to minimal anthropogenic influence
- A range of bird species of high conservation significance are confirmed to be nesting in Preah Sakhon
- There is considerable livelihood and economic value attached to the human use of biodiversity, especially fisheries, in and around Preah Sakhon
- Poorer people are most dependent on common property resources, such as fish, aquatic plants and other wetland species
- Resource users are highly mobile and move throughout the Ramsar Site and beyond. These movements take a number of forms, from the seasonal *trey riel* fishery, to the pioneering activities adopted by many of the poorest in communities (e.g., those settling channel islands such as Koh Kon Kham for farming and fishing)
- Current resource use patterns indirectly affect critical habitats within Preah Sakhon that are important for threatened biodiversity. Unintentional disturbance, such as from dogs and livestock introduced by local people, is impacting habitats of sandbar nesting species (including regionally-threatened River Tern). Invasive filamentous green alga threatens the ecology and natural processes in Preah Sakhon, especially in the dry season
- Designating Preah Sakhon and its perimeter as a no-go area (sanctuary) is questionable from an economic, social, cultural and biodiversity perspective
- Banning fishing will have serious impacts on livelihoods, especially of the poorest
- Limiting/banning access for non-fishing purposes will have minimal impact on livelihoods

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*Migratory fishers drying* trey riel *in Stung Treng Ramsar Site*

- Local stakeholders should be included in planning, management and monitoring of conservation initiatives

When considering the impact of management options on groups from different wealth classes which employ a range of livelihood strategies, it is clear that the poorest will be affected most by exclusion measures. Total exclusion is not a viable option for managing the proposed Core Zones due to the negative impacts on the livelihoods of those currently using these areas. Conservation management interventions should instead aim to restrict access during periods critical for biodiversity, such as breeding seasons, whilst at other times allowing sustainable activities with due consideration to sustaining ecological integrity. Limited protection is proposed that balances the needs of biodiversity conservation with the livelihood needs of people.

### C4.5 Policy recommendations

Stakeholder participation in wetland conservation initiatives is highly desirable given the high incidence of poverty, relatively high resource exploitation, and the proximity of local and migratory communities to key biodiversity areas within the Stung Treng Ramsar Site. Efforts to implement initiatives without local participation in assessment, planning, management, monitoring, and enforcement are likely to fail as a consequence of the negative impacts of management interventions on livelihoods.

The Ramsar implementing authority should seek advice and input from community fisheries organizations where they exist, and ensure representation from surrounding communities including those from outside of the authority's jurisdiction (such as Koh Khon Kham) in the planning and management of Preah Sakhon. It is vital to engage local government bodies to gain their endorsement and support for management regimes.

The high incidence of poverty in wetland areas, especially in households solely dependent on fishing, coupled with a lack of viable livelihood alternatives, make it of utmost importance to link conservation with the continuation or development of income-generating activities, awareness-raising, and the investigation of alternative livelihood options.

Critical areas for biodiversity (refugia) are often areas of minimal anthropogenic influence. Preah Sakhon is one example of such an area. The assessment revealed the complex inter-relationships between resource users and biodiversity. The reality in the case of Stung Treng, in common with many wetland areas, is that pioneering settlements (usually established by the poorest) are often the greatest threat to biodiversity. By applying an integrated assessment approach, as piloted through the IUCN-Darwin project, it becomes clear that effective management solutions that sustain livelihoods whilst conserving biodiversity are possible.

*Project outputs*

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# References

## General and Chapters 1-8

Additional to the key readings already suggested in each chapter above, this section provides further suggested readings, and full details for references cited in the text. Additional to the key references provided for each of the chapters, this section provides further reading.



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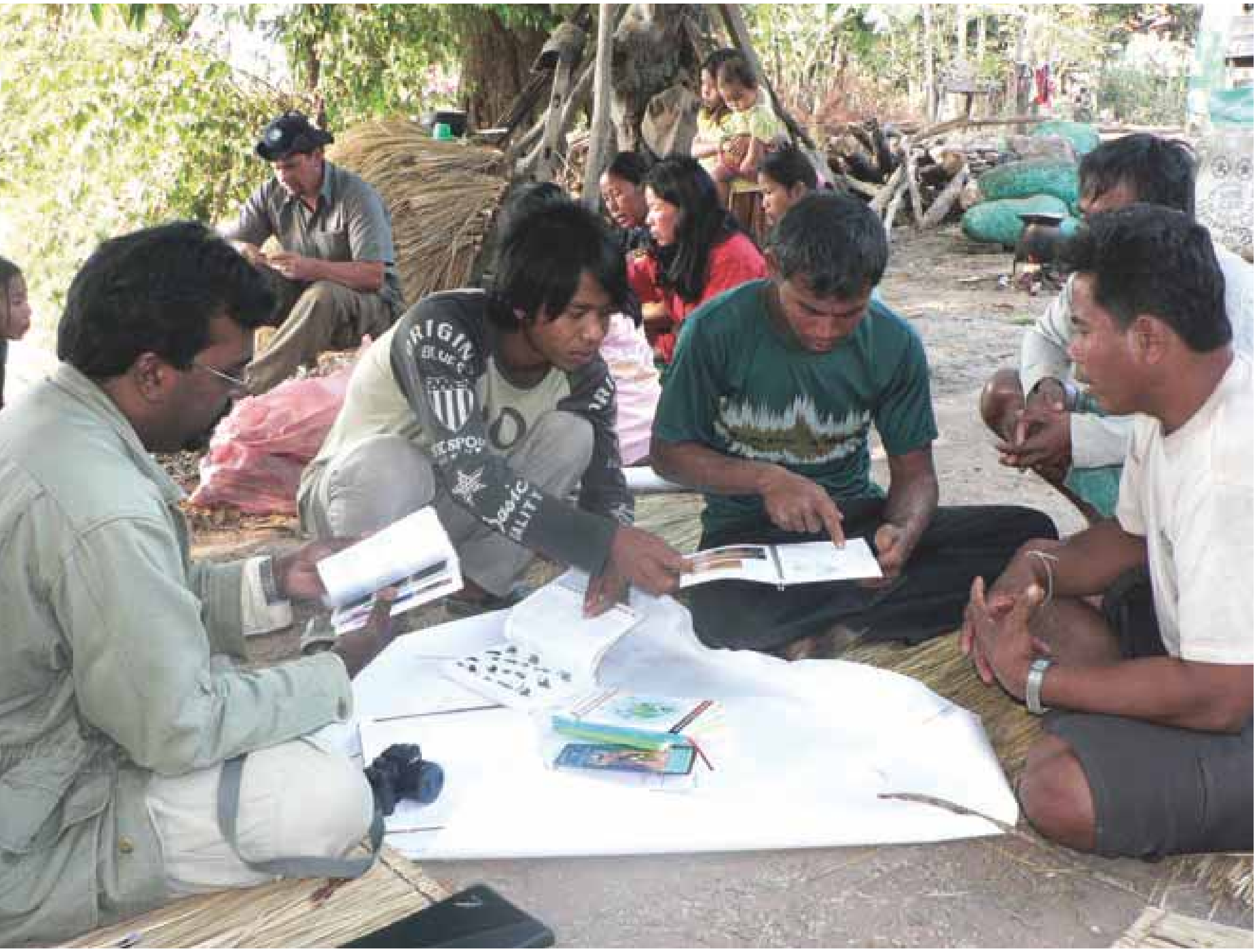
# Appendix

## Sample data collection sheets

Data collection requires careful preparation, a major part of which is clarifying the questions to be asked and the level of detail needed in responses. Data collection sheets can then be produced. Example formats are presented here to illustrate the possibilities for gathering and collating field data. In practice formats used in each study will need to be tailored to the local issues and conditions through a thorough process of planning, piloting and review.



*Kong Kim Sreng/Darwin Integrated Wetland Assessment Project*

**1** ***Specify management issue*** **being addressed (or purpose of assessment):**

**3** ***Select appropriate survey methods:***
*(see Section II for methods)*

**2** **Identify required *data types:***
Basic data requirements for an integrated assessment
*- select those required to answer the management issue in question*
*- add in any new data type needed*

| | ***Required data types*** | Household questionnaire<br>E1–E6, L4–L9, L12–L13 | Market surveys<br>B9 | Biodiversity assessments<br>B1– B11 | Focus group interviews<br>L6, L7, L12, L11 | Key informant interviews<br>L12 | Wealth ranking<br>L9 | National/District data<br>L5 | Literature survey<br>A3 | Other Method... |
|---|---|---|---|---|---|---|---|---|---|---|
| **Species status and distribution** | | | | | | | | | | |
| **Habitat quality/ecosystem status?** | | | | | | | | | | |
| **Species common names** | | | | | | | | | | |
| **Drivers of threats** | | | | | | | | | | |
| **Socio-economic status of target communities** | | | | | | | | | | |
| **Access rights to resource** | | | | | | | | | | |
| **Resource use** | | | | | | | | | | |
| **Value to livelihoods** | | | | | | | | | | |
| **Economic value of ecosystem services (and disservices)** | | | | | | | | | | |
| … | | | | | | | | | | |

**Table 4: Assessment planning matrix (please refer to p.25 for detailed explanation)**

## Biodiversity assessment data collection sheet

*Suitable for use if there are few species at each location*

**BIODIVERSITY DATA COLLECTION SHEET**

Sheet no. ☐

Name of recorder ______ Date ______ Wetland Habitat Type ______

Taxonomic group(s) being sampled ______

Sampling **methods** used and time/effort put in:

**Records**

| ID / no. | Location GPS Lat/Long /WayPoint no. | Species identified? | Species collected? | Photo(s) taken? | Species name OR Specimen no. AND/OR Photo nos. | Habitat where found and notes on ecology | Local name(s) for species, habitat, location | Notes on use, value, any other information |
|---|---|---|---|---|---|---|---|---|
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**Figure 48: Example of a biodiversity field data recording sheet**

## Livelihood assessment data collection sheet

## L11 Example tabulation for summarising group discussion

(illustrated by the information asked in Section B4 of the Methods Manual)

Village: ______________ Checklist ID (Sections of Manual): ______

This form is for summarising information obtained from group discussions in each village. The form will vary with respect to the topics listed down the left hand side according to the group or sub-group of topics under discussion (Sections B3, B4, B5 etc). A form like this provides a convenient way of summarising qualitative research findings but should be completed in rough first, making sure from field notes that all main points of general agreement are covered, before making a clean version later.

| Group Question | Now | 5 Years Ago | 10 Years Ago |
|---|---|---|---|
| | | | |
| Main | | | |
| Incomes | | | |
| *Comments:* | | | |
| | | | |
| | | | |
| New | | | |
| Activities | | | |
| (started) | | | |
| *Comments:* | | | |
| | | | |
| | | | |
| Got | | | |
| Worse? | | | |
| *Comments:* | | | |
| | | | |
| | | | |
| Got | | | |
| Better? | | | |
| *Comments:* | | | |
| | | | |
| Agric and | | | |
| Marketing | | | |
| Problems | | | |
| *Comments:* | | | |
| | | | |
| Access to | | | |
| Natural | | | |
| Resources | | | |
| *Comments:* | | | |
| | | | |

**Figure 49: Example tabulation for summarising group discussions**

## L12 Household survey forms

The following diagram shows the survey forms available (below in this document, and in the LADDER database). These forms may need to be adapted for surveys in different areas and aimed to address different management questions. Some forms may not be necessary for some surveys.

The database itself (including all the Excel data collection forms which those examples shown below were developed from) is available for download from the LADDER web-site:
http://www.uea.ac.uk/dev/odg/ladder/Data

**Figure 50: Example household survey forms**

### **Figure 50: A1:** Residents data

Household Code

Country | District | Villages | Study Location

*Members of HH currently resident*

| ID | Name | Age | Sex | | Relationship to H/H head | | Education Level Reached | | Main Occupation | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CODE | | CODE | | CODE | | CODE | |
| *Data not entered* | | | | | | | | | | |

Total no. of residents

## **Figure 50:A3:** Summary basic household (HH) data

| Household Code | |
|---|---|

| Country | | District | | Villages | | Study Location | |
|---|---|---|---|---|---|---|---|

Total no. of residents [ ]

Total no. of non-residents [ ]

HH Size: AEUs (Residents) [ ]

HH Size: AEUs (Non-residents) [ ]

HH Size: AEUs (Total) [ ]

HH Size: EAAs (Residents) [ ]

HH Size: EAAs (Non-residents) [ ]

HH Size: EAAs (Total) [ ]

Gender of HH head (incl. de facto) [ ]

Gender of HH head (M/F) [ ]

Education of HH head (proxy years) [ ]

Age of HH head [ ]

HH education (total proxy years for resident EAAs) [ ]

HH education (per capita years for resident EAAs) [ ]

Fishing HH? [ ]

Total annual remittances (US$) [ ]

## **Figure 50: B:** **Assets 1** – Land, Livestock and Housing

| Household Code | |
|---|---|

| Country | | District | | Villages | | Study Location | |
|---|---|---|---|---|---|---|---|

**B1:** Land Owned and Operated by the Household

Current price of land in the area (US$) [ ]

*Shambas and Gardens*

| Field ID | Area (ha.) | Ownership | | Rent In Land (US $) | Rent Out Land (US $) | Use of Field | Field Cultivated By | |
|---|---|---|---|---|---|---|---|---|
| | | CODE | | | | | CODE | |
| A | | | | | | | | |
| B | | | | | | | | |
| C | | | | | | | | |
| D | | | | | | | | |
| E | | | | | | | | |
| F | | | | | | | | |
| G | | | | | | | | |
| H | | | | | | | | |
| I | | | | | | | | |
| J | | | | | | | | |

No. of Plots [ ] Rent totals (US $) [ ] [ ]

Total Area Owned [ ] Total Area Used for Farming [ ]

## **Figure 50: B2:** Numbers of Livestock

| Livestock Type | Number Now | Number Year Ago | Number Born | Number Died | Number Bought | Number Sold | Number Gifts In | Number Gifts Out | Number Eaten | Current Price (US$) | *Check Number Now* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cattle | | | | | | | | | | | *0* |
| Goats | | | | | | | | | | | *0* |
| Sheep | | | | | | | | | | | *0* |
| Pigs | | | | | | | | | | | *0* |
| Chickens | | | | | | | | | | | *0* |
| Turkeys | | | | | | | | | | | *0* |
| Ducks | | | | | | | | | | | *0* |
| Donkeys | | | | | | | | | | | *0* |
| | | | | | | | | | | | *0* |

| | |
|---|---|
| Total livestock holding in Cattle Equivalent Units: | |

## **Figure 50: B3:** House Construction

Wall Construction: ____ Roof Construction: ____

Piped Water? ____ Water source ____ Mains Electricity? ____

## **Figure 50: C1: Assets 2** – Selected farm and household assets

| | |
|---|---|
| Household Code | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Country | | District | | Village | | Study Location | |

| Item | No. Owned | Current Price (US$) | Current Price (Local currency) |
|---|---|---|---|
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## **Figure 50: C2:** Savings and credit

Household Code: ____________

Country: ________ District: ________ Village: ________ Study Location: ________

Does anyone in this household belong to a credit group or scheme? ☐ Yes ☐ No

If YES, names? ____________ ☐ Male ☐ Female
____________ ☐ Male ☐ Female

Name and type of scheme: ____________
____________

Last amount borrowed (US$) ________ Purpose of loan: ________

Interest rate: ________ % Loan Repayment Period: ________ ________ Grace Period: ________ ________

Does this scheme allow for savings? ☐ Yes ☐ No

If YES, are these regular saving? ☐ Yes ☐ No Amount (US$) ________ (and how often?) ________

Aside from the scheme, do any members of the household have savings with a credit organisation or bank? ☐ Yes ☐ No

(Optional) estimated total amount of savings at time of interview (US$) ________

## **Figure 50: D:** Crop outputs and income (US$)

Household Code: ____________

Country: ________ District: ________ Village: ________ Study Location: ________

| Crop name + Harvest month | | | Unit | Quantity Consumed | | Quantity Sold | | Total Produc'd | Average Price | Gross Income | *Check Gross Income* | Variable Costs | Net Total Income | *Check Net Total Income* | Net Cash Income | *Check Net Cash Income* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Full | Standardised | Month | | Q'ntity | % | Q'ntity | % | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | |
| Number of types of crop grown | | | | | | | | Crop totals: | | | | | | | | |

## **Figure 50: E1:** Livestock and other NR outputs and income (US$)

| Household Code | |
|---|---|

| Country | | District | | Village | | Study Location | |
|---|---|---|---|---|---|---|---|
| Milk cattle: No. | | Breed | | Total days milked (per cow) | | Average daily milk yield | |

| Livestock product | Unit | Quantity Consumed | | Quantity Sold | | Total Produc'd | Average Price | Gross Income | *Check Gross Income* | Variable Costs | Net Total Income | *Check Net Total Income* | Net Cash Income | *Check Net Cash Income* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Q'ntity | % | Q'ntity | % | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| Number of livestock products: | | | | | Livestock Totals: | | | | | | | | | |

| Other NR activity | | Unit | Quantity Consumed | | Quantity Sold | | Total Produc'd | Average Price | Gross Income | *Check Gross Income* | Variable Costs | Net Total Income | *Check Net Total Income* | Net Cash / Income | *Check Net Cash Income* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | Details | | Q'ntity | % | Q'ntity | % | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Number of other NR products: | | | | | | Other NR Totals: | | | | | | | | | |

## **Figure 50: F:** Non-Farm Income Received by the Household (US$)

| Household Code | |
|---|---|

| Country | | District | | Village | | Study Location | |
|---|---|---|---|---|---|---|---|

| No. of HH members with non-farm income | | Annual total non-farm income for HH | |
|---|---|---|---|

| HH member with non-farm income: Name | Gender | Type of work | Income last month | Income last year | Place of work | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | No. of employees (if self-employed) | |
| | | | | | | |
| | | | | | No. of employees (if self-employed) | |
| | | | | | | |
| | | | | | No. of employees (if self-employed) | |

## **Figure 50: G2:** Regular Food Consumption of Household (main staple foods during past week)

| Main Staple Foods (Last Week) | Number of Days | Amount eaten per day | | Current price per Unit (local currency) | Cost of Main Foods (local currrency) | | |
|---|---|---|---|---|---|---|---|
| | | Unit | Quantity | | per Day | per Week | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | *Check Total Cost per week* |
| | | | | | | | |
| | | | | | | | |
| | | | | **Total cost of main foods per week** | Local currency | | 0 |
| | | | | | US$ | | |

## **Figure 50: G3:** Food stocks and losses

| Crop name | Last Harvest (approx. date) | Total Stored Last Harvest | | Amount in Store Now | When Store Ran Out (approx. date) | Loss in Store | Estimated Quantity Lost | | % Loss | Main Reasons for Loss |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
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Has HH bought food during the past year? [ ]

## **Figure 50: G4:** Response to shocks (last 3 years)

Months when bought [ ] No. of times each month [ ]

Amount bought each time [ ] [ ] Total amount of food purchased (past year) [ ] [ ]

**G4:** Response to shocks (last 3 years)

| Event | When Happened | Effects of Event | Response to Event |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

## **Figure 50: H:** Household income survey

| Household Code | |
|---|---|

| Country | | District | | Village | | Study Location | |
|---|---|---|---|---|---|---|---|

| ID | Description of Income | Source of data | Amount |
|---|---|---|---|
| 1 | Crop income | Form D | |
| 2 | Livestock income | Form E | |
| 3 | Income from renting out land | From B | |
| 4 | Other household/NR-based income | Form E | |
| 5 | Non-Farm income (year totals) | Form(s) F | |
| 6 | Remittance income | Form A | |
| 7 | Income from fishing | Form K | |
| 8 | Estimated income in-kind | Form G | |

| | |
|---|---|
| Total income from all sources | |
| *Check on total income from all sources* | |

## **Figure 50: H:** Fishing asset and income data

| Household Code | | Fishing assets (index) | |
|---|---|---|---|

| Country | | District | | Village | | Study Location | |
|---|---|---|---|---|---|---|---|

| Boat type | | No. | Ownership Own/Rent | | Main power source | | Current boat cost (local currency) |
|---|---|---|---|---|---|---|---|
| CODE | | | CODE | | CODE | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

| Gear type | | No. | Ownership Own/Rent | | Current boat cost (local currency) |
|---|---|---|---|---|---|
| CODE | | | CODE | | |
| | | | | | |
| | | | | | |
| | | | | | |

| How much does an outboard motor cost? | Size HP: | | Current cost (local currency) | |
|---|---|---|---|---|

## **Figure 50: K2:** Estimated income from fishing

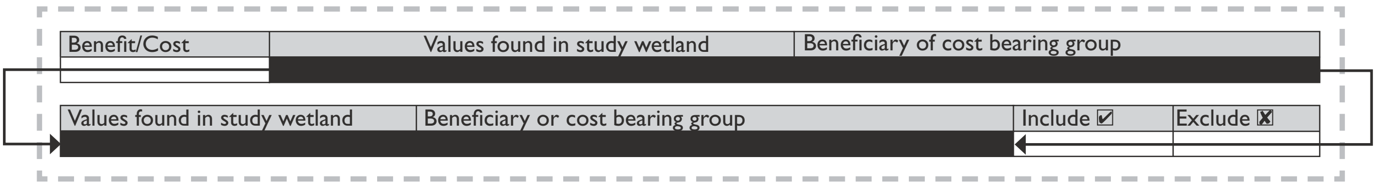
| ID | Name | Fishing work | | | Per week | | | | Weeks fishing per year | Annual fishing income | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | *If owner or renter* | | | *If labour* | | | |
| | | | | | Value of catch | Operating costs | Net value | Cash or equivalent | | | |
| | | CODE | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | *Check total* |
| | | | | **Total household income from fishing:** | | | | Local currency | | | *0* |
| | | | | | | | | US$ | | | |

# Wetland economic valuation data collection sheets

### Field checklists for wetland valuation

| Category of value | Values found in study wetland | Beneficiary or cost bearing group |
|---|---|---|
| Direct Values | | |
| | | |
| | | |
| | | |
| Indirect Values | | |
| | | |
| | | |
| | | |
| Option Values | | |
| | | |
| | | |
| | | |
| Existence Values | | |
| | | |
| | | |
| | | |
| Direct Costs | | |
| | | |
| | | |
| | | |
| Opportunity Costs | | |
| | | |
| | | |
| | | |
| Costs to other activities | | |
| | | |
| | | |
| | | |

**Figure 51: Valuation checklist #1 – Identifying and listing wetland values**




| Values found in study wetland | Beneficiary or cost bearing group | Include ☑ | Exclude ☒ |
|---|---|---|---|
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**Figure 52: Valuation checklist #2 – Selecting wetland costs and benefits**

| Values found in study wetland | Beneficiary or Cost bearing group | Include ☑ | Exclude ☒ |
|---|---|---|---|
| | | | |

| Values included in study | List of possible valuation techniques | Technique to be used ☑ | Technique not to be used ☒ |
|---|---|---|---|
| | | | |

| Values included in study | List of possible valuation techniques | Technique to be used ☑ | Technique not to be used ☒ |
|---|---|---|---|
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**Figure 53: Valuation checklist #3 – Choosing wetland valuation techniques**

| Values included in study | List of possible valuation techniques | Technique to be used ☑ | Technique not to be used ☒ |
|---|---|---|---|
| | | | |

| Values included in study | Selected valuation technique | Data required | Source of data |
|---|---|---|---|
| | | | |

| Values found in study wetland | Selected valuation technique | Data required | Source of data |
|---|---|---|---|
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**Figure 54: Valuation checklist #4 – Identifying data needs and sources**

INTERNATIONAL UNION FOR
CONSERVATION OF NATURE

WORLD HEADQUARTERS
Rue Mauverney 28
1196 Gland
Switzerland
Tel: +41 22 999 0000
Fax: +41 22 999 0020
www.iucn.org/species