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## Guidance for the Assessment of

# Ecosystem Services in African Biosphere Reserves

**A WAY FORWARD TO SUSTAINABLE DEVELOPMENT**

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**Authors**
A-J. Rochette (CEBioS, Royal Belgian Institute of Natural Sciences), J. Hugé (Open University of the Netherlands, the Netherlands; Vrije Universiteit Brussel, Belgium; Université Libre de Bruxelles, Belgium), I. Janssens (Vrije Universiteit Brussel, Belgium), E. Bocquet (University of Liège, Gembloux Agro-Bio Tech, Belgium), H. Azadi (University of Antwerp, Belgium), K. Vanderhaegen (KU Leuven University, Belgium), S. Van Passel (University of Antwerp, Belgium), B. Verbist (KU Leuven University, Belgium), S. Jacobs (Research Institute for Nature and Forest (INBO), Belgian Biodiversity Platform, Belgium), and L. Janssens de Bisthoven (CEBioS, Royal Belgian Institute of Natural Sciences, Belgium).

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Graphic design and layout: Anna Mortreux
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**Illustrations**
Figures 4, 5, 6, 11, 15, 37: M. Berthet (Royal Belgian Institute of Natural Sciences, Belgium).

**Reading Committee**
B. Decadt (Belgian Science Policy Office (BELSPO), Belgium), H. Eggermont (Belgian Biodiversity Platform, Belgium), N. Raondry Rakotoarisoa (UNESCO-MAB, Paris), H. Tabuna (Communauté Economique des Etats de l'Afrique centrale), M. Van Noordwijk (World Agroforestry (ICRAF), Bogor, Indonesia), L. Vasseur (Canadian MAB Committee, Canada), and Chapter 5: S. Lhoest (University of Liège, Gembloux Agro-Bio Tech, Belgium).

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## SHORT SUMMARY

# Guidance for the Assessment of Ecosystem Services in African Biosphere Reserves

### A COMPLETE GUIDE TO HARNESSING ECOSYSTEM SERVICES ASSESSMENT

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)' 2020 "Global assessment report on biodiversity and ecosystem services" states that nature and its contributions to people play an important role not only for the health of the planet, but also to achieve the Sustainable Development Goals. It highlighted notably the need for improved understanding of the interactions between ecosystem services and the goals and targets to end poverty and hunger and to enhance people's well-being.

**70%**

**of MAB stakeholders in favour of ecosystem service tools for awareness raising and education**

(Source: Delphi Study, Evamab team, 2017)

Ecosystem services, we know, encompass all of nature's contributions to people. It can be raw materials such as water or wood, but also actual services like pollination of crops or carbon sequestration. Being able to assess these ecosystem services is, for communities, another step in understanding the area in which they live and how to live sustainably, in harmony with their direct environment.

For the first time, a specific, user-friendly manual dedicated to assess ecosystem services was created for biosphere reserve managers and decision-makers, and adapted to the African biosphere reserve context. Filling a gap in the Man and theBiosphere community and beyond, this manual will provide its readers with the necessary tools and knowledge to engage their communities in achieving the Sustainable Development Goals.

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*"Since wars begin in the minds of men and women it is in the minds of men and women that the defences of peace must be constructed"*

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## Guidance for the Assessment of

# Ecosystem Services in African Biosphere Reserves

A WAY FORWARD TO SUSTAINABLE DEVELOPMENT

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## List of abbreviations

| | |
|---|---|
| **AFD** | Academics for Development |
| **AfriMAB** | African Network of Biosphere Reserves |
| **ARIES** | Artificial Intelligence for Ecosystem Services |
| **BELSPO** | Belgian Science Policy Office |
| **BR** | Biosphere reserve |
| **CAZ** | Controlled Agricultural Zone |
| **CBD** | Convention on Biodiversity |
| **CDM** | Clean Development Mechanism |
| **CDM-POA** | Clean Development Mechanism – Program of Activities |
| **CEBioS** | Capacities for Biodiversity and Sustainable Development |
| **CICES** | Common International Classification of Ecosystem Services |
| **C$N** | Co$ting Nature |
| **DPSIR** | Drivers-Pressures-State-Impact-Response |
| **ES** | Ecosystem services |
| **ESP-VT** | Ecosystem Services Partnership Visualization Tool |
| **ESVCA** | Ecosystem service value chain analysis |
| **EV** | Ecosystem Services Valuation |
| **EVAMAB** | Economic valuation of ecosystem services in Man and Biosphere reserves |
| **FGD** | Focus Group Discussion |
| **FPIC** | Free, Prior and Informed Consent |
| **GEBR** | Green Economy in Biosphere Reserves |
| **GEI** | Green Economy Initiative |
| **GEOMOD** | Geographic Information Systems-based LUC change model |
| **GIS** | Geographic Information System |
| **IA** | Integrated assessment |
| **IDSD** | Interdisciplinary Decision Support Dashboard |
| **ILK** | Indigenous and local knowledge |
| **InVEST** | Integrated Valuation of Ecosystem Services and Tradeoffs |
| **IPBES** | Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services |
| **IUCN** | International Union for Conservation of Nature |
| **MAB** | Man and the Biosphere Programme |
| **MCA** | Multi-criteria decision analysis |
| **MEA** | Millennium Ecosystem Assessment |
| **NBSAP** | National Biodiversity Strategy and Action Plan |
| **NCP** | Nature's Contributions to People |
| **NGO** | Non-governmental organization |
| **NGT** | Nominal group technique |
| **NP** | National park |
| **NTFP** | Non-timber forest products |
| **PA** | Protected area |
| **PA-BAT** | Protected Areas Benefits Assessment Tool |
| **PBR** | Pendjari Biosphere Reserve |
| **PES** | Payments for ecosystem services |
| **PR** | Periodic review |
| **Q** | Q methodology |
| **RBINS** | Royal Belgian Institute of Natural Sciences |
| **SDGs** | Sustainable Development Goals |
| **SITE** | Simulation of terrestrial environments |
| **SNV** | Netherlands Development Organisation |
| **SolVES** | Social values for ecosystem services |
| **SWAT** | Soil water and assessment tool |
| **TEEB** | The Economics of Ecosystems and Biodiversity |
| **TESSA** | Toolkit for Ecosystem Service Site-based Assessment |
| **TEV** | Total economic value |
| **TGB** | Trees for Global Benefits |
| **UN** | United Nations |
| **UNEP** | United Nations Environment Programme |
| **UNESCO** | United Nations Educational, Scientific and Cultural Organization |
| **VT** | Valuation Toolkit |
| **WCS** | Wildlife Conservation Society |
| **WTCL** | Willingness to contribute in days of labour |
| **WTP** | Willingness-to-pay |
| **WWF** | World Wide Fund for Nature |

# FOREWORD BY UNESCO AND BELSPO

The Belgian Science Policy Office (BELSPO) entered into partnership with the UNESCO Man and the Biosphere (MAB) Programme to promote research in Africa in line with UNESCO's mandate in Natural Sciences and the Belgian Science Policy Office (BELSPO) efforts related to biodiversity and climate change challenges. UNESCO and BELSPO have already carried out successful cooperation activities in the past and both Parties wished through this partnership to increase and expand their cooperation to areas of mutual interest with the aim of creating a knowledge and evidence-based decision making for the sustainable management of biosphere reserves (BR).

Our adherence to the multi-stakeholder approach of the MAB Programme, linking biodiversity, culture and society, including through the World Network of Biosphere Reserves (WNBR) as 'science and learning hubs', also formed the basis of a cooperation agreement between BELSPO and the UNESCO-MAB Secretariat in 2016. For UNESCO, mobilizing the scientific know-how and technical expertise of the Belgian scientific community was a valuable opportunity to support the Man and the Biosphere Programme and its global network of biosphere reserves.

In 2013, the network of MAB programme in Africa (AfriMAB) identified the need to develop the scientific capacity on ecosystem services issues in the region. BELSPO welcomed this area of cooperation with MAB considering that ecosystem services are the pulsating heart of the biosphere reserves. Through a call of proposal, the project Economic valuation of ecosystem services in Man and Biosphere Reserves (EVAMAB) was selected as the best project to support the African biosphere reserves' needs.

The enthusiasm and openness of the multi-disciplinary EVAMAB team produced a snowball effect inside African partner countries as well as in Europe, leading to the involvement of Universities, Scientific Institutes and a large number of young researchers both in Belgium and in the four participating countries in Africa, namely Benin, Ethiopia, Tanzania and Uganda.

Biosphere reserves are also 'living labs' that adhere to a green development vision, and have impacts beyond their borders. Their efforts are aligned with MAB's Lima Action Plan and its implementation, as well as the UN Sustainable Development Goals and future targets under the post-2020 Global Biodiversity Framework.

Through tools, methods and case studies, EVAMAB showcases the relevance and impact of combining local and indigenous knowledge with scientific insights and innovative, participative cooperation approaches. This methodology aligns closely with the spirit of thinking globally while acting locally, and propagating the motto "Reconnecting people and nature".

In the spirit of turning challenges into opportunities, this manual – a major output of the EVAMAB-project – will be an essential tool for biosphere reserve managers and beyond, enabling them to harness the full potential of biosphere reserves and strengthen the science-policy interface in practice. The manual is both a scientific review on ecosystem services valuation and a practical handbook for practitioners in supporting them making the right choices, in order to contribute to the protection of biological and cultural diversity alongside sustainable socio-economic development. It may also promote smart investments in nature-based solutions and over the longer term create jobs, which will in turn promote resilience, wellbeing, sustainable tourism and the prosperity of current and future generations.

The manual is a starting point for new ventures that can blossom through increased awareness raising, educational and 'action oriented' initiatives worldwide. With citizens and particularly young people becoming increasingly part of the game, it will create ownership and accelerate the building of a resilient, vibrant and biodiverse future.

We hope that this manual will support the management of biosphere reserves and enhance their contribution to the Sustainable Development Goals and the African Union Agenda 2063.

Published in the year of its 50th anniversary, this book shows to what extent the MAB programme has been able to remain relevant to the challenges of its time by preserving its forward-looking and innovative approach from the beginning, which gives it a definite value in promoting sustainable development.

**Shamila Nair-Bedouelle**
UNESCO Assistant Director-General
for Natural Sciences

**Frank Monteny**
Director-General of Research
and Space, BELSPO

# PREFACE BY CEBIOS CAPACITIES FOR BIODIVERSITY AND SUSTAINABLE DEVELOPMENT/COORDINATOR OF THE EVAMAB PROJECT

The uneasy relationship between humans and nature is one of constant evolution. However, we find ourselves now at the brink of major ecological and climatic global changes that will affect us all. The search for new concepts and solutions as alternatives to 'business as usual' approaches is essential to steer a course towards a future scenario more respectful of our environment and, ultimately, ourselves.

Global biodiversity policies should be implemented at all scales, linking the conservation and restoration of existing biodiversity to people, and working to ensure an equilibrium of mutual respect and responsible stewardship.

The UNESCO Man and the Biosphere (MAB) Programme, established in 1971, is the ideal platform to contribute to this global effort. As the custodian of over 700 sites across the world, each of which has its own national protection status and management type, it encompasses some of the world's most iconic natural areas and offers a multitude of opportunities to showcase successful biodiversity policies in action.

Following the recommendations of the Lima Action Plan, UNESCO-MAB commissioned the Belgian Science Policy administration (BELSPO) to mobilize expertise to carry out research on the possibilities offered by the concept of 'ecosystem services' in the context of the World Network of Biosphere Reserves (WNBR).

The CEBioS programme, funded by Belgian Development Cooperation and housed at the Royal Belgian Institute of Natural Sciences, took up the challenge and assembled a consortium composed of KU Leuven, the Université Libre de Bruxelles and the University of Antwerp. Each institution brought its own expertise, track record and, most importantly, dedicated scientific African partners to tackle specific aspects of this venture. One of the major outcomes of the three-year EVAMAB project (2017-2019) was the production of this manual, based on general information combined with specific case studies and results from the EVAMAB research.

As readers will discover, the EVAMAB project consistently scoped the real needs and concerns of African MAB stakeholders in a participative manner – an approach which ensured that tools and methods were tested in real contexts. This resulting manual is a remarkable co-production of knowledge and advice.

I sincerely hope that this publication, as a complement to the multitude of other excellent reviews and guides, will be useful to policy-makers, communities and MAB managers or management entities alike, and will help them to better and more sustainably harness the potential of ecosystem services for local stakeholders in biosphere reserves and beyond.

**Dr. Luc Janssens de Bisthoven**
Coordinator of the CEBioS programme
financed by the Belgian Development Cooperation DGD
http://cebios.naturalsciences.be

# Introduction

## Biosphere reserves and people: Emerging needs demand a better understanding of ecosystem services

L. Janssens de Bisthoven, A-J. Rochette, I. Janssens and J. Hugé

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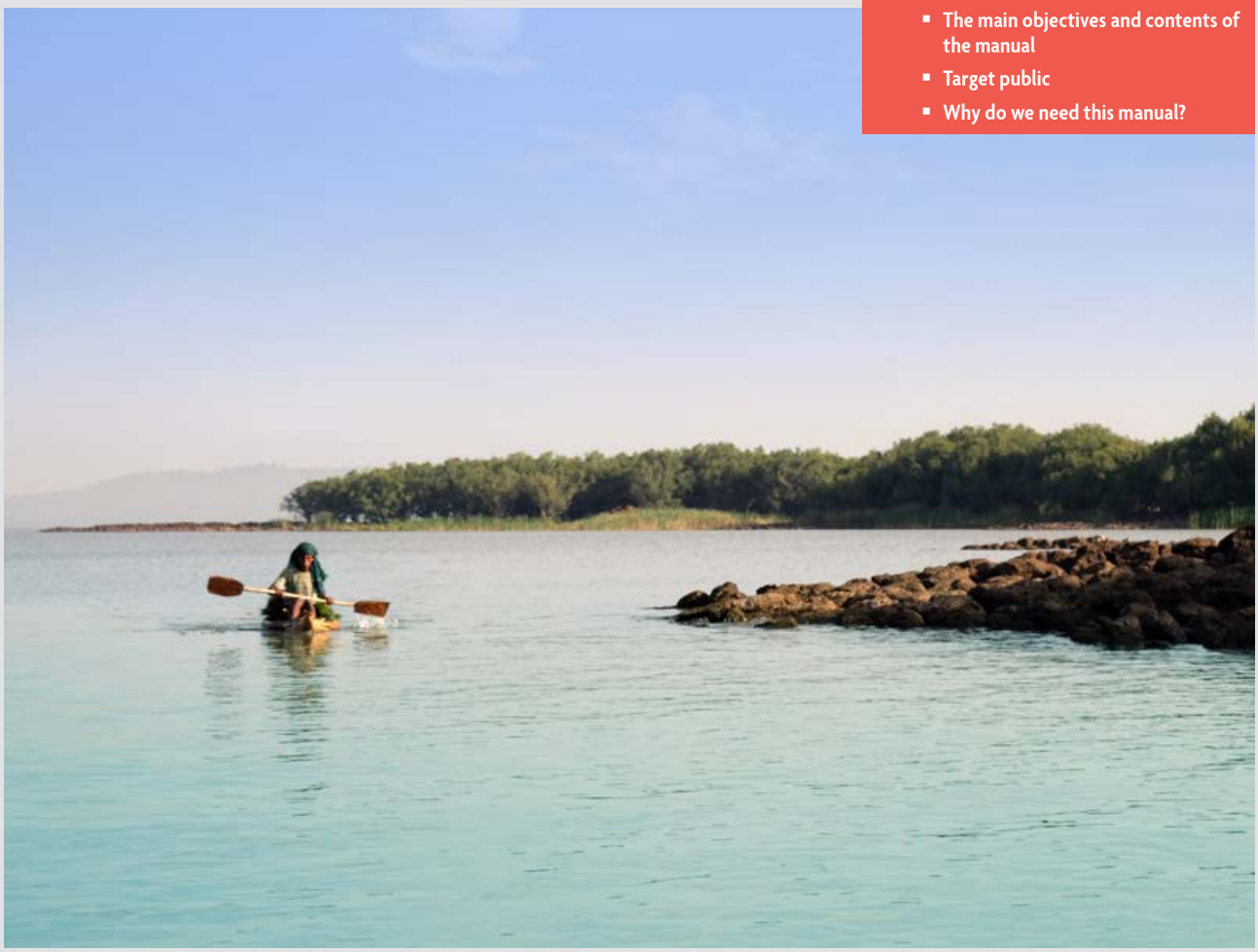


A fisherman on Lake Tana Biosphere Reserve, Ethiopia © A-J. Rochette

## WHY THIS MANUAL?

### Meeting the needs of the AfriMAB network

The idea of documenting ecosystem services for biosphere reserves arose out of a need expressed by the African Network of Biosphere Reserves (AfriMAB) network at a General Assembly on the 'Green Economy and ecosystem services' held in 2013. During the meeting it became apparent that the concept of ecosystem services (ES) was relatively new for many of the participants, all of whom wanted to better understand the issues involved in order to work towards better management of their biosphere reserves.

In 2017, the EVAMAB project was launched to address this need (see **Box 1**). The project provided an opportunity to involve many MAB stakeholders, and observe good practices and study cases related to ES. A logical outcome was to summarize the main findings and lessons learned in an easy to use manual that would inspire MAB managers and other stakeholders to address ES at their sites.

**BOX 1.**
**THE EVAMAB PROJECT**

EVAMAB stands for "Economic valuation of ecosystem services in Biosphere Reserves: testing effective rapid assessment methods in selected African biosphere reserves".

The project addresses the evaluation (economic or not) ecosystem services in biosphere reserves from a regional perspective (Africa) and focuses on sites from four countries: **Benin**, **Ethiopia**, **Tanzania**, and **Uganda**.

This project lasted 30 months (2017-19) and was financed within the framework of a Memorandum of Understanding between Belspo (Belgian Science Policy) and UNESCO to support research activities in biosphere reserves.

About 20 scientists from the global north and south conducted field work and carried out research in four African biosphere reserves. This included field surveys and stakeholder workshops in:

- Tanzania: Lake Manyara BR
- Uganda: Mount Elgon BR
- Ethiopia: Lake Tana BR
- Benin: Pendjari BR

Closing workshop: About 35 scientists and African biosphere reserve managers gathered in Ethiopia to discuss the results of the EVAMAB project, and priorities for this manual.

**THE EVAMAB PROJECT**

The draft manual was presented at the AfriMAB meeting in Abidjan (October 2019), with around 150 representatives of the AfriMAB network.

A reading committee reviewed and validated the content of the manual.

For more info, visit: http://www.biodiv.be/evamab

# AFRICAN MAB MANAGERS: THIS IS YOUR MANUAL

## The main objectives and contents of the manual

The manual aims to

- outline the **significance and value of ecosystem services** for the management of African biosphere reserves;
- **increase awareness, knowledge and use** of ecosystem services among stakeholders involved with African biosphere reserves; and
- contribute to **sustainably maintaining ecosystems** and their services in African biosphere reserves, and support the management of biosphere reserves for **nature and people**.

## Target audience

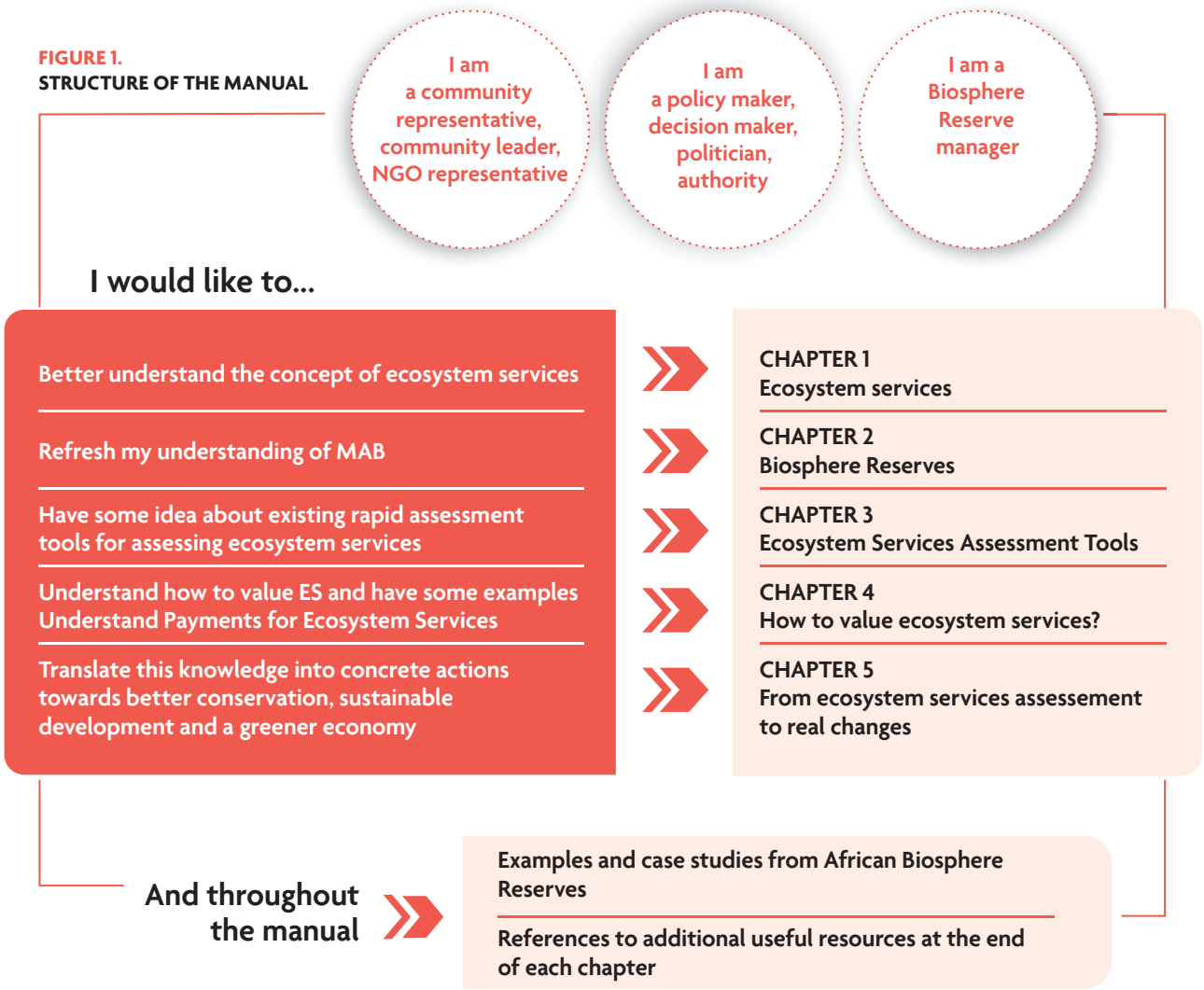
This manual has been developed to meet the needs of multiple target groups on the understanding that management of a biosphere reserve is not the sole responsibility of a few individuals. However, the primary audience is the ***managers*** and administrators of African biosphere reserves – those based in the field who need to take day-to-day decisions, defuse conflicts and look for benefits or trade-offs, while engaging in dialogue with numerous stakeholders. However, other stakeholders may also benefit from this manual, such as local authorities, rural development structures, land use conflict managers and planners, and many others.

The manual can also be used by different types of management, ranging from national authorities to NGOs working with communities in the surrounding area and community-led biosphere reserves. In addition, it aims to provide guidance to authorities and communities interested in establishing a new biosphere reserve.

## Why do we need this manual?

Given the extent of the available literature on protected areas and their management (**Box 2**), it is reasonable to enquire whether there is a real need for another manual on the topic. This manual is designed to provide user friendly guidance for biosphere reserve decision-makers and managers, specifically and explicitly for them, and adapted to the African biosphere reserve context. A distinction is made between biosphere reserves and protected areas, as the former maintain a continuum of conservation, development and logistical

**FIGURE 1.**
**STRUCTURE OF THE MANUAL**



integrated activities across the same territory. Africa, moreover, is in dire need of capacity development (Vanhove, Rochette and Janssens de Bisthoven, 2018).

Some features inherent to the **African MAB context** include:

- isolation (distance, communication, transport) of biosphere reserves;
- lack of sufficient skilled human resources;
- lack of sufficient implementation of conservation policies;
- heavy bureaucracies and hierarchical burdens;
- lack of technological support for conservation and monitoring, such as remote sensing, aerial surveillance, anti-poaching material, etc.;
- unfair resource allocation by powerful individuals;
- corruption;
- complex competition for land/water use; and
- compartmentalization of competencies, responsibilities, mandates, decision power and structure.

It is hoped that the messages and tools conveyed in the present manual will enable **more efficient and stakeholder inclusive biosphere reserve management** and associated policies, and hence have a positive effect on these political economy issues over the long run. Many aspects of this manual may also prove useful outside the African context, as biosphere reserves worldwide *share* common characteristics and objectives.

**BOX 2.**
**A WEALTH OF RESOURCES**

**More than 100 handbooks, guidelines or manuals exist to assist policy-makers or managers in their tasks of conservation in protected areas. Here is a small sample illustrating their diversity and pertinence.**

Assessing Ecosystem Services in UNESCO Biosphere Reserves (Vasseur and Siron, 2019)
https://en.ccunesco.ca/-/media/Files/Unesco/Resources/2019/03/AssessingEcosystem.pdf

IUCN produces a series of manuals on protected areas
www.iucn.org/theme/protected-areas/resources/best-practice-guidelines

Management Manual for UNESCO Biosphere Reserves in Africa (Amer et al., 2015)
www.unesco.de/sites/default/files/2018-01/Manual_BR_Africa_en-1.pdf

Making Protected Areas Relevant: A Guide to Integrating Protected Areas into Wider Landscapes, Seascapes and Sectoral Plans and Strategies (Ervin et al., 2010)
www.cbd.int/doc/pa/tools/Making%20Protected%20Areas%20Relevant%20A%20guide%20to%20Integrating%20Protected%20Areas.pdf

Protected Area Governance and Management, IUCN (Worboys et al., 2015)
https://press.anu.edu.au/publications/protected-area-governance-and-management

Ontario Protected Areas Planning Manual (Ontario Ministry of Natural Resources, 2009)
www.ontario.ca/page/ontarios-protected-areas-planning-manual

Ecosystems and Human Well-being: A Manual for Assessment Practitioners (Ash et al., 2010)
https://portals.iucn.org/library/sites/library/files/documents/2010-029.pdf

Tools for Measuring, Modelling, and Valuing Ecosystem Services: Guidance for Key Biodiversity Areas, Natural World Heritage Sites, and Protected Areas (Neugarten et al., 2018)
https://portals.iucn.org/library/sites/library/files/documents/PAG-028-En.pdf

**BOX 3.**
**INTERNATIONAL BIODIVERSITY POLICY AND GOVERNANCE CONTEXT**

The majority of African countries have ratified the UN Rio Convention on Biological Diversity (CBD) and its 2010-2020 Aichi targets (and post-2020 targets), as well as the broader 2015-2030 Sustainable Development Goals (SDGs), which have strong links with the Aichi targets.

These international commitments encourage, motivate and stimulate parties to take concrete actions towards protecting their biodiversity, both for climate change adaptation and mitigation (in the context of the 2015 Paris agreement) and for sustainable development of their local communities, through different means, such as the stimulation of the green economy.

Within the specific African context, African countries committed themselves within the framework of the African Union to Agenda 2063 (2013-2063). This significantly increases member states' ownership of these important processes towards development in harmony with nature.

*By 2063, Africa's biodiversity, including its forests, wild life, wetlands (lakes and rivers), genetic resources, as well as aquatic life, most notably fish stocks and coastal and marine ecosystems, including transboundary natural resources will be fully conserved and used sustainably. Forest and vegetation cover would be restored to 1963 levels; while national parks and protected areas (both terrestrial and marine) will be well managed and threats to them significantly reduced.*

*Land degradation and desertification would have been stopped and then reversed. All agricultural land will be managed in a manner that is environmentally and socially sustainable. African countries would have reduced loss of biodiversity by at least 90 per cent; and natural habitats conserved.*

(*Excerpt* from Agenda 2063)

Agenda 2063 includes a clear reference to the status of both marine and terrestrial ecosystems, irrespective of actual borders. The declaration also refers clearly to national parks and protected areas, as well as social and environmental sustainability.

The 20 goals of Agenda 2063 are clearly linked to the SDGs, especially Goal 6 (Blue/ocean economy for accelerated economic growth) and Goal 7 (Environmentally sustainable and climate resilient economies and communities), which are linked to the following SDGs:

**FIGURE 2.**
**ICONS ILLUSTRATING THE SDGS THAT RELATE TO GOALS 6 AND 7 OF AGENDA 2063 OF THE AFRICAN UNION**


*Source:* United Nations (2020).

UNESCO biosphere reserves fall within the realm of these widely acclaimed policies and offer a unique governance, management and research model to achieve these goals. The present manual aims to contribute to better access to existing tools for an effective understanding of ES, to support African governments in complying with the Convention on Biological Diversity (CBD) post-2020 Global biodiversity framework, the SDGs and the African Agenda 2063 goals.

# Chapter 1
# Ecosystem services

I. Janssens, E. Bocquet, J. Hugé, L. Janssens de Bisthoven and A-J. Rochette

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Salt production in Djégbadji village, in a coastal lagoon of South Benin
© A.-J. Rochette

### RELEVANCE FOR AFRICAN BIOSPHERE RESERVES

The concept of ecosystem services **links the conservation of biodiversity and human development**. This concept is central to the Man and the Biosphere (MAB) Programme, which aims to combine conservation of ecosystems and sustainable development through the zonation of biosphere reserves and other approaches.

Biosphere reserves are excellent learning sites to study the interactions between people and nature, especially how people benefit from nature (ecosystem services), stakeholders' perceptions and use of nature, important anthropogenic pressures, etc. The concept of ecosystem services helps to structure and study all of these interactions.

Biosphere reserves would benefit from **incorporating the concept of ecosystem services into their management**. A better knowledge and integration of ecosystem services into management plans is a key priority for African biosphere reserves, which face high anthropogenic pressures such as rapid population growth, high dependence on natural resources for livelihoods, weak institutions and competing stakeholder interests under challenging governance conditions (German Federal Agency of Nature Conservation, 2011).

**Africa**, in particular, hosts multiple biodiversity hotspots and has a **high level of direct dependency on ecosystem services**. Economies and a large proportion of the population depend on goods and services provided by local ecosystems (IPBES, 2018a). The well-being of people is directly dependent on ecosystem services and access to the benefits provided by a steady flow of ecosystem services, which contribute to poverty alleviation (Fisher et al., 2014).

## WHAT IS BIODIVERSITY?

Biodiversity is the variability among living organisms and encompasses terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. It includes diversity within species, between species and of ecosystems (CBD, 1992) (**Figure 3**).

# HUMANS AND NATURE

## Ecosystems

The ecosystem concept can help us better study and understand nature. Ecosystems are physically defined environments consisting of abiotic components (water, soil, temperature, etc.) and living organisms (e.g. plants and animals), which interact with each other. These populations form communities of species that thrive in a given habitat. By studying ecosystems at different levels, we can analyse ecological interactions, production of biomass, prey-predation dynamics, migration, and many more spatial and temporal interactions (**Figure 4**).

The more you zoom out from an individual to a community level, the more complex the interactions between biotic and abiotic elements. Nowadays, management of natural resources leans towards the more holistic **Ecosystem Approach**, a 'strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way' (CBD, 2000). This approach stands at the meeting point between sustainable ecosystem management and enhanced livelihood security, thereby encompassing both conservation and development concerns (Beaumont et al., 2007; Shepherd, 2008).

A related methodology is the **Landscape Approach**, which aims to balance 'competing land use demands in a way that is best for human well-being and the environment. It means creating solutions that consider food and livelihoods, finance, rights, restoration and progress towards climate and development goals' (Global Landscapes Forum, 2020).

**FIGURE 3. THE THREE LEVELS OF BIOLOGICAL DIVERSITY**

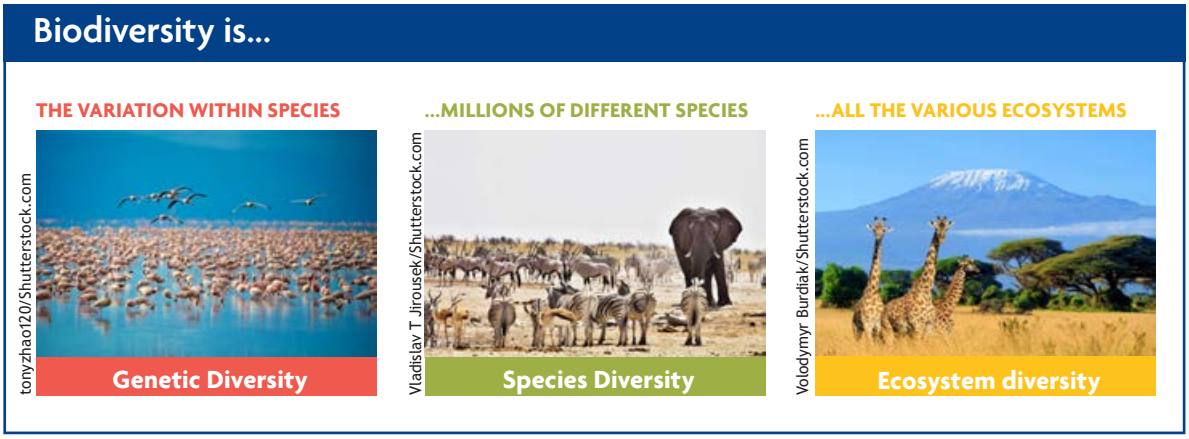



**FIGURE 4. DIFFERENT LEVELS OF COMPLEXITY WITHIN AN ECOSYSTEM (A TO C)**

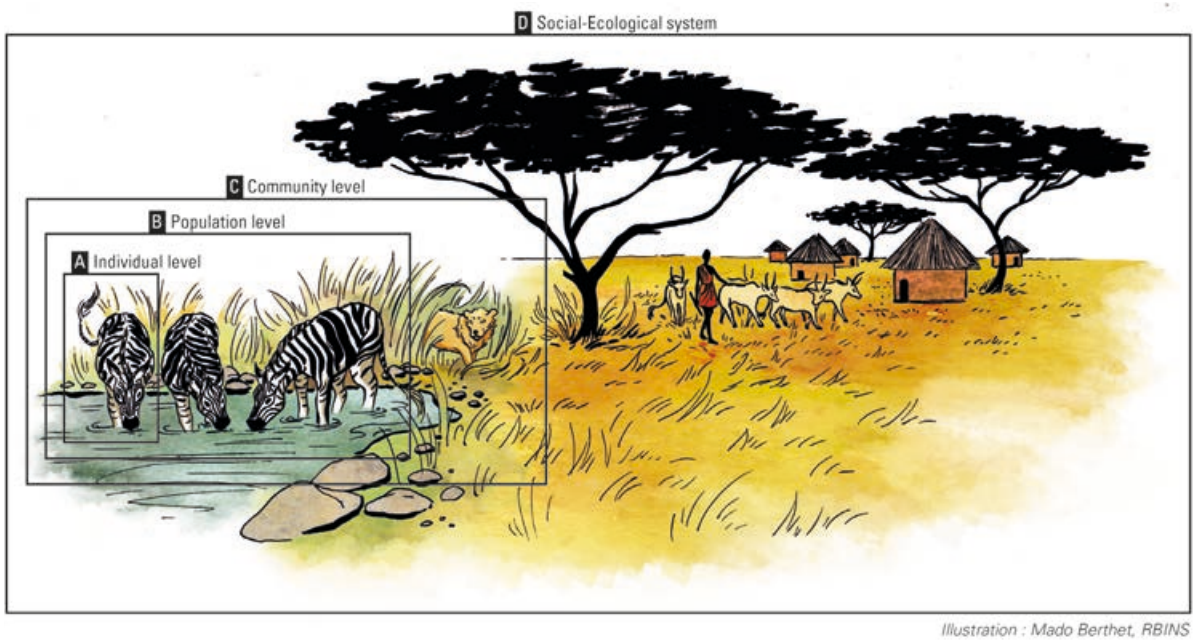


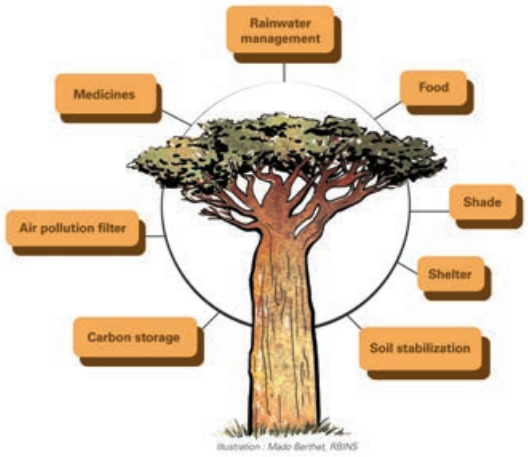

*Illustration : Mado Berthet, RBINS*

## Social-ecological system

We as **humans** are part of this complex web of interactions referred to as the 'social-ecological system'. We influence nature and depend on it for our survival, sustenance and well-being.

The **direct or indirect benefits** provided by ecosystems are called 'ecosystem services' (MEA, 2005). One single tree, for example, can provide multiple ecosystem services (ES) (**Figure 5**). These services can directly benefit people, for example through shade and food, or more indirectly via soil stabilization and carbon storage.

**FIGURE 5.**
**EXAMPLES OF DIFFERENT ECOSYSTEM SERVICES PROVIDED BY A SINGLE TREE**




## WHY DO WE PROTECT NATURE?

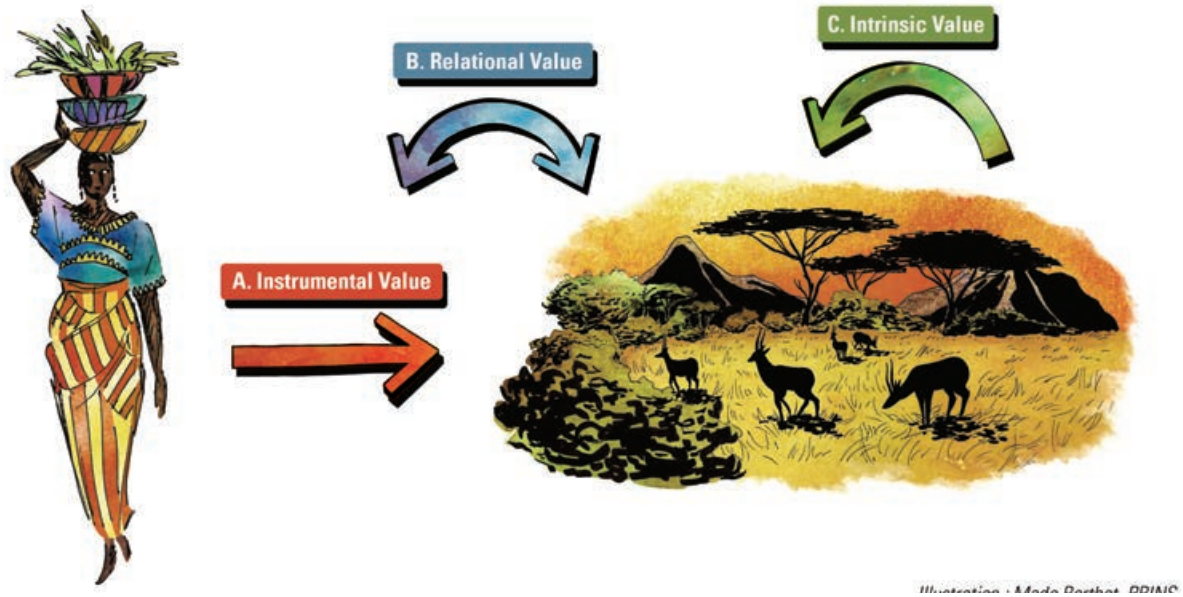
We protect nature because of its value for us. What this value entails differs among people (**Figure 6**):

- Nature can be valued for itself, independent from humans. This is its '**intrinsic value**'.
- Nature can be valued because of its utility to humans. This is what we refer to as **'instrumental value'**. Ecosystem services are an example of this approach, where nature provides certain services that benefit us and our well-being.
- Nature can be valued based on the relationship established with it. This '**relational value'** of nature can be linked to individual and/or collective preferences and norms. Nature can be meaningful to humans, for example, because of the memories it evokes, the sense of identity it provides, or the sense of responsibility and connection it triggers. When nature is endangered, the special meaning that part of nature has in our lives is also threatened. Caring for nature is thus understood as a moral and social responsibility, and as essential to meeting our needs and those of future generations. These relational values are often associated with traditional and indigenous communities, but can be important to anyone.

For example, farmers may value the food they produce in different ways, such as a pure market commodity producing a financial benefit, or as an integral part of their continued cultural identity and self-determination. Furthermore, the same farmers may hold conflicting and evolving values about the food they produce. Hence, the ways in which values are understood, acknowledged and addressed in practice are complex and have an impact on decisions that may affect both present and future outcomes (Pascual et al., 2017).

This multidimensional valuation of nature should ideally inform environmental management and policy, with particular attention to the kinds of relationships that people already have with nature. Any conservation initiative should be seen as a collective negotiated action towards good stewardship (Chan et al., 2016). The upcoming Thematic Assessment on the multiple values of nature and its benefits, produced by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), is expected to provide an in-depth synthesis of the multidimensional valuation of nature.

**FIGURE 6.**
**DIFFERENT TYPES OF VALUES PEOPLE CAN ASCRIBE TO NATURE: a) instrumental value, b) relational value, and c) intrinsic value**



## What are ecosystem services?

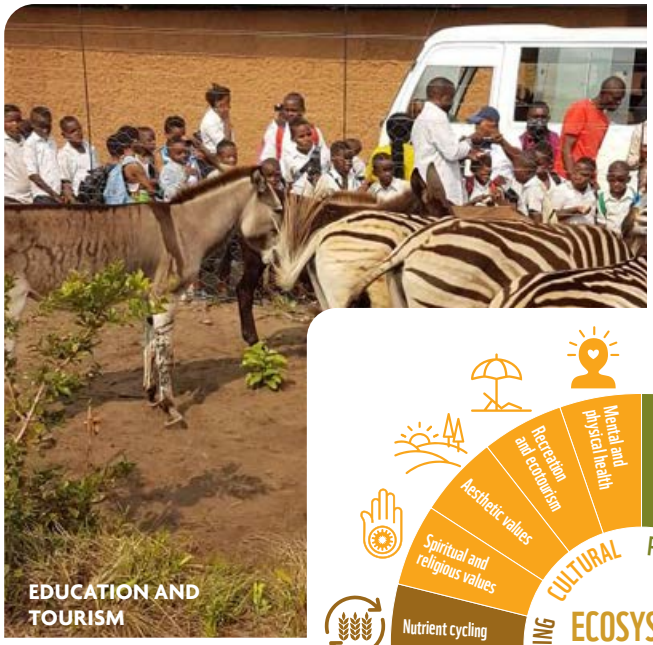
Ecosystem services were first defined as the multiple benefits that ecosystems provide to humans. They are typically categorized into four types (MEA, 2005) (**Figures 7 and 8**):

- **supporting services** such as nutrient cycling, primary production (photosynthesis) and soil formation;
- **provisioning services** such as providing food, fresh water, wood and fibre, fuel, etc.;
- **regulating services** such as the regulation of climate, flood, diseases and water purification; and
- **cultural services** such as aesthetic, spiritual, educational and recreational uses.

Further details of recent evolutions in the concept of ecosystem services can be found in **Box 4**. **Figure 8** provides some concrete examples of ecosystem services.

The global economic value of Earth's ecosystem services for the entire biosphere was estimated to amount to US$125 trillion/year, highlighting their importance in our society and in decision-making processes (Costanza et al., 2014).

**FIGURE 7. FOUR TYPES OF ECOSYSTEM SERVICES AND EXAMPLES FOR EACH CATEGORY**
*(Source:* WWF)



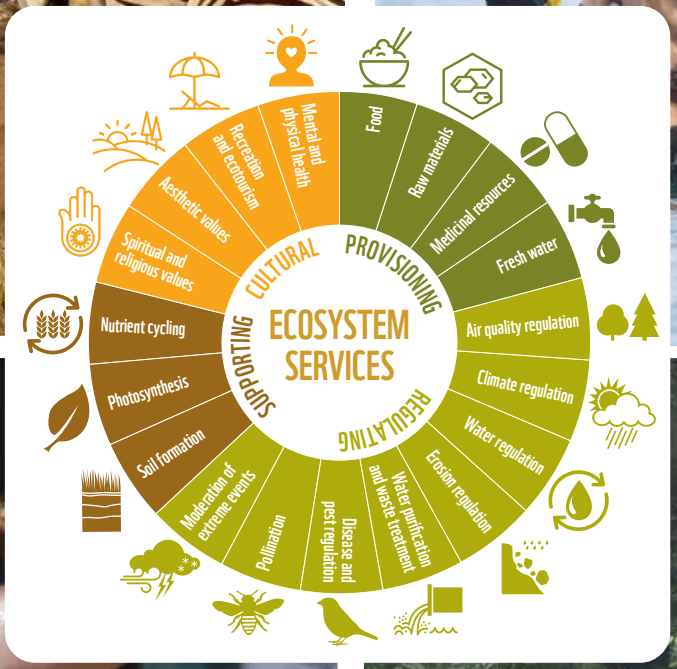
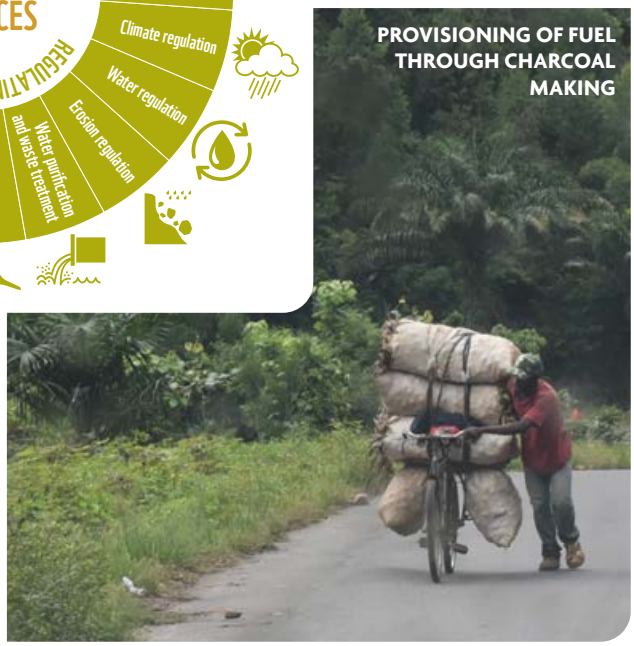




**FIGURE 8.**
**EXAMPLES OF ECOSYSTEM SERVICES**
© L. Janssens de Bisthoven and H. Keunen





## Services provided by ecosystems are essential to human well-being

There is a growing consensus among conservationists that nature conservation should aim to preserve biodiversity and improve long-term human well-being through sustainable development. 'Human well-being' refers to the state of physical and mental health of individuals (Díaz et al., 2015), and is an essential component of a good quality of life, which depends on multiple factors including access to food, water, health, education and security, as well as cultural identity, material prosperity, spiritual satisfaction and freedom of choice (Ngo et al., 2019). All of these dimensions are closely interlinked with ecosystem services.

**Figure 9** demonstrates the importance of ecosystem services as a crucial link between nature and a good quality of life. In order to maintain or even improve our current level of well-being, we need to be able to sustain the delivery of ecosystem services. Other parameters such as direct and indirect drivers, further detailed in **Figure 12**, also have a crucial role to play.

The rest of this manual uses the term 'ecosystem services' but recognizes the concepts embraced by NCP associated with other worldviews on human–nature relations and knowledge systems (e.g. 'nature's gifts' in many indigenous cultures).

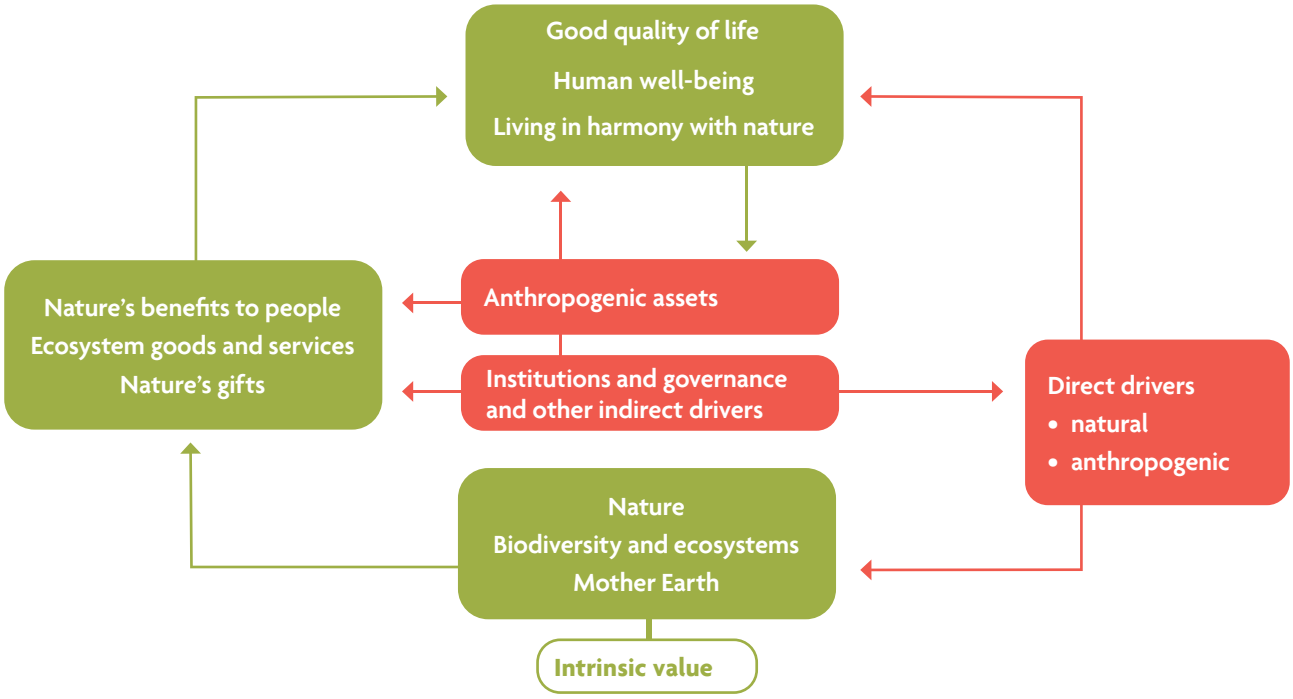
**Figure 10** shows how NCPs influence quality of life, and places them on a value gradient from instrumental to relational. The grading of green and brown colours indicates whether NCPs are associated more with natural (green) or with cultural (brown) systems.

**BOX 4.**
**NATURE'S CONTRIBUTIONS TO PEOPLE: ANOTHER LENS FOR CONSIDERING ECOSYSTEM SERVICES**

Ecosystem services can be classified in several ways and the concept itself is constantly evolving. According to the Millennium Ecosystem Assessment (MEA) (2005), four types of services provided by ecosystems may be distinguished (see **Figure 7**). The Common International Classification of Ecosystem Services (CICES, 2019) recognizes three types of ecosystem services, merging the MEA categories of supporting and regulating services into one. In this manual, we use the MEA classification which recognizes four types.

IPBES has recently introduced the term **Nature's Contributions to People (NCP)** (Pascual et al., 2017), which embodies the concept of ecosystem goods and services and notions of nature's gifts from indigenous and local knowledge systems. It emphasizes the cultural aspects and considers the importance of social sciences while assessing the interaction between people and nature, thereby recognizing the central role that culture plays in defining all links between people and nature (Díaz et al., 2018). NCP consists of 18 categories including regulation of climate, food and feed, learning and inspiration, and is organized into three partially overlapping groups: regulating, material and non-material contributions (see **Figure 10**) (IPBES, 2019). IPBES assumes that some contributions can be detrimental for humanity, such as pests in crops (IPBES, 2018a; Pascual et al., 2017).

**FIGURE 9.**
**THE IPBES CONCEPTUAL FRAMEWORK PROVIDES A SIMPLIFIED MODEL OF THE COMPLEX INTERACTIONS BETWEEN THE NATURAL WORLD AND HUMAN SOCIETIES**




*Source:* adapted from Díaz et al. (2015), IPBES

## Who benefits from ecosystem services?

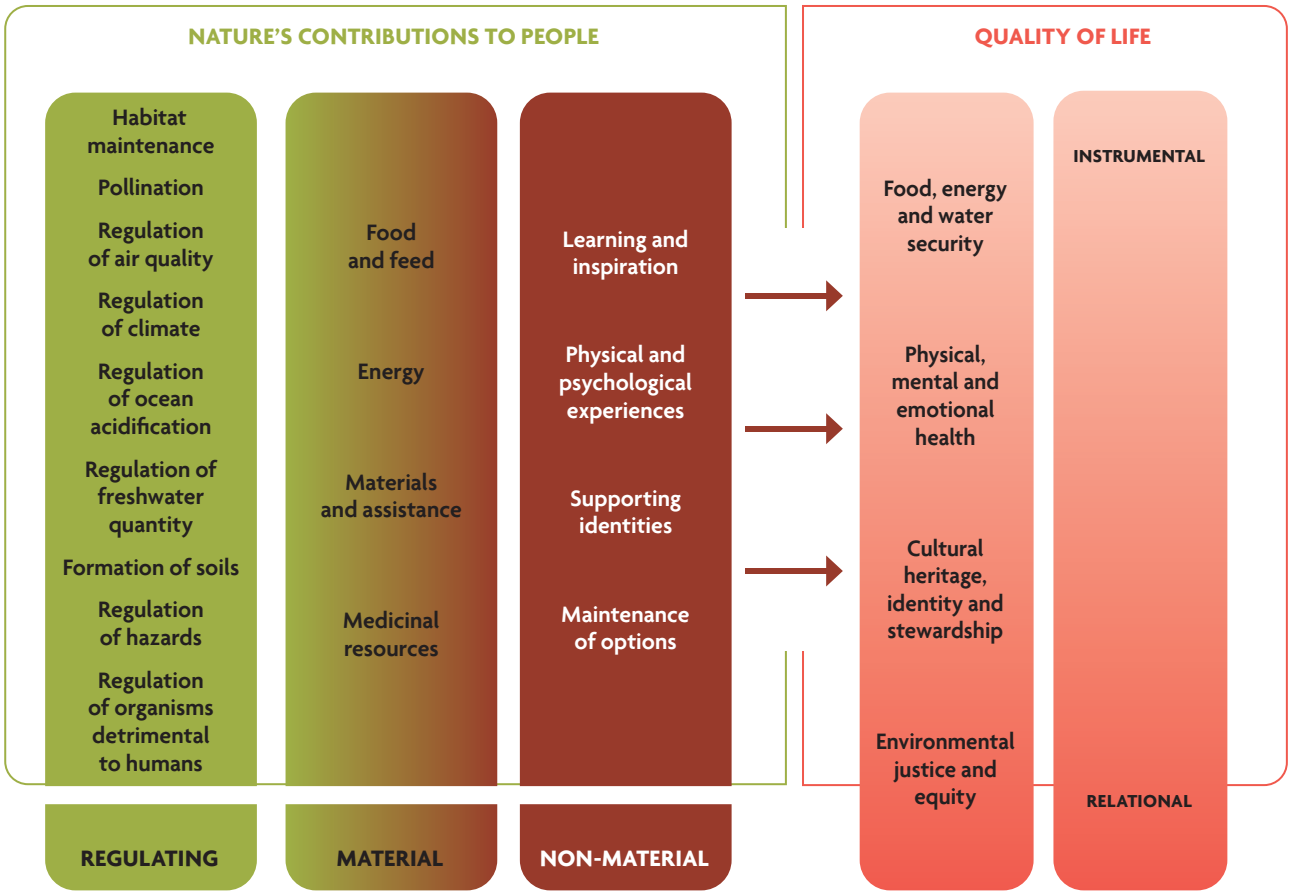
The services provided by an ecosystem extend beyond the ecosystem itself. Ecosystems provide services at different geographical scales, and human activity can benefit from ecosystem services that are sometimes very distant. Take the example of forest ecosystems (see **Figure 11**):

- **Locally produced benefits.** At the local level, the forest influences the formation of soils (e.g. by providing litter), among others.
- **Omnidirectional neighbourhood benefits.** Forest ecosystems can play an important role for neighbouring ecosystems, for example by hosting a number of pollinating species. These species will pollinate neighbouring fields.
- **Directional neighbourhood benefits.** A forest may protect against external disturbances. For instance, mangroves protect coasts from storms.
- **Long distance directional benefits.** The forest ecosystem plays a role at the regional level, in particular by regulating the flow of rivers in the surrounding watershed.
- **Globally distributed benefits.** Finally, large forest ecosystems can provide a global climate regulation service.

People benefiting from the ecosystem services provided by an area (the beneficiaries) often depend significantly on these services, which sometimes come from far away, as shown in **Table 1**.

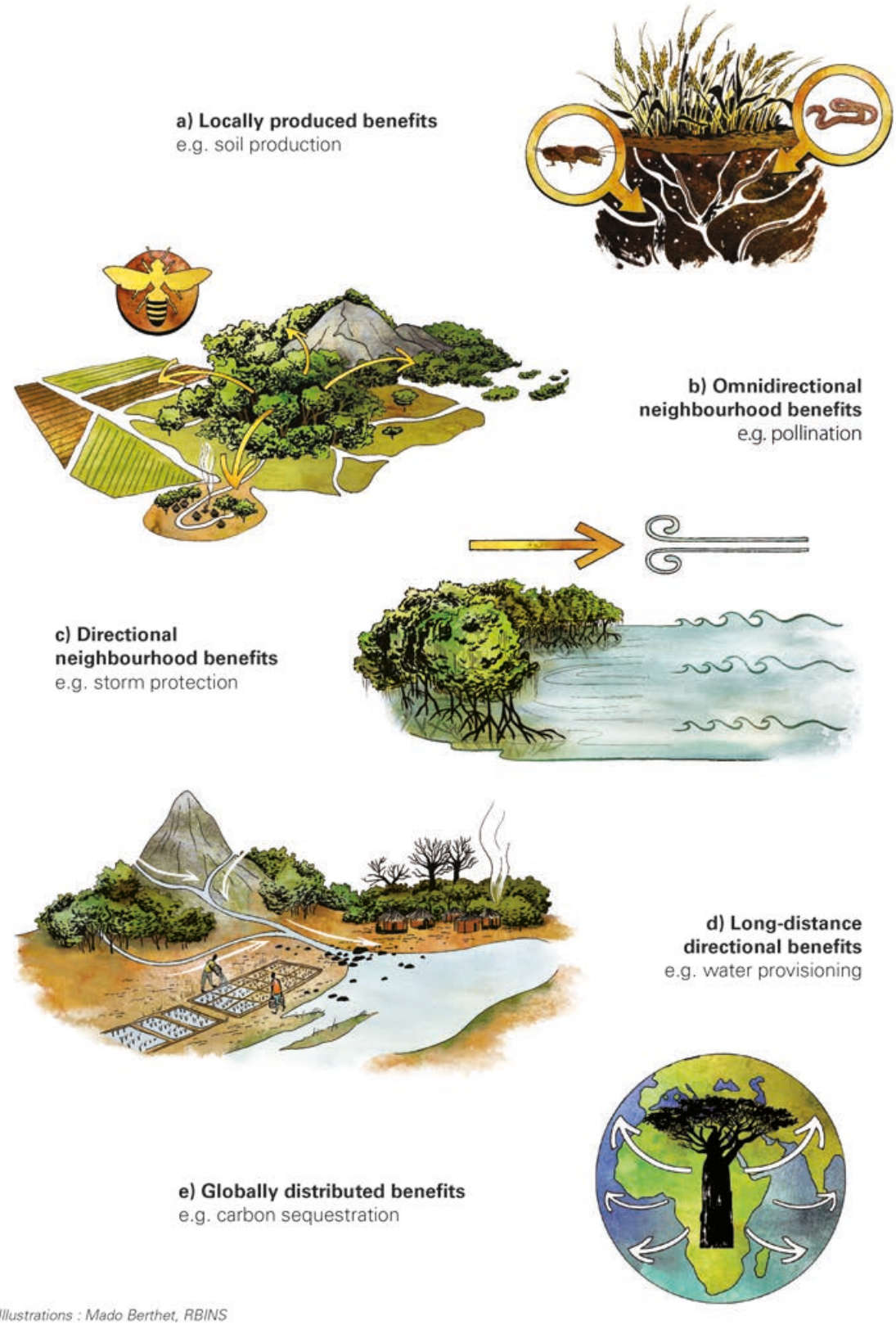
Different stakeholders will have different priorities and vary in the level of their dependency on ecosystem services. People living in and around biosphere reserves are usually **more visibly and directly dependent** on ecosystem services for their livelihood compared to those living in cities or further from natural areas. Therefore, it is essential to consider ecosystem services across different scales when targeting sustainable development and human well-being in biosphere reserves.

**FIGURE 10.**
**NATURE'S CONTRIBUTIONS TO PEOPLE AND THEIR RELATION TO QUALITY OF LIFE IN TERMS OF INSTRUMENTAL AND RELATIONAL VALUES**




*Source:* IPBES (2018b).

**FIGURE 11.**
**CATEGORIES OF ECOSYSTEM SERVICE FLOW IN RELATION TO THEIR SPATIAL CONFIGURATION**




*Source:* adapted from Fisher, Turner and Morling (2009).

**TABLE 1.**
**EXAMPLES OF ECOSYSTEM SERVICES AND THEIR BENEFICIARIES IN THE PENDJARI BIOSPHERE RESERVE, BENIN**

| Ecosystem service | Beneficiaries | Scale | More information |
|---|---|---|---|
| **TOURISM AND RECREATION** | Local population of riparian villages | Local | Local population involved in tourism activities (e.g. local guides) may receive incomes, or park benefits if these are redistributed to the population, or benefit from job creation by the national park. |
| | People from Natitingou | Neighbourhood | Pendjari National Park attracts tourists to northern Benin, thereby developing the tourism industry in Natitingou, the closest town. |
| | Tourists | Global | Tourists can enjoy beautiful scenery and wildlife, or participate in trophy hunting. |
| **WATER SUPPLY** | Local population | Local | The local population uses water for drinking, for cattle and agriculture, and for laundry. |
| | Benin | Long distance | Northern Benin, including the Pendjari Biosphere Reserve, is the source of water for a large part of the country. |
| **FODDER** | Local population | Local | Livestock keeping is the second economic activity around Pendjari National Park. |
| | Pastoralists | Long distance | Pendjari Biosphere Reserve is an important transhumance route, with livestock keepers stopping around the National Park for grazing (and to sell water and cheese to the locals). |
| **CARBON SEQUESTRATION** | People at the global scale | Global | Forest ecosystems contribute to global climate regulation services. |
| **COTTON** | Local communities | Local | Cotton is as an important cash crop around the Pendjari Biosphere Reserve, providing substantial income to farmers. |
| | The state, and outside Benin | Long distance | Cotton is produced around the biosphere reserve, is sold to the state and is exported outside Benin. |
| **CULTURE** | Local communities | Local | The sacred baobabs are linked to the Voodoo religion. |

*Source:* EVAMAB

## Ecosystem services at risk

Biodiversity is declining drastically both at the global and local scale. Human actions have been driving biodiversity loss and ecosystem deterioration, as illustrated in **Figure 12** (Díaz et al., 2019; IPBES, 2019).

IPBES (2019) has identified the five most important direct drivers behind nature degradation (see **Figure 13**).

Those five direct drivers are the result of an array of underlying causes – indirect drivers of change – which are in turn underpinned by societal values and behaviours that include production and consumption patterns, human population dynamics and trends, trade, technological innovations and various governance structures (see **Figure 12**, IPBES, 2019). Key drivers of biodiversity change in Africa, per subregion and ecosystem type, are shown in **Figure 17** (**Box 5**).

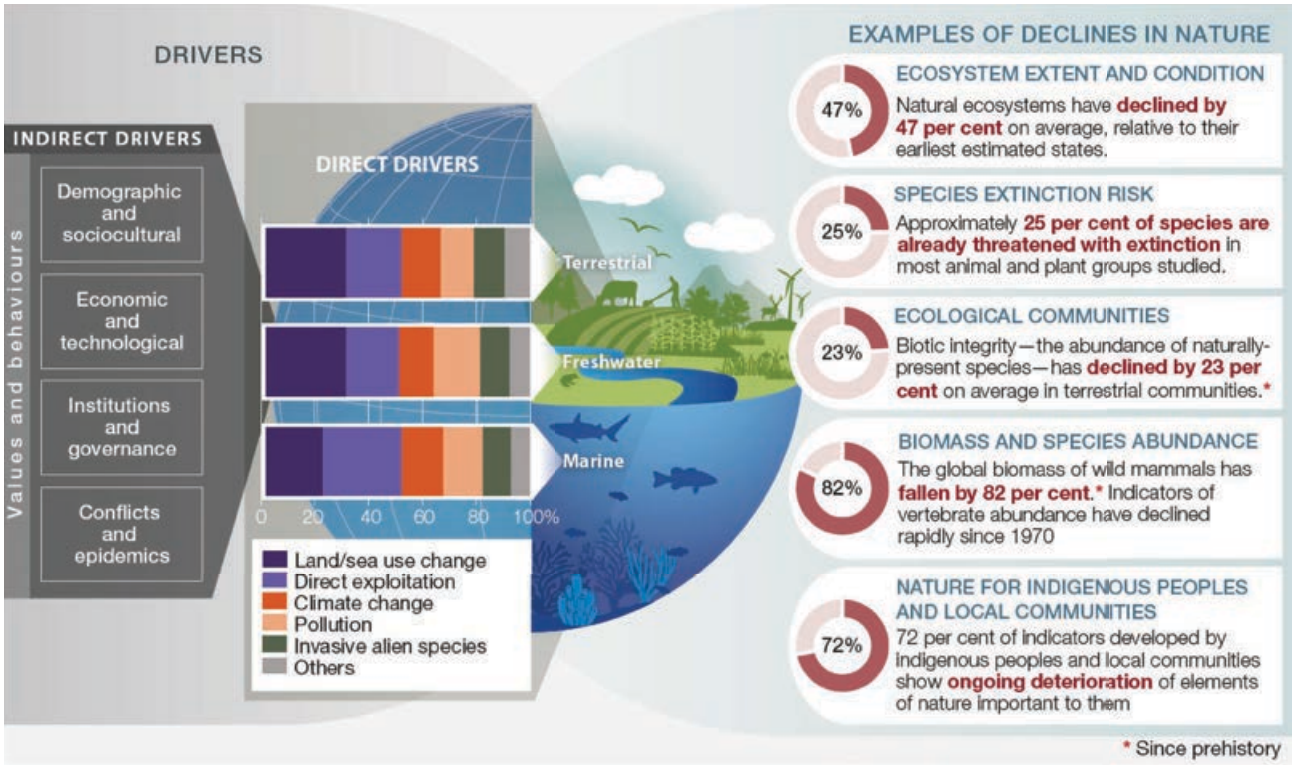
The ability of ecosystems to provide services to society and thus support human well-being is decreasing (**Figure 14 and 15**).

The cultural and natural richness of Africa in terms of biodiversity and ecosystem services, and indigenous and local knowledge, is extraordinary. Across the continent, more than 62% of the rural population is directly dependent on ecosystem services for their survival. Today, 14% of its land and 2.6% of its sea surface are designated as protected areas (IPBES, 2018a).

The true value of ecosystem services is still underappreciated in decision-making. It is therefore essential to transform agricultural practices, improve land-use planning and protect existing natural areas, in order to guarantee food security and human well-being for current and future generations (Tilman et al, 2017). In Africa, where threats to biodiversity are significant owing to a growing population and unsustainable economy, sustainable development is key for the continued delivery of ecosystem services.

> *'Africa is the last place on earth with a significant assemblage of large mammals'*
>
> *IPBES (2018a)*

**FIGURE 12.**
**EXAMPLES OF GLOBAL DECLINES IN NATURE CAUSED BY DIRECT AND INDIRECT DRIVERS OF CHANGE**




*Source:* IPBES (2019).

**FIGURE 13.**
**MAIN DIRECT DRIVERS BEHIND NATURE DEGRADATION**


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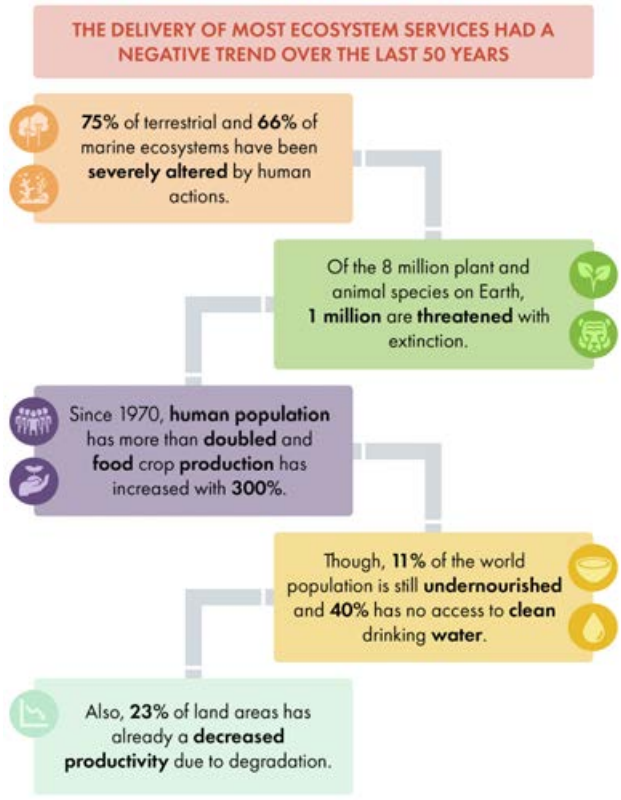
**FIGURE 14.**
**THE DEGRADATION OF NATURE AND ITS VITAL CONTRIBUTIONS TO PEOPLE WORLDWIDE**



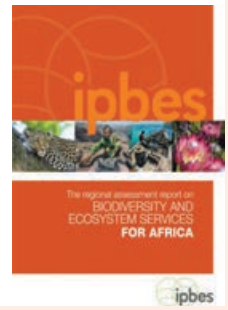

*Source:* IPBES (2018a).

**BOX 5.**
**IPBES REGIONAL ASSESSMENT REPORT ON BIODIVERSITY AND ECOSYSTEM SERVICES FOR AFRICA**

The Africa regional assessment is the first of its kind for the continent and constitutes one of four regional assessments conducted under the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). The assessment is a synthesis of the state of knowledge on biodiversity and ecosystem services. It aims to provide the foundation for a meaningful dialogue across the full range of stakeholders involved in African development.

A number of key thematic challenges are considered by the assessment, including the food-energy-water-livelihood nexus, climate-related risks, land degradation, invasive alien species, sustainable use and technological innovations. By focusing on biodiversity and nature's contributions to people, this regional assessment is critical to African policy-makers, all constituents of African communities, civil society, the private sector and other stakeholders involved in environmentally sensitive investments and land-use decisions.

Two key figures address the economic value of ecosystem services in Africa (**Figure 16**) and key drivers of biodiversity change in Africa (**Figure 17**).




The report is composed of a Summary for Policymakers and six chapters, all of which can be accessed at https://ipbes.net/assessment-reports/africa.

**FIGURE 15.**
**DEGRADING THE ECOSYSTEM AND ITS SERVICES CAN HAVE MAJOR IMPACTS, SUCH AS LANDSLIDES RISKS OWING TO DEFORESTATION – A COMMON ISSUE IN MOUNT ELGON BIOSPHERE RESERVE, UGANDA**

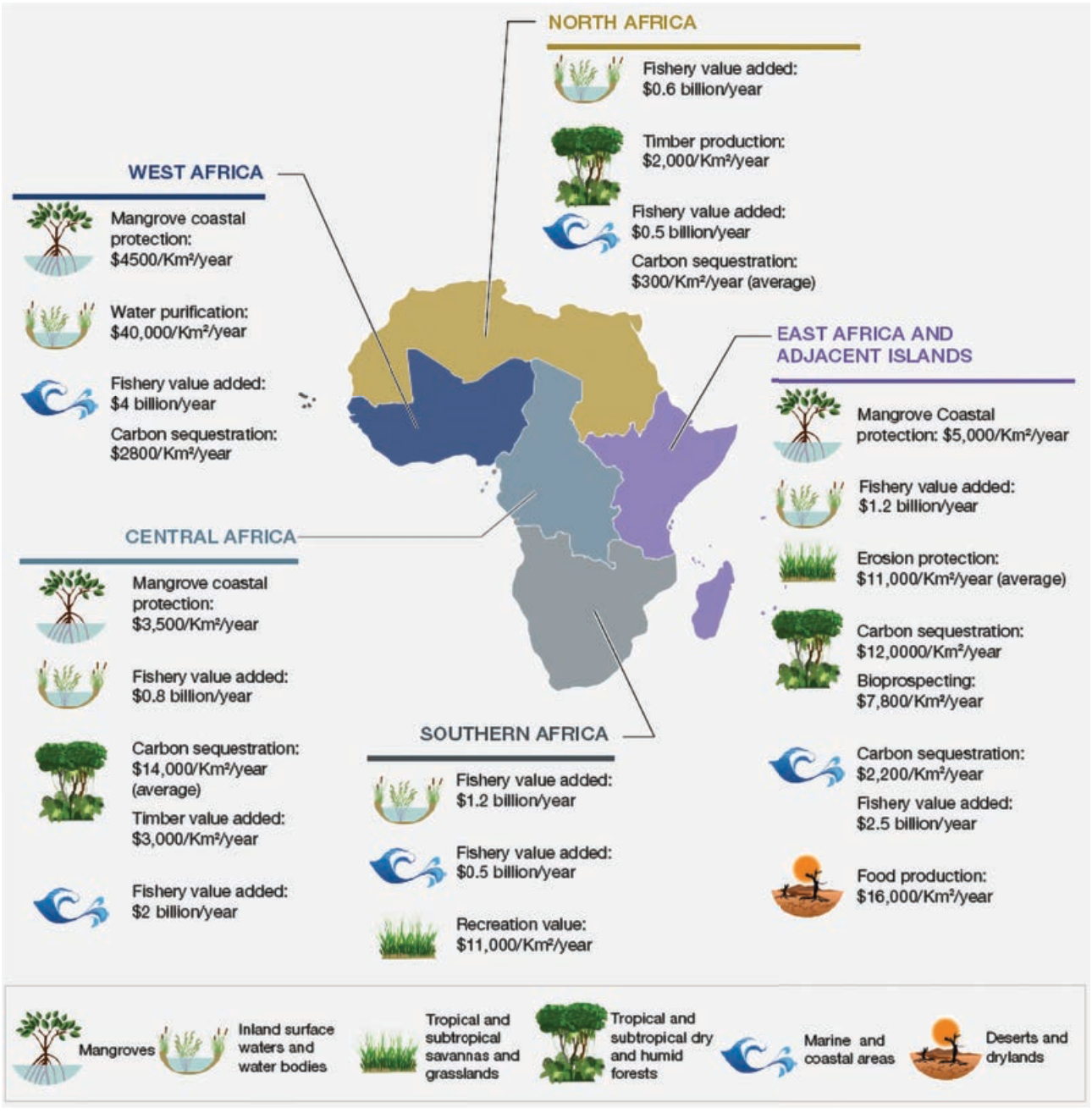
*Illustrations:* Mado Berthet, RBINS

***'Disrespect ecosystem services, and they will punish you'***

*A MAB manager present at the EVAMAB closing workshop*

**Figure 16** provides sample values of some ecosystem services in selected ecosystems (freshwater, marine and coastal areas, and forests) in Africa. One of the key messages is that the true value of biodiversity and nature's contributions to human well-being tends to be underappreciated in decision-making processes in Africa, in particular for non-material and regulating contributions.

**FIGURE 16.**
**INDICATIVE LISTS OF THE ECONOMIC VALUE OF NATURE'S CONTRIBUTIONS TO PEOPLE IN AFRICA**




*Source:* IPBES (2018a).

**Figure 17** presents a general qualitative assessment of the various drivers of change of biodiversity and nature's contributions to people in Africa. It assesses the trend of the impact (high, moderate or low increase) of respective drivers on the various ecosystem types. The thickness of the arrows indicates the level of agreement for the countries sampled for the report (IPBES, 2018a).

**FIGURE 17.**
**KEY DRIVERS OF BIODIVERSITY CHANGE IN AFRICA SHOWN PER SUBREGION AND ECOSYSTEM TYPE**

| SUBREGIONS | ECOSYSTEM TYPE | DRIVERS OF BIODIVERSITY CHANGE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Direct drivers | | | | | | Indirect drivers | |
| | | Climate change | Habitat conversion | Over harvesting | Pollution | Invasive alien species | Illegal wildlife trade | Demographic change | Protected areas |
| Central Africa | Terrestrial/Inland waters | ↗ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↗ |
| | Coastal/Marine | ↗ | ↑ | ↑ | ↗ | ↗ | ↑ | NI | ↔ |
| East Africa and adjacent Islands | Terrestrial/Inland waters | ↑ | ↗ | ↑ | ↗ | ↗ | ↑ | ↑ | ↗ |
| | Coastal/Marine | ↑ | ↗ | ↗ | ↗ | ↗ | ↑ | ↑ | ↔ |
| North Africa | Terrestrial/Inland waters | ↑ | ↗ | ↗ | ↗ | ↑ | ↔ | ↗ | ↗ |
| | Coastal/Marine | ↗ | ↗ | ↗ | ↗ | ↑ | NI | ↗ | ↗ |
| Southern Africa | Terrestrial/Inland waters | ↗ | ↗ | ↑ | ↗ | ↑ | ↗ | ↗ | ↗ |
| | Coastal/Marine | ↗ | ↗ | ↗ | ↗ | ↑ | ↗ | ↗ | ↗ |
| West Africa | Terrestrial/Inland waters | ↑ | ↑ | ↑ | ↗ | ↗ | ↑ | ↗ | ↗ |
| | Coastal/Marine | ↑ | ↗ | ↗ | ↗ | ↗ | ↑ | ↗ | ↗ |

Width of an arrow = level of agreement for countries sampled
Arrow = Trend of the respective impact of the driver

↑ High Increase ↗ Moderate Increase ↗ Low Increase ↓ Decrease **NI** No information available ↔ Unchanged/Under control

*Source:* IPBES (2018a).

# MORE INFORMATION

## Online courses

- Ecosystem Services: a Method for Sustainable Development, Université de Genève, Switzerland
  www.mooc-list.com/course/ecosystem-services-method-sustainable-development-coursera.
- Environmental Challenges: Rights and Values in Ecosystem Services, University of Leeds
  www.futurelearn.com/courses/environmental-challenges-rights-values.

## Other sources

- The IPBES Regional Assessment Report on Biodiversity and Ecosystem Services for Africa
  https://ipbes.net/assessment-reports/africa.
- The Ecosystem Approach: Learning from Experience. G. Shepherd. 2008. Gland, Switzerland, IUCN
  www.cbd.int/doc/external/iucn/iucn-ecosystem-approach-en.pdf.
- The comparison between the concepts of nature's contribution to people and Ecosystem Services: Disentangling 'ecosystem services' and 'nature's contributions to people'. Kadykalo et al., 2019 .
  www.tandfonline.com/doi/full/10.1080/26395916.2019.1669713.
- Ecosystem services in Lake Manyara Biosphere Reserve, Tanzania (video).
  www.youtube.com/watch?v=s1bUmMxwGcU&list=UUp9IYI9IsQjYugUFddS9O4Q&index=10.
- 'Social-ecological assessment of Lake Manyara basin, Tanzania: A mixed method approach'. Janssens de Bisthoven et al., 2020
  www.sciencedirect.com/science/article/pii/S0301479720305272.

# Chapter 2
# Biosphere reserves
## Living laboratories for sustainable development

I. Janssens, E. Bocquet, J. Hugé, L. Janssens de Bisthoven and A-J. Rochette

Contents



Lake Manyara Biosphere Reserve, Tanzania
© L. Janssens de Bisthoven

**RELEVANCE FOR AFRICAN BIOSPHERE RESERVES**

- For biosphere reserves stakeholders, this chapter functions as a good reminder of the objectives of the MAB Programme and the role and structure of biosphere reserves.
- This chapter also emphasizes the extensive range and diversity of the World Network of Biosphere Reserves (WNBR) in terms of ecosystems, social contexts and management types, and highlights its promotion of North-South and South-South collaboration as a unique tool for international cooperation through sharing knowledge, exchanging experiences, building capacity and promoting best practices.
- The chapter further underlines the importance of stakeholders and notes that other biosphere reserves both in Africa and worldwide face similar challenges and share common objectives.
- For non-MAB stakeholders, this chapter can help better understand the **MAB Programme** and its network of biosphere reserves, as well as their specificities.

# THE MAN AND THE BIOSPHERE (MAB) PROGRAMME

The Man and the Biosphere (MAB) Programme was created in 1971. It focuses on studying **interactions between human populations and ecosystems**, in order to ensure both human well-being and the sustainable management of natural resources.

## The MAB network in 2022

The World Network of Biosphere Reserves (WNBR) promotes North-South and South-South collaboration and represents a unique tool for international cooperation through sharing knowledge, exchanging experiences, building capacity and promoting best practices.

- 738 biosphere reserves
- They cover 134 countries, including 90 sites located in 33 African countries (since June 2022).

**FIGURE 18. WORLDWIDE LOCATION OF BIOSPHERE RESERVES IN 2020-21**

*The 2022 map was not available at the time of the publication.

## Biosphere reserves

While recognized internationally, biosphere reserves fall under the sovereign jurisdiction of the states in which they are located. The aim of these sites is to combine the conservation of ecosystems with the sustainable use of natural resources for the benefit of local communities.

They also serve as a model for solutions to promote sustainable development at the regional level, showcasing the possibilities for combining protection of nature with the sustainable development of local communities.

In order to become part of the MAB Programme, biosphere reserves should fulfil **three main integrated functions**:

- **Conservation of diversity** – maintaining the natural diversity of ecosystems and species, genetic diversity and cultural diversity of languages and ethnicities.
- **Sustainable development** – promoting human and economic growth in a sustainable way (fulfilling the current generation's needs without compromising those of the future) (United Nations, 1987).
- **Logistics** – using education, tourism and communication tools like social media, as well as scientific activities such as research and monitoring, to reach all parts of society.

**Why are biosphere reserves important?**

'They are important because they enable managers of biosphere reserves to balance the consumption and the protection of biodiversity. If they were any other national park, we wouldn't even be able to touch the natural resources. This enables sustainable harvesting of the resources by the communities.'

***Fredric Kizza, Chief Warden, Mount Elgon Conservation Area, Uganda***

**What are some of the advantages of joining the World Network of Biosphere Reserves?**

'What is unique with this network is that all those people are struggling to implement sustainable development solutions in their sites. So, we have a common framework, and a ten-year plan on how to improve sustainable development in these sites. Since it's a huge area, if we manage to establish sustainable development approaches in those sites, we believe it will have a huge impact worldwide.'

***Noëline Raondry Rakotoarisoa, UNESCO-MAB***

**BOX 6.**
**UNESCO MAB: MORE THAN BIOSPHERE RESERVES**

The World Network of Biosphere Reserves (WNBR) works to implement the UNESCO MAB Programme in the field. Achieving this involves the efforts of several different but linked entities at the international, national and regional levels.

At the international level:

- The **International Coordinating Council** is the main governing body of the MAB Programme. It comprises 34 Member States and defines the agenda of the MAB Programme.
- The **MAB Bureau** consists of a Chair and five vice-chairpersons from each of UNESCO's geopolitical regions, one of which functions as a rapporteur.
- The **MAB Secretariat** is part of UNESCO Secretariat and is located at UNESCO's Headquarters in Paris. The Secretariat works closely with the different UNESCO Field Offices around the world to coordinate the work of the MAB Programme at national and regional levels.
- Two international bodies provide advice to the MAB Programme: the **International Advisory Committee for Biosphere Reserves** and the **International Support Group (ISG)**.

At the regional level:

- **UNESCO Field Offices** implement the UNESCO's MAB Programme at the regional level. They work in coordination with the MAB Secretariat and serve as focal points for all issues relating to the Programme both at regional and national levels.
- **Regional MAB Networks** have a key role to play in the exchange of information and experience regionally. The MAB regional network in Africa[1] is called AfriMAB, the African Biosphere Reserves Network. It aims at promoting regional cooperation in the fields of biodiversity, conservation and sustainable development through transborder projects, which are based primarily in biosphere reserves.

At the national level:

- **MAB National Committees** ensure maximum national participation in the international programme, defining and implementing each country's activities. Every Member State is invited to establish a permanent and fully functioning national committee.
- Biosphere Reserves.

1 At UNESCO, AfriMAB is the regional group of sub-Saharan countries. Arab States are members of ArabMAB.

## Three zones for different activities

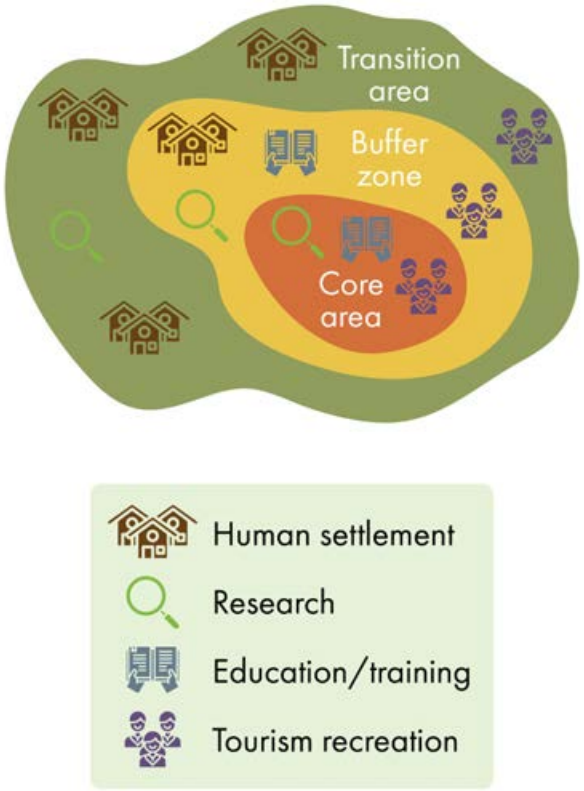
A biosphere reserve is composed of **three zones** (UNESCO, 2017). A zonation plan is mandatory and should be the spatial reference for the management plan of each biosphere reserve.

In order to be designated as biosphere reserve, a site must fulfil certain **general criteria** which can be found back in the Statutory Framework (UNESCO, 1996). The site must:

- contain all representative ecosystems of the region with a gradation of human occupation;
- be of significance for biological diversity conservation;
- provide an opportunity to explore and demonstrate approaches to sustainable development on a regional scale;
- have an appropriate size to serve the three functions of biosphere reserves;
- include these functions through appropriate zonation (see **Figure 19**);
- involve different stakeholders, including local populations and public authorities;
- make provision for
  - **mechanisms to manage human use and activities in the buffer zone(s),**
  - **a management policy or plan for the area as a biosphere reserve,**
  - **a designated authority or mechanism to implement this policy or plan,**
  - **programmes for research, monitoring, education and training.**

Every ten years, the biosphere reserve is subjected to submit a self-assessment known as the **periodic review**. This report is reviewed by the MAB International Coordinating Council in order to assess whether or not the biosphere reserve meets the criteria of the Statutory Framework of the WNBR. The periodic review should detail changes in the biosphere reserve during the reporting period and provide a detailed description of human, physical and biological characteristics, as well as institutional aspects. **Economic valuation and quantification of ecosystem services can serve to show quantifiable changes and trends in their provision.**

**FIGURE 19.**
**ZONATION OF BIOSPHERE RESERVES**




**One - or several - core area(s)**

- **all human activities are prohibited - except non-destructive research and other low-impact uses (education, tourism)**

**The buffer zone surrounding or adjacent to the core area(s)**

- **activities in harmony with the conservation goals are allowed: scientific research, education and low impact tourism**
- **important connectivity function**

**The transition area**

- **focus on the co-living relationship between people and nature (people often live there)**
- **sustainable economic and human development: stakeholders work together to manage and sustainably develop the area's resources**

**BOX 7.**

**HOW TO TAKE ECOSYSTEM SERVICES INTO ACCOUNT WHEN ESTABLISHING A NEW BIOSPHERE RESERVE**

### CATEGORIZING ECOSYSTEM SERVICES IN THE NOMINATION FORM

Ecosystem services assessment tools help to identify the state of ecosystem services in a biosphere reserve, as well as threats and trends (increasing, decreasing, stable). This knowledge can also be translated into a simple categorization of ecosystem services, in order to highlight which services should be priority targets for management and conservation.

These priorities can then be used to make a case for why an area should be nominated as a biosphere reserve, and can be used to help complete the 'Ecosystem Services' section of the nomination form.

### LINKING PRIORITY ECOSYSTEM SERVICES TO BIOSPHERE RESERVE ZONATION

Linking key ecosystem services to the three different zones of the biosphere reserve may help to set zone-specific management goals in the biosphere reserve. For example, in the Pendjari Biosphere Reserve (**Table 1**), key ecosystem services relate to specific zones, suggesting that management should reflect this zonation:

- **Core area** – water provision, safari tourism and research.
- **Buffer zone** – trophy hunting, religious worshipping (e.g. voodoo fetishes) and fodder gathering.
- **Transition area** – agriculture (cotton, food, etc.).

### ASSIGNING KEY ECOSYSTEM SERVICES TO THE THREE BIOSPHERE RESERVE FUNCTIONS MAY ALSO HELP STRUCTURE DESCRIPTIONS OF THESE FUNCTIONS:

- **Conservation function** – the importance of the site for the conservation of biological and cultural diversity at regional or global scales.
  - The main ecosystem services concerned are cultural (e.g. sacred sites) and supporting services (habitats for wildlife).
- **Development function** – this implies securing flows of ecosystem services from the biosphere reserve to foster sustainable economic and socio-cultural development. Knowledge of key ecosystem services is essential to accurately describe this function.
  - Any ecosystem service identified as a priority in the area (ideally following the application of an assessment tool, see **Chapter 3**) may be linked to this function, for example, food and water provision, climate regulation and recreational use (tourism).
- **Logistical support:** support for demonstration projects, environmental education and training, research and monitoring
  - The main ecosystem services concerned are cultural (educational use and research).

**FIGURE 20.**

**EXAMPLE OF A THREAT CATEGORIZATION FRAMEWORK FOR ECOSYSTEM SERVICES: CATEGORIZING ECOHYDROLOGICAL THREATS TO ECOSYSTEM SERVICES, THE ASSESSMENT FRAMEWORK**

| CATEGORY | DEFINITION | THRESHHOLD |
|---|---|---|
| Functionally extinct | Ecohydrological conditions characterising the region are such that ESs are no longer supplied and are practically unrecoverable. | LOST |
| Dormant | Ecohydrological conditions characterising the region are such that ESs are no longer supplied in the region but are potentially recoverable. | |
| Critically endangered | Current levels of demand exceed what the ecohydrology of a region can supply and the ratio of natural capital supply to demand is declining or is expected to decline. | UNDERSUPPLIED |
| Endangered | Current levels of demand exceed what the ecohydrology of a region can supply and the ratio of natural capital supply to demand is stable but supply is declining. | |
| Stable but undersupplied | Current levels of demand exceed what the ecohydrology of a region can supply but neither supply of natural capital nor the ratio of supply to demand is declining. | |
| Vulnerable | Ecohydrological conditions characterising the region are such that the ratio of natural capital supply to demand is declining or expected to decline such that supply is likely to be insufficient to meet demand within a set time horizon. | AT RISK |
| Least Concern | Ecohydrological conditions characterising the region are such that natural capital supply currently meets or exceeds demand, and does not meet the criteria for Vulnerable. | SECURE |

*Source*: Adapted with modifications from Maron et al. (2017:243) and IUCN Red List Classification System

*Gondo* et al., 2019

## BOX 8. HOW TO ADDRESS ECOSYSTEM SERVICES IN PERIODIC REVIEWS

Every ten years, biosphere reserves must undertake a periodic review. These reports are submitted to the MAB Secretariat where they are evaluated resulting in a 'satisfactory' or 'unsatisfactory' judgment regarding the state of the site.

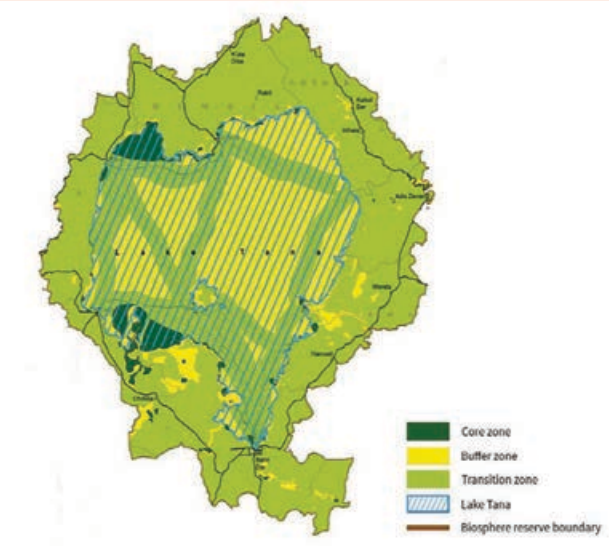
As a soft evaluation tool, the periodic review report has led to improvement in the implementation of the biosphere reserve concept, with a particular focus on design and planning aspects. However, it lacks results-based indicators to measure delivery of objectives linked to the three functions of biosphere reserves: conservation, sustainable development and logistical support.

The periodic reviews consist of ten chapters describing the biosphere reserve, its functions, governance and management, and so on. **Chapter 3** of the review concerns the ecosystem services in the biosphere reserve, their beneficiaries, trends and assessment, as well as their utility in relation to the management plan.

The ecosystem services assessment tools summarized in **Chapter 3** of this manual can help to address all these elements.

## BOX 9. ZONATION OF LAKE TANA BIOSPHERE RESERVE

Each biosphere reserve can determine the activities that are allowed or not allowed in each zone. **Table 2** presents a list of activities that are permitted and prohibited in the different zones of Lake Tana Biosphere Reserve, Ethiopia.




Map: UNESCO, Photo : S. Van Passel

### TABLE 2. ACTIVITIES THAT ARE PERMITTED AND PROHIBITED IN THE THREE ZONES OF LAKE TANA BIOSPHERE RESERVE (2019)

| | PERMITTED | PROHIBITED |
|---|---|---|
| CORE AREA | **Let nature take care of itself**<br>Entering the core area(s) is allowed only for non-destructive activities, such as research (with a special permit from the biosphere reserve authorities). | **Destructive and economic activities**<br>• hunting and removal of wild animals (including their eggs);<br>• cutting, collecting or damaging plants/trees;<br>• lighting fires, smoking, or slash and burn practices;<br>• picking up, taking away or damaging any items, natural or humanmade;<br>• fishing, farming, and livestock grazing;<br>• mineral exploration, digging or sand extraction;<br>• any disposal of waste or other humanmade materials;<br>• any type of construction works; and<br>• damaging, changing or removing any boundary marks of a core area. |
| BUFFER ZONE | **Sustainable use of natural resources (e.g. traditional fishing and organic farming)**<br>• Traditional (seasonal) fishery, organic farming, beekeeping and similar activities;<br>• environmental research and education;<br>• recreation and eco-tourism; and<br>• limited human activity (allowed and often guarded by community management systems and governed by utilization bylaws). | **Harmful and destructive practices**<br>• use of chemical fertilizer and pesticides;<br>• washing of clothes and vehicles near water sources;<br>• (infrastructure) construction (buildings, roads);<br>• mining, drilling and other large-scale earth movement; and<br>• over-use of water and plants (e.g. for grazing). |
| TRANSITION AREA | **All other legal human activities**<br>A focus on sustainable and ecologically sound practices should be favoured and promoted to ensure Lake Tana Biosphere Reserve becomes model region for sustainable development. | **Purely destructive and damaging activities**<br>Activities illegal according to Ethiopian law. |

# CHALLENGES AND STAKES IN BIOSPHERE RESERVES, AND LINKS WITH ECOSYSTEM SERVICES

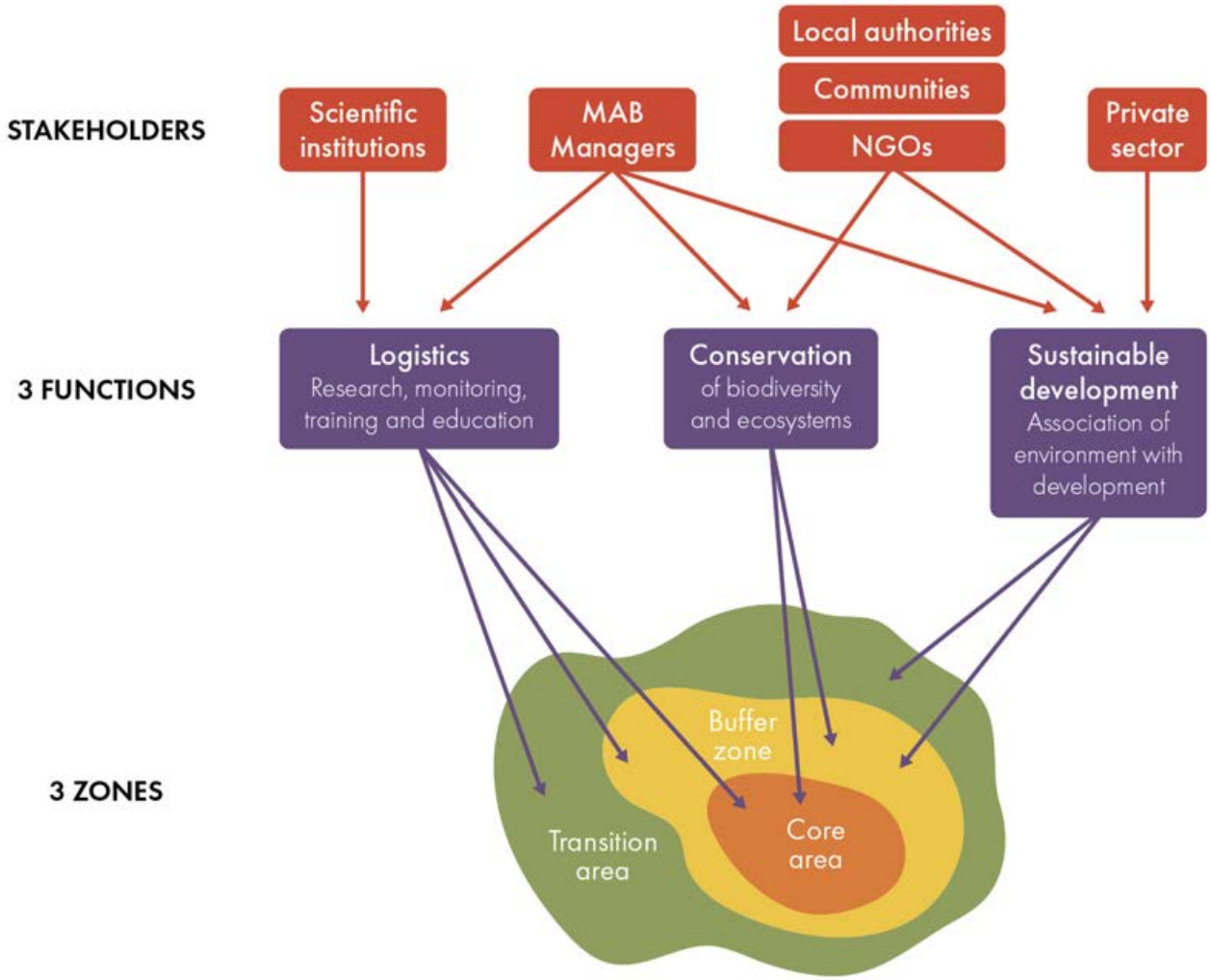
Biosphere reserves may be regarded as 'Sites supporting Science for Sustainability' – learning sites for testing interdisciplinary approaches to understanding and managing changes and interactions between social, cultural and ecological systems, including those related to climate change, ecosystem services and green economies.

## The central role of stakeholders

Conservation only works with people. The people that have a 'stake' in and around a biosphere reserve whether locally or at a distance are the relevant stakeholders – the actors who will conceive and implement this dual purpose of conservation and sustainable development. Stakeholders must therefore be the 'owners' of conservation processes as well as the main beneficiaries and service providers in any conservation effort (see also **Chapter 5**). Many different stakeholders are involved in the varying functions of a biosphere reserve (**Figure 20**).

The ways in which stakeholders interact and influence the functioning of biosphere reserves can be appreciated by examining the different categories of governance and management (**Box 10** and **Table 3**).

**FIGURE 21.**
**ZONATION, THE THREE FUNCTIONS OF A BIOSPHERE RESERVE AND THE STAKEHOLDERS ASSOCIATED WITH EACH OF THESE FUNCTIONS**




*Note:* Main links are indicated but may differ from one biosphere reserve to another.

**BOX 10: DIFFERENT TYPES OF GOVERNANCE AND MANAGEMENT**

Biosphere reserves can be managed in different ways. Management categories and governance types provide substantial information about the characteristics of any area.

| | |
|---|---|
| **Management is about...** | • What is done in pursuit of given objectives<br>• The means and actions to achieve such objectives |
| **Governance is about...** | • Who decides what the objectives are, what to do to pursue them and with what means<br>• How those decisions are taken<br>• Who holds power, authority and responsibility<br>• Who is (or should be) held accountable |

Worboys et al. (2015)

Four main governance types are usually proposed for protected areas, according to the IUCN matrix (see **Table 3**), and may apply to biosphere reserves.

**Top-down governance** describes an approach where governments establish a management board that takes decisions without necessarily involving all stakeholders. This allows for clear and efficient management, but risks not representing the vision of all stakeholders. Conversely, when governance is spread among a plethora of ministries and other institutions, the management vision may become blurred resulting in lower efficiency.

**Public-private partnerships** are established when a government determines the policy but mandates a non-governmental organization to execute day-to-day management. These governance systems are more open than a top-down governance system. In addition, they can provide long-term financial and technical help – a critical issue for African protected areas with underfunding and lack of capacity. However, critics have raised questions about the ethics of delegating law enforcement, the loss of sovereignty of the state and the perception of protected areas being 'sold' to foreigners (Baghai et al., 2018).

**Participatory management** theoretically allows for better representation of local communities on the management board, which can improve the attitude of these communities towards conservation (Mutanga et al, 2015). In their global assessment, IPBES (2019) found protected areas that engage with local communities in management to be on average less degraded. However, a participatory approach with too many stakeholders, or not representative of the community, risks diluting conservation goals and increasing corruption and conflict (Sterling et al., 2017).

Different governance and management structures show varying degrees of success in different areas. The local situation will therefore dictate which structure should be applied.

**TABLE 3.**
**CLASSIFICATION SYSTEM FOR MANAGEMENT CATEGORIES AND GOVERNANCE TYPES**

| | Governance by government | Shared governance | Private governance | Governance by indigenous peoples and local communities |
|---|---|---|---|---|
| MANAGEMENT | Federal or national ministry or agency in charge | Transboundary governance | Conserved areas established and run by individual landowners | Indigenous peoples' conserved areas and territories - established and run by indigenous peoples |
| | Sub-national ministry or agency in charge | Collaborative governance (various forms of pluralist influence) | ...by non-profit organisations | Community conserved areas and territories - established and run by local communities |
| | Government-delegated management (e.g. an NGO) | Joint governance (pluralist governing body) | ...by for-profit organisations (e.g., corporate land owners) | |

*Source:* adapted from Worboys et al. (2015).

## What is the strategy for biosphere reserves at the global level?

There are a number of key documents on historical implementation, monitoring, evaluation and improvement of the Man and the Biosphere Programme (**Figure 22**).

**FIGURE 22.**
**KEY DOCUMENTS, STRATEGIES AND ACTION PLANS OF THE MAN AND THE BIOSPHERE PROGRAMME**


The first action plan established the basics of what it means to be a biosphere reserve.

Approved by the General Conference of UNESCO.

Implemented the Statutory Framework of the World Network of Biosphere Reserves, presenting - among others - the criteria that need to be met to become a biosphere reserve.

Aimed to re-establish biosphere reserves as the main internationally designated areas dedicated to sustainable development in the twenty-first century.

Identified three key challenges of the twenty-first century: urbanization, climate change and biodiversity degradation.

Presented a set of actions aimed at ensuring the effective implementation of the MAB Strategy 2015-2025.

Placed a strong emphasis on thriving societies in harmony with the biosphere for the achievement of the Sustainable Development Goals (SDGs).

## Main challenges in African biosphere reserves

**BOX 11.**
**WHAT ARE THE MAIN MANAGEMENT CHALLENGES IN AFRICAN BIOSPHERE RESERVES?**

During the 2017 meeting of AfriMAB in Nigeria, 22 participants were asked to complete a two-round Delphi survey (following Mukherjee et al., 2015), in order to identify the main management challenges in African biosphere reserves. The results are presented in **Table 4**.

**TABLE 4.**
**MAIN MANAGEMENT CHALLENGES IN AFRICAN BIOSPHERE RESERVES**

| CHALLENGE | CONSENSUS LEVEL |
|---|---|
| Inadequate financial resources | 90% |
| Pressure from human activities | 70% |
| Limited capacity (e.g. human resources) | 55% |
| Unavailability of data to support management | 55% |

'The main one is that some of **the land is privately owned**, but it's under the national park's authority. The other land is owned by big investors, so making everyone respect the policies in place is difficult. There are contradictions between one operator, and the other. So it becomes very complicated to manage the natural resources.'

**Dr Noelia Myonga, Senior Assistant Conservation Commissioner, Lake Manyara National Park (Lake Manyara Biosphere Reserve, Tanzania)**

'Institutional challenges like **capacity and institutional organizations**. For example, in Ethiopia, the MAB National Committee is established to communicate with UNESCO and to decide on issues of biosphere reserves such as nominations or action plans. The challenge is that, so far, in Ethiopia, there is no formalized institutional structure within the government sector. The MAB Committee alone won't be successful in managing the biosphere reserve unless sectorial offices have their own structure at the federal and regional governments.'

**Motuma Didita, Ethiopian MAB Committee**

'There is no proper **land use system** around the biosphere reserves. People are in a hurry to develop, so they end up encroaching on areas that should have been conserved. This is coupled with high population density and poverty around these biosphere reserves.'

**Fredric Kizza, Chief Warden, Mount Elgon Conservation Area (Mount Elgon Biosphere Reserve, Uganda)**

**BOX 12.**
**CHALLENGES IN THE LAKE TANA BIOSPHERE RESERVE, ETHIOPIA**

Lake Tana is the largest aquatic resource of Ethiopia and the source of the Blue Nile River. The Lake Tana basin and the Blue Nile River also provide economic, social, political, environmental, ecological and religious benefits for downstream eastern Nile countries. However, they face many challenges, especially related to food security and environmental sustainability.

**AERIAL VIEW OF LAKE TANA BIOSPHERE RESERVE AND THE BLUE NILE OUTFLOW, ETHIOPIA**

© L. Janssens de Bisthoven

The various ecosystems and services are under severe pressure from the following processes:

- soil erosion and land degradation due to overgrazing, deforestation, unsustainable agricultural practices and wetland degradation;
- uncontrolled agricultural expansion to the lake's zone;
- illegal fishing and unregulated overfishing;
- increased trend of eutrophication due to increasing use of fertilizers;
- risk of toxic bioaccumulation in plants and animals of pesticides from agriculture and construction materials;
- environmental pollution, especially domestic and industrial wastes from the growing urban population (Bahir Dar), leading to reduced water quality and diminished possibilities of irrigation with freshwater from the lake during the dry season;
- increasing rainfall variability causing droughts and floods; and
- invasive plants such as the Water Hyacinth.

Root causes of threats include:

- socio-economic and environmental shortcomings such as poverty and population pressures;
- shortage of agricultural land derived from increased human and livestock populations;
- low awareness among communities of ecosystem conservation;
- institutional shortcomings (i.e. giving high priority to short-term economic benefits rather than sustainability issues, including the construction of buildings in the Lake shore areas, which are natural breeding and feeding grounds for certain fish and bird species);
- poor legal enforcement;
- poor organizational and institutional linkages; and
- lack of action research and knowledge building.

*Source:* Michael Succow Foundation (2012); Berihun (2019); Goshu and Aynalem (2017)

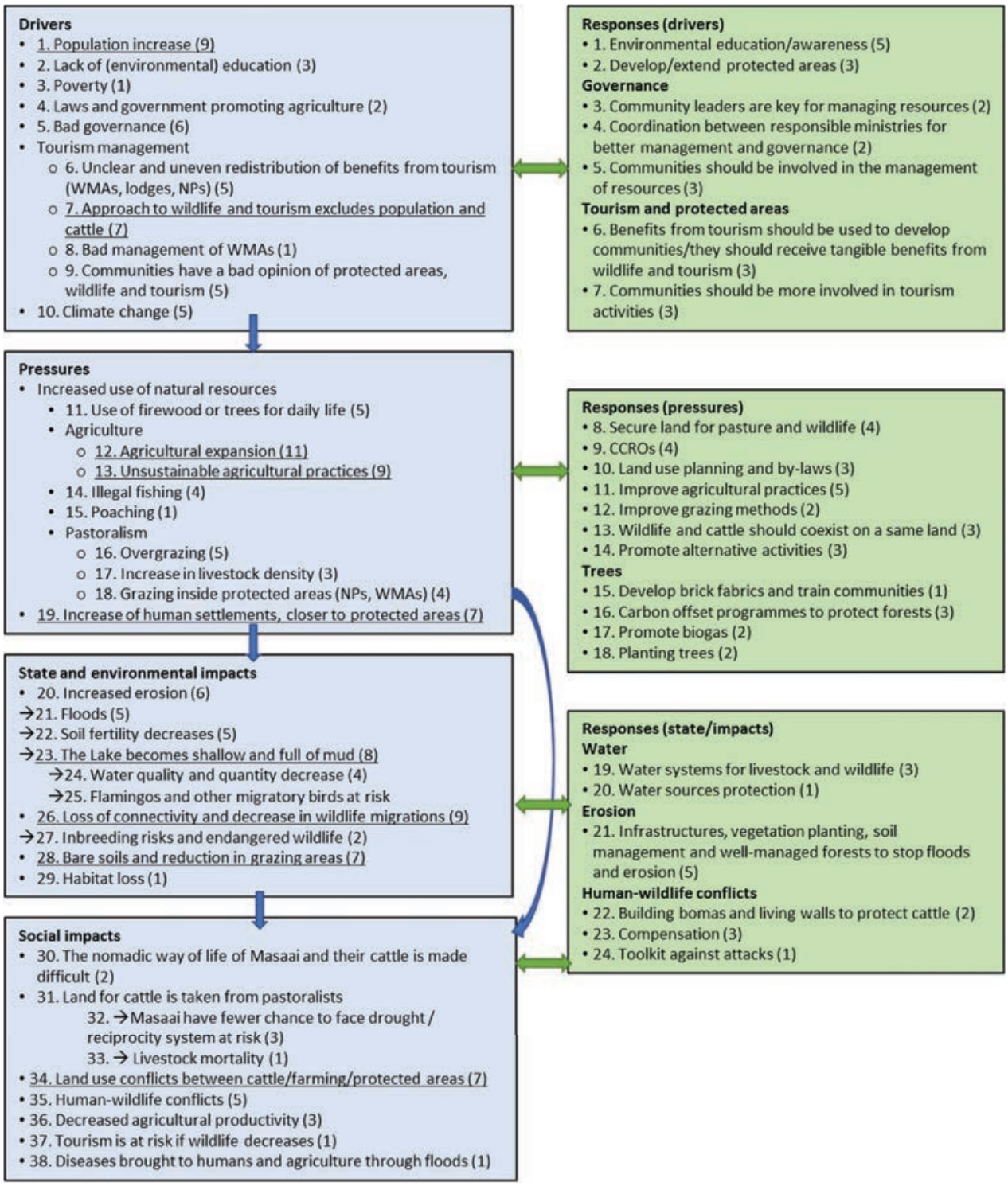
**BOX 13.**
**VISUALIZING THE CAUSE-EFFECT CHAIN OF ENVIRONMENTAL CHALLENGES IN BIOSPHERE RESERVES: THE DPSIR FRAMEWORK**

Structuring the challenges that occur in a biosphere reserve into an organized framework may help to better understand their cause-effect chain and existing or potential solutions. The Drivers-Pressures-State-Impact-Response (DPSIR) framework is an analysis approach that describes the interactions between society and the environment. It consists of five interrelated factors:

- **Drivers** – changes in the social, economic and institutional system that directly and indirectly trigger pressures on the environmental state
- **Pressures** – anthropogenic factors inducing environmental change
- **State** – this may range from the characteristics of ecosystems, the quantity and quality of resources, living conditions for humans, to even larger socio-economic issues
- **Impact** – changes in environmental functions affecting social, economic and environmental dimensions, which are caused by changes in the state of the system
- **Response** – actions attempting to prevent, eliminate, compensate or reduce the impacts.

The DPSIR framework may help to identify important relationships and reveal underlying problems. **Figure 23** shows an example for Lake Manyara Biosphere Reserve, based on answers from interviews about environmental challenges in the area (Janssens de Bisthoven et al., 2020).

**FIGURE 23.**
**RESPONSES FROM INTERVIEWS ABOUT ENVIRONMENTAL CHALLENGES IN LAKE MANYARA BIOSPHERE RESERVE, TANZANIA, STRUCTURED USING THE DPSIR FRAMEWORK**




*Note:* The numbers represent responses. Arrows refer to a causality relationship. Green double arrows link responses ('R') to a corresponding 'DPSI' category.

## MORE INFORMATION

- Biosphere reserve nomination form
  www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/biosphere_reserve_nomination_form_2013_en.pdf.
- For official UNESCO MAB documents such as nomination forms, periodic review form, MAB guidance and policies, see
  www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/related-info/publications/mab-official-documents.
- Charter of the African Biosphere Reserves Network (AfriMAB)
  www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/Final_Charter_AfriMAB_en.pdf.
- MAB Governance https://en.unesco.org/mab/governance.
- An example of a completed periodic review
  www.keskkonnaamet.ee/sites/default/files/periodic_review_2015_toim2017.pdf.
- Protected Areas Governance and Management (IUCN compendium textbook)
  https://press.anu.edu.au/publications/protected-area-governance-and-management.
- Protected area governance and management A resource book for practitioners in development cooperation (GIZ publication)
  https://www.snrd-africa.net/protected-area-governance-and-management.
- ENVISION project: developing an inclusive approach to the management of protected areas, known as 'inclusive conservation', with the aim of improving biodiversity and human well-being
  https://inclusive-conservation.org.
- 'UNESCO–MAB Biosphere Reserves already deal with ecosystem services and sustainable development' (PNAS)
  www.pnas.org/content/pnas/114/22/E4318.full.pdf.
- The World Network of Biosphere Reserves (WNBR)
  https://en.unesco.org/biosphere/wnbr.
- Video about the importance of biosphere reserves:
  www.youtube.com/watch?v=RDVsJJmjUsk&t=20s.

# Chapter 3
# Ecosystem services assessment tools

J. Hugé, L. Janssens de Bisthoven,
I. Janssens and A-J. Rochette

Contents



Ecosystem services ranked by the inhabitants of Bushiyi, located next to the Mount Elgon Biosphere Reserve
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**RELEVANCE FOR AFRICAN BIOSPHERE RESERVES**

- In order to improve evidence-based management and the livelihoods of local populations, biosphere reserve managers need to **identify the ecosystem services** delivered by their site and ensure their long-term provision. Ecosystem services assessments contribute directly to local policy-making. Insight into the state and flux of these services, their use and the risks they face, is key for sustainable management (Maron et al., 2017).
- Greater appreciation of the potential of ecosystem services for management and socio-economic integration may help better protect biosphere reserves and their biodiversity for future generations. An **assessment of the social and economic values of ecosystem services** can provide important leverage to safeguard and manage biosphere reserves and their ecosystem services in multiple ways, acknowledging the interests of a wide range of stakeholders.
- Moving from scientific knowledge and societal awareness about ecosystem services to effective real-world decision-making and impact remains a challenge. **Well-founded methods exist** to assess and map ecosystem services, and help their contributions to human well-being become systematic, quantifiable, robust and credible (Bagstad et al., 2013). This chapter presents a selection of widely applicable, rapid and affordable tools to assess multiple ecosystem services. The selected tools were considered the most suitable for the context of African biosphere reserves, building on the expectations of members of the AfriMAB network.
- To aid selection of the most suitable tool for a particular context, the chapter presents an overview of the selected tools, a series of visualizations highlighting the main components of each selected assessment tool and a decision tree.
- Various **case studies** also illustrate how the tools have been **applied in different biosphere reserves**, and the key outcomes that resulted.

## WHAT ARE ECOSYSTEM SERVICES ASSESSMENT TOOLS, AND WHAT ARE THEY FOR?

This chapter offers a brief introductory guide to ecosystem services assessment tools, and provides a guide for prospective users to select the tool most appropriate for their goals. The approach to tool description and selection is based on a combination of user preferences and an in-depth analysis of the literature (see **Box 14**).

While ecosystem services are now recognized as a useful concept for the sustainable management of biosphere reserves, the question of how to actually translate this concept into action remains unanswered. What is the best method to collect ecosystem services data? How should these data be used and interpreted? How can they be translated into relevant information for biosphere reserve managers and other stakeholders? Many ecosystem services assessment tools have been developed to address these questions. These diverse tools typically cover a range of ecosystem services, and include and integrate many different methods. Despite their number and diversity, they all share at least one of the following objectives:

- They **collect** ecosystem services data.
- They **integrate** various methods, disciplines and sources of knowledge regarding ecosystem services.
- They **synthesize** ecosystem services information in a user-friendly manner.
- They **communicate** ecosystem services data to various stakeholders.

Scientifically robust methods to assess ecosystem services exist, but remain insufficiently known, used and communicated (Maes et al., 2013; Ruckelshaus et al., 2015). Many ecosystem services assessment tools have been developed in recent years, yet their applicability and user-friendliness are often context, site and user-specific.

Moreover, their application is often limited owing to high demands for data, skills, time and resources. In order to structure and understand the diversity of these tools, some authors have performed reviews to classify these methods and analyse their trade-offs (see Bagstad et al., 2013; Grêt-Regamey et al., 2017; Hugé et al., 2020; IUCN, 2018; Pandeya et al., 2016).

In short, ecosystem services assessment tools are meant to translate the booming scientific interest in ecosystem services into management-relevant decision support (**Figure 25**).

This means that ecosystem services assessment tools must be able to guide, or at least offer advice to managers dealing with complex interactions between nature and humans – a mandatory feature of any biosphere reserve.

**FIGURE 24.**
**INTER-CONNECTED OBJECTIVES OF ECOSYSTEM SERVICES ASSESSMENT TOOLS**

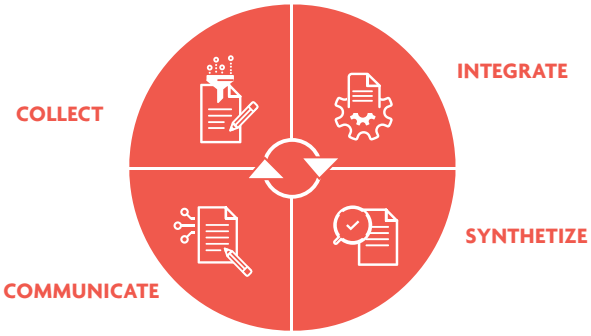
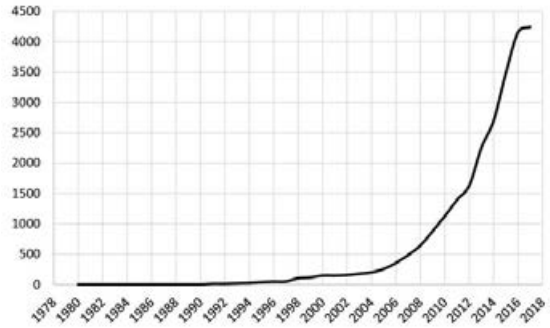


**FIGURE 25.**
**EVOLUTION OF THE NUMBER OF CITATIONS ON THE TOPIC 'ECOSYSTEM SERVICES' IN WEB OF SCIENCE BETWEEN 1980 AND 2017**




*Source:* Van der Biest, 2018.

In a marine environment:

- Fishers interact, with larger boats and smaller boats targeting different species, at varying times, in a shared space. Management and coordination are needed to avoid conflict and to ensure the smooth and sustainable use of natural resources (fish).
- Below the surface, different fish species also interact as part of food webs, with some fish preying on others, and different species using the ocean habitat in different ways.
- Finally, harvesting activities link the human system (fishers and their boats) with the natural system (the fish in their ocean habitat).

Thus, even an apparently simple system contains complexity. Ecosystem services assessment tools need to clarify which ecosystem services will be impacted by the above fisheries system. This means providing information about how the species interact, how the fisheries impact these species, how management can manage these impacts and so on. The tools also need to synthesize all necessary information to enable biosphere reserve managers, management entities and other relevant stakeholders to make sound and sustainable decisions.

We now know in general terms what ecosystem services assessment tools are for, but in order to have a clear view about what biosphere reserves stakeholders expect, we need to fine tune the objectives of these tools, so as to align them with the specificities of biosphere reserves (**Box 14**).

## WHAT ARE THE REASONS FOR USING (AND NOT USING) ECOSYSTEM SERVICES TOOLS?

During the EVAMAB closing workshop held in Ethiopia in 2019, following a presentation of different ecosystem services assessment tools presented in this chapter, various MAB managers, decision-makers and scientists debated the reasons for and against their use. Their discussions are summarized in **Table 6**:

**BOX 14.**
**WHAT DO BIOSPHERE RESERVE STAKEHOLDERS EXPECT FROM ECOSYSTEM SERVICES TOOLS?**

During the 2017 AfriMAB meeting held in Ibadan, Nigeria, all participants were asked to complete a two-round Delphi survey (following Mukherjee et al., 2015), in order to identify preferences regarding the purposes, characteristics, inputs and outputs of ecosystem services tools. The results are presented in Table 5.

**TABLE 5.**
**CONSENSUS-DESCRIPTORS OF ECOSYSTEM SERVICES TOOLS**

| Tool descriptors | | Consensus level among stakeholders (in %) |
|---|---|---|
| **Purpose** | Awareness raising and education | 70 |
| | Describing ecosystem services | 65 |
| | Monitoring and evaluating ecosystem services | 65 |
| | Identifying opportunities | 55 |
| **Characteristics** | Ability to assess multiple ecosystem services | 60 |
| | Low expertise requirement | 55 |
| | Easily communicable results | 55 |
| **Outputs** | Quantitative outputs | 53 |
| | Economic valuation of ecosystem services | 58 |
| **Inputs** | Maps | 78 |
| | Quantitative inputs | 83 |
| | Qualitative inputs | 61 |

*Source:* EVAMAB team.

**TABLE 6.**
**THE MAIN REASONS FOR USING AND NOT USING TOOLS FOR THE RAPID ASSESSMENT OF ECOSYSTEM SERVICES**

| Why use such tools? What are their positive aspects? | Why are such tools not used? What are their negative aspects? |
|---|---|
| • Such tools provide step-by-step approaches and are well documented **(user friendly)**.<br>• Most of them require **stakeholder involvement**.<br>- They offer a chance for all involved to contribute and strengthen the link between stakeholders.<br>- They raise awareness about ecosystem services allowing stakeholders to appreciate the value of particular resources.<br>• They provide a **clear picture** of the quantity and quality of ecosystem services to local communities.<br>• Most of them are customizable to a specific situation.<br>• They give **legitimacy** to the results (the tools are developed by experts and are used internationally).<br>• They help show biosphere reserve managers that they are part of a **global agenda** (CBD, MAB network, Lima action plan).<br>• The results have **multiple uses** (beyond the local context), including assessment of ecosystem services, impacts on decision-making/management plan, and inputs to national biodiversity reports, CBD reports and MAB reports. | • They are **unknown**.<br>• People already have enough information.<br>• Insufficient time – biosphere reserve managers are too busy.<br>• Lack of **capacities/skills** to apply the tools.<br>• They are **not used in everyday life**, but only when dealing with a specific issue.<br>• If not interpreted adequately, they might have **negative consequences**, for example on non-priority ecosystem services. It is therefore essential to be aware of the interpretation, significance and limitations of the data.<br>• Some tools are **too general** and may not be applicable to a specific site (they may need to be customized – also cited as a positive point).<br>• There is a risk of **under/over economic evaluation** (see Chapter 4). |

*Source:* EVAMAB (2019).

This manual, and more specifically the present chapter, aims to overcome some of the issues raised in the right-hand column of **Table 6**, by providing a selection of the most suitable rapid tools for the specific context of African biosphere reserves.

Other points that were raised about the use of such tools included the following:

- Perceptions may lead to results that do not reflect reality. This is why complementary tools are important.
- The process should be an iterative one, with participants reflecting on the results and adapting the process accordingly. However, care should be taken not to overburden communities and stakeholders with research.
- On the base of recommendations, MAB managers should aim to use such tools at least once (e.g. for their periodic review), to become familiar with the concept and their use.
- The use of such tools should be clearly linked to the objectives and management of the biosphere reserve.

**BOX 15.**
**TOOL OR METHOD? WHAT'S IN A NAME?**

There are many ways of describing, measuring and understanding ecosystem services – and a variety of tools to this end. These tools differ in terms of the questions they ask, the way they are applied and the things they can do. They range from checklists, online interfaces and manuals to modelling software. This manual does not propose an all-encompassing, hypothetically 'correct' definition of ecosystem services assessment tools. Instead, it defines an **ecosystem services assessment tool** as:

***'Any range of data-collection approaches that are used and presented together, with the aim of providing synthetic information to a non-scientific audience regarding ecosystem services'.***

All these **ecosystem services tools** have been influenced by, are linked to, or simplify existing scientific **methods** and approaches. While a tool typically has a hands-on, pragmatic approach aimed at producing directly applicable information, a (scientific) method is a way to gather information in a systematic and repeatable manner. Ecosystem services tools often combine and integrate different methods as part of a coherent 'package'. The integration of natural and human sciences is a key characteristic of the field of ecosystem services. This inter-disciplinary integration is at the centre of many assessment tools, creating many opportunities as well as challenges for the users of such integrative tools.

**Box 17** provides an introduction to a selection of conservation social science methods, which can be embedded into, or used together with ecosystem services assessment tools. Practical examples of the applications of these methods are provided in **Boxes 16-18.**

# HOW TO SELECT THE RIGHT ECOSYSTEM SERVICES TOOL

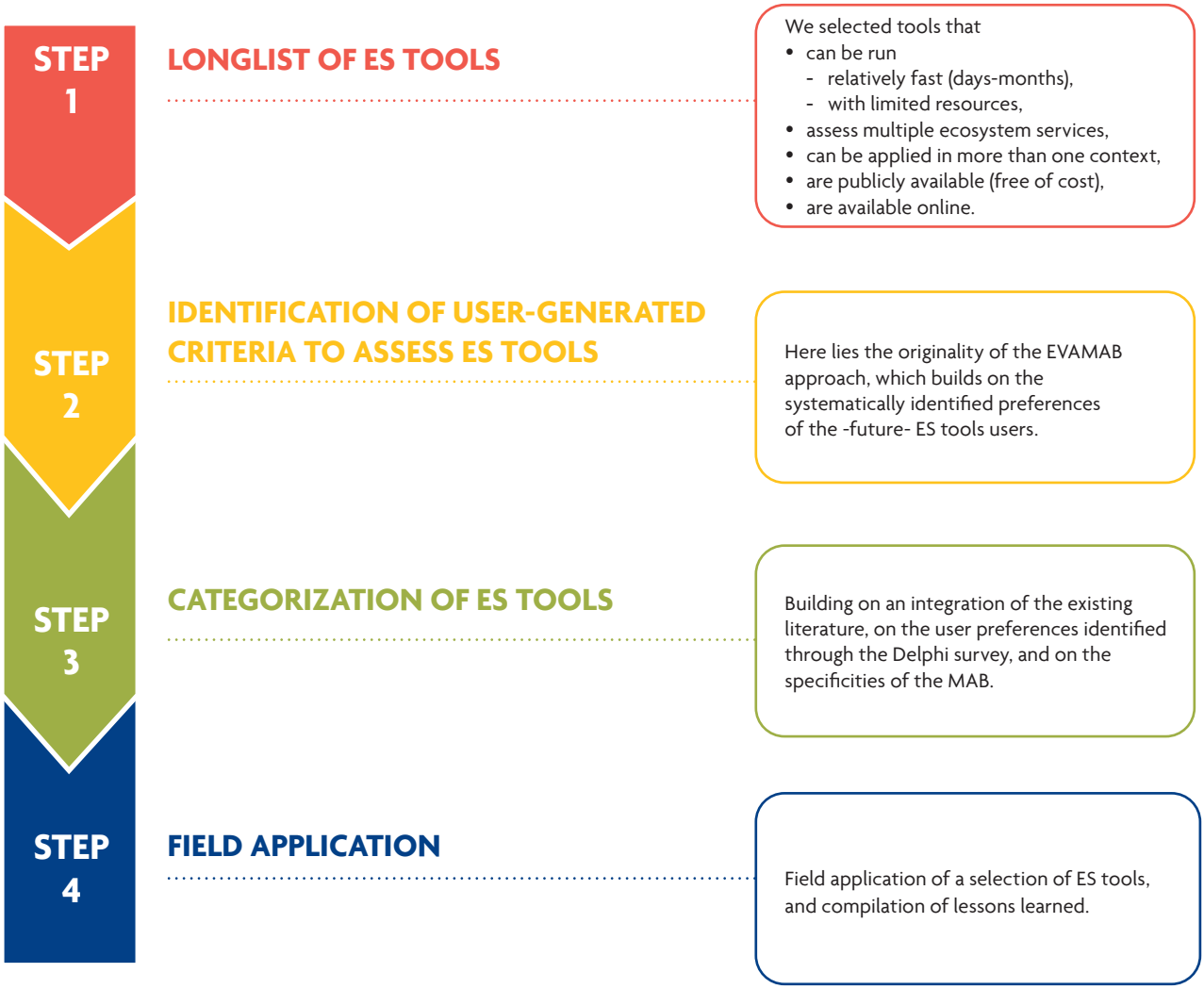
Although a wealth of ecosystem services tools have been developed, their application is often limited. As stated in **Table 6**, this can be due to unrealistic data requirements, a lack of specialized skills and/or lack of financial, human and time resources to apply these tools in the field, and/or to inappropriate scope (mismatch between users' needs and what the tool(s) can offer). **This manual aims to reduce these mismatches between user demand and ecosystem services tool offer**. We aim to support the user in navigating the ever-changing landscape of ecosystem services tools.

This section provides guidance on two main challenges:

- Which ecosystem services tools exist?
- How to select an ecosystem services tool?

In order to respond to these challenges, the section first outlines the approach adopted in the EVAMAB project.

**FIGURE 26.**
**STEPS FOLLOWED BY EVAMAB TO SELECT AND APPLY ECOSYSTEM SERVICES RAPID ASSESSMENT TOOLS SUITED TO AFRICAN BIOSPHERE RESERVES**



## WHICH ECOSYSTEM SERVICES TOOLS EXIST?

Tools selected as the most suitable for the rapid assessment of ecosystem services in African biosphere reserves are summarized in the table below (for full information see Hugé et al. 2020), using the following key:

| TIME | INPUT | SKILLS | OUTPUT | ECOSYSTEM SERVICES CATEGORY |
|---|---|---|---|---|
| Days-weeks | Spatial data | Geographic Information System (GIS) | Qualitative data | Supporting services |
| Weeks-months | Field sampling | Field ecology | Quantitative data | Regulating services |
| Months-year | Stakeholder-based input | Stakeholder involvement | Spatial data | Provisioning services |
| | Available data | | Economic values | Cultural services |

**TABLE 7.**
**DESCRIPTION OF ECOSYSTEM SERVICES ASSESSMENT TOOLS**

| TOOL | INPUT | SKILLS INVOLVEMENT | OUTPUT | ECOSYSTEM SERVICES | PURPOSE |
|---|---|---|---|---|---|
| A Geographic Information Systems-based LUC change model (GEOMOD)<br>(Estoque and Murayama, 2012) | | | | | • Modelling land use/cover changes between two time periods |
| ARIES Artificial Intelligence for ecosystem services<br>(Bagstad et al., 2011; Villa et al., 2009) | | | | | • Modelling and mapping ecosystem services flows and distribution of beneficiaries<br>• Comparison between different scenarios (e.g. climate, land use, etc.) |
| CLIMSAVE Integrated Assessment (IA) Platform<br>(Harrison et al., 2015) | | | | | • Undertaking impact prediction of climate change and vulnerability<br>• Identifying adaptation strategies and their cost-effectiveness |
| Co$ting Nature (C$N)<br>(King's College London, 2018) | | | | | • Mapping ecosystem services<br>• Assessing impact of policy or future scenarios on ecosystem services<br>• Prioritizing areas for conservation |
| Ecosystem Services Review<br>(Hanson et al., 2012) | | | | | • Identifying business dependencies, risks and opportunities related to ecosystem services |

| TOOL | INPUT | SKILLS INVOLVE-MENT | OUTPUT | ECOSYSTEM SERVICES | PURPOSE |
|---|---|---|---|---|---|
| Ecosystem Services Review for Impact Assessment<br>  <br>(Landsberg et al., 2014) |  |  |  |  | • Identifying dependencies and impacts of a project on priority ecosystem services<br>• Identifying options to mitigate negative project impacts |
| ESP-VT Ecosystem Services Partnership Visualization Tool<br>  <br>(Drakou et al., 2015) | (visualization tool) |  |  |  | • Visualizing existing information about ecosystem services in an area |
| Green Infrastructure Valuation Toolkit (Green Infrastr. VT)<br>  <br>(Natural Economy Northwest et al., 2010) |  | |  |  | • Preparing, assessing and reporting on the value of a 'green' asset or investment<br>• Comparing project options<br>• Supporting and mainstreaming of green infrastructure |
| Interdisciplinary Decision Support Dashboard (IDSD)<br>  <br>(Fegraus et al., 2012) |  | |  |  | • Visualizing state and dynamics of natural resource and agricultural metrics and indicators; decision support |
| InVEST Integrated Valuation of Ecosystem Services and Tradeoffs<br>  <br>(Tallis et al., 2013) |  |  |  |  | • Mapping ecosystem services<br>• Supporting spatial planning and conservation strategies<br>• Comparing scenarios<br>• Undertaking impact assessment |
| i-Tree Eco. Tools for assessing and managing forests & community trees<br>  <br>(USDA, 2015) |  |  |  |  | • Providing baseline data to influence decision-making; capacity building for small stakeholders<br>• Improving forest management |
| MARXAN and MARXAN with zones<br>  <br>(Ball et al., 2009) |  |  |  | Any ecosystem service that can be modelled spatially | • Identifying areas suitable for conservation<br>• Providing information about cost-effective conservation alternatives<br>• Assessing the performance of existing reserves<br>• Identifying alternative management options |
| PA-BAT The Protected Areas Benefits Assessment Tool<br>  <br>(Dudley and Stolton, 2009) |  |  |  |  | • Identifying benefits provided by Protected Areas |

| TOOL | INPUT | SKILLS INVOLVE-MENT | OUTPUT | ECOSYSTEM SERVICES | PURPOSE |
|---|---|---|---|---|---|
| Simulation of Terrestrial Environments (SITE)<br>(Helmholtz Centre for Environmental Research-UF, Leipzig) |  |  |  |  | • Undertaking scenario analysis<br>• Assessing the impacts of land-use change on socio-environmental aspects |
| Social values for ecosystem services (SolVES)<br>(Sherrouse and Semmens, 2015) |  |  |  |  | • Assessing, mapping and quantifying the social values of ecosystem services.<br>Facilitating discussions among diverse stakeholders about trade-offs among services |
| Soil Water and Assessment Tool (SWAT)<br>(Duku et al., 2015) |  |  |  |  | • Evaluating the effect of land management on hydrological processes, sediment, nutrients and pesticide yields<br>• Investigating decade-long impacts |
| Toolkit for Ecosystem Service Site-based Assessment (TESSA)<br>(Peh et al., 2013) |  |  |  |  | • Prioritizing, quantifying and estimating the monetary value of ecosystem services<br>• Comparing current situation with the most likely state of the site |

**BOX 16.**
**ZOOMING IN ON ONE PARTICULAR ECOSYSTEM SERVICES TOOL: TESSA**

TESSA, the Toolkit for Ecosystem Services Site-based Assessment, provides non-experts with a methodological framework to identify and evaluate the ecosystem services that an area provides. Presented as a set of interdependent PDF files in a simple workbook structure, TESSA is accessible to non-experts and conservation practitioners alike, and collects locally relevant data. It yields a comprehensive understanding of ecosystem services, facilitating their inclusion in policy and decision-making.

Stakeholder engagement is emphasized throughout the framework's recurrent steps: preliminary work, rapid appraisal, the identification of plausible (alternative, future) states, method selection, data acquisition, and analysis and communication. TESSA recommends the use of existing data where appropriate and places an emphasis on enabling users to collect new field data at relatively low cost.

By using TESSA, users also gain valuable information about alternative land uses (Chan et al., 2012). It is important to note that TESSA does not provide a strict formula or blueprint. Users must apply and adapt the approach and methods provided as appropriate according to the local circumstances. In this sense, TESSA is locally relevant and site-specific.

TESSA has been applied across a number of sites worldwide and by a range of users including students, conservation practitioners, governments and collaborative researchers. For examples of applications, see **Box 18**, **Box 20** and www.birdlife.org/assessing-ecosystem-services-tessa/case-studies.

**FIGURE 27.**
**OUTLINE STRUCTURE OF THE TESSA TOOL**


*Source:* Toolkit for Ecosystem Service Site-based Assessment - Version 2.0 (TESSA)

# VISUAL SUPPORTS TO SELECT THE MOST RELEVANT TOOL

This decision tree in **Figure 28** will help you to choose the most appropriate ecosystem services assessment tool for a specific case, based on purpose and the type of expected outputs (qualitative/quantitative/spatial).

While **Table 7** provides a schematic description of all ecosystem services assessment tools, **Figures 29 to 32** illustrate the inputs, outputs, required skills and addressed ecosystem services for each tool. The full names and references of the tools can be found in **Table 7**.

This visual representation allows prospective tool users to quickly select the tool that best suits their needs and capacities (Hugé et al., 2020). This visualization tool complements the decision tree in **Figure 28**.

**FIGURE 28.**
**DECISION TREE TO HELP SELECT THE MOST APPROPRIATE ASSESSMENT TOOL**

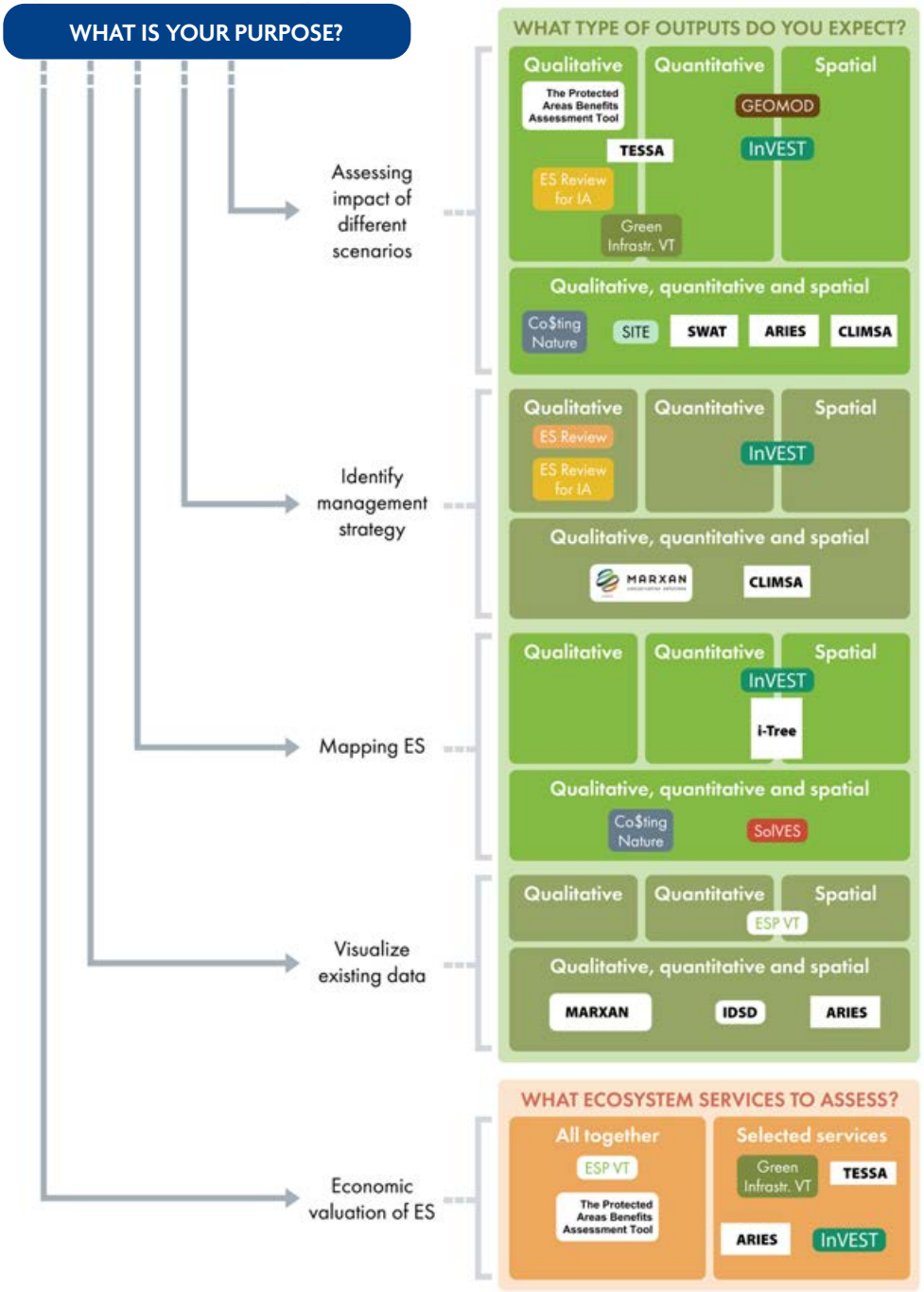


**FIGURE 29.**
**OVERVIEW OF ECOSYSTEM SERVICES TOOLS BASED ON REQUIRED INPUT DATA**

Do you want to pick your tool based on the types of **inputs needed**?

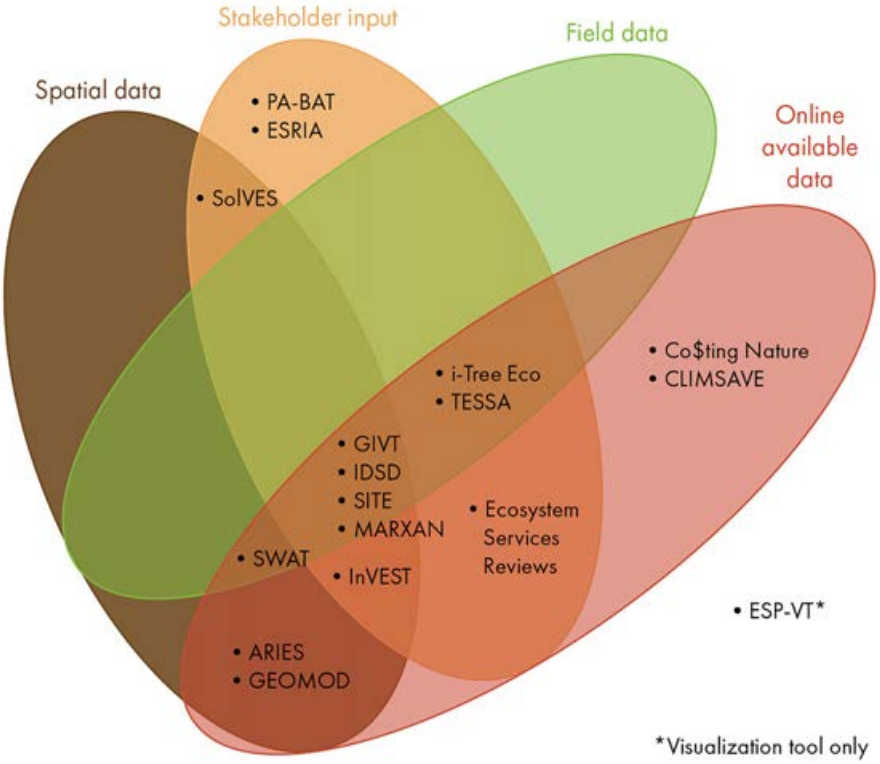



**FIGURE 30.**
**OVERVIEW OF ECOSYSTEM SERVICES TOOLS BASED ON REQUIRED SKILLS**

Do you want to pick your tool based on the **skills required**?

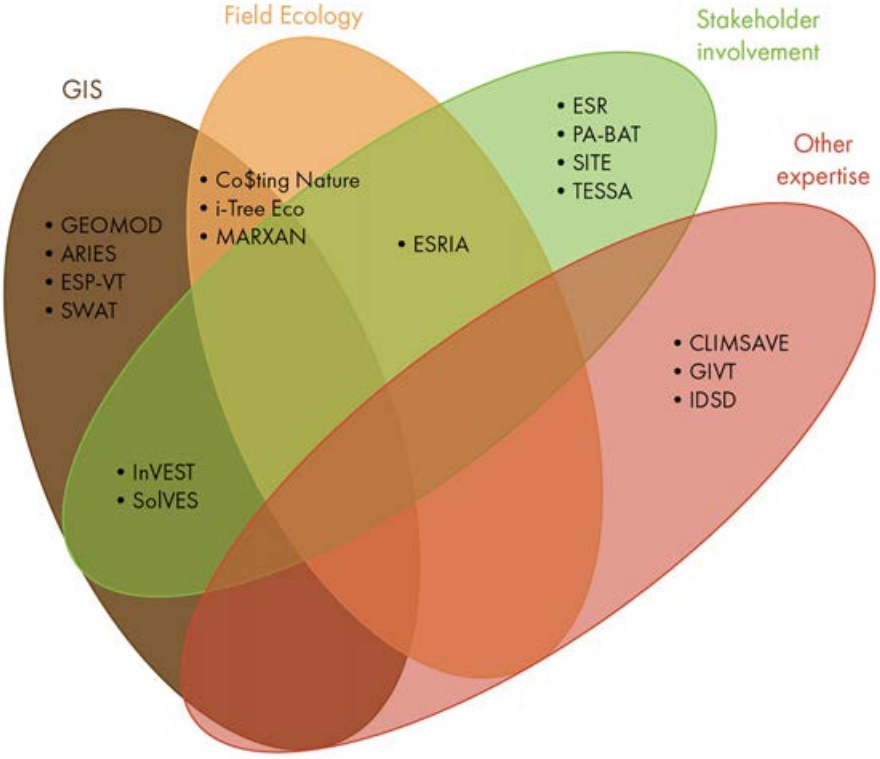


**FIGURE 31.**
**OVERVIEW OF ECOSYSTEM SERVICES TOOLS BASED ON GENERATED OUTPUT DATA**

Do you want to pick your tool based on the **type of output data** you will get?

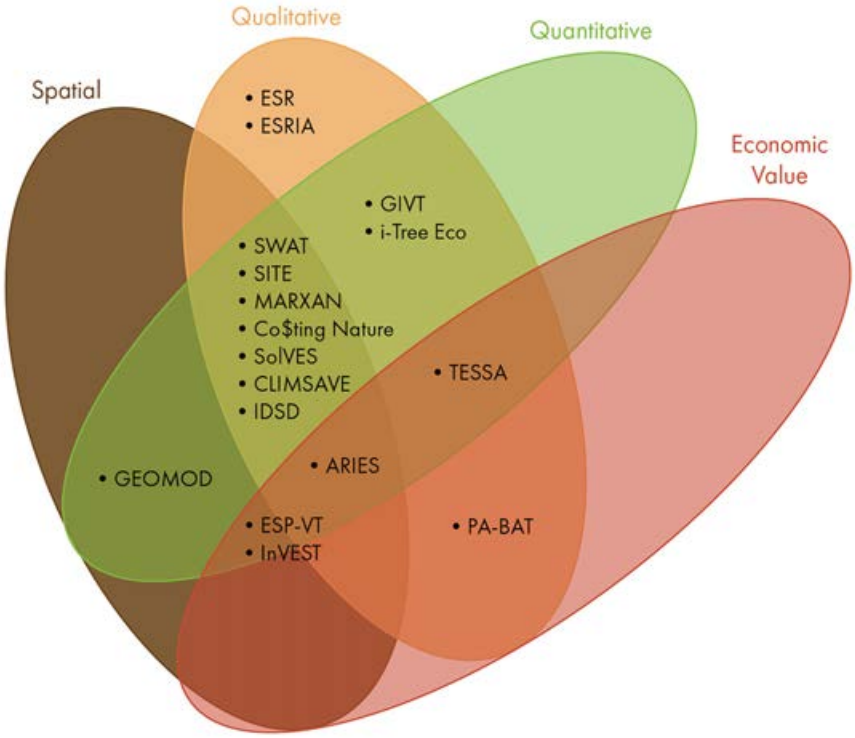
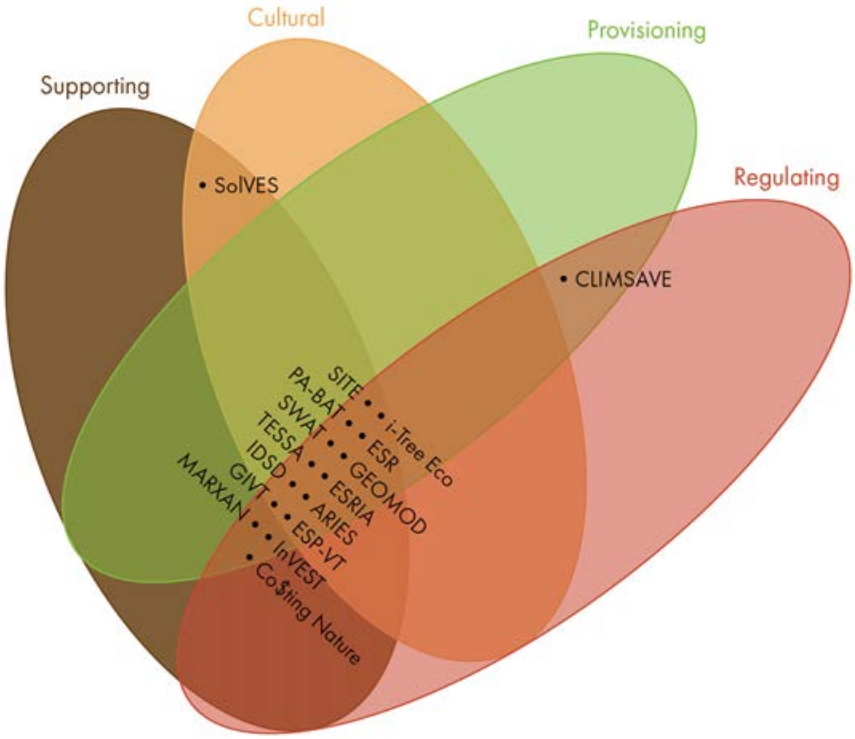



**FIGURE 32.**
**OVERVIEW OF ECOSYSTEM SERVICES TOOLS BASED ON ECOSYSTEM SERVICES COVERED**

Do you want to pick your tool based on the **ecosystem services** covered?



# APPLYING ECOSYSTEM SERVICES TOOLS IN PRACTICE

## Lessons learned from ecosystem services tool applications

Nowadays, ecosystem services tools are applied by a multitude of users every day, in a variety of contexts, and with a varying degree of experimentation and combination of existing approaches. This flexibility is inherent to the dynamic field of ecosystem services, and in particular ecosystem services tools. Hence, a comprehensive review of all tool applications falls outside the scope of this manual. Instead, we focus on a limited sample of ecosystem services tools applied by the EVAMAB team and beyond, to illustrate the contexts in which they are applied, and to provide a snapshot of the findings generated by their use.

## Ecosystem services tools and beyond - 'hybrid' tools harnessing the best of different approaches

No single one-size-fits-all tool will suit all contexts and meet all users' expectations and requirements. As noted earlier, biosphere reserve stakeholders can have different objectives when using an ecosystem services tool. As such, they may base the decision on which tool to use on different criteria (the available input data, the output data they want, the skills they have or can realistically acquire internally or externally, the types of ecosystem services covered, etc.).

While the overview of ecosystem services tools covers a wide range of approaches, we encourage all users, and anyone interested in biosphere reserve management, to experiment, to try out different tools and methods, and combine the best elements and the best modules of different tools. Only by iterative trial and error can most management-relevant information be gathered, understood and disseminated. However, it is important to make sure that all requirements are met before starting to apply such tools (skills, resources, time). Boxes 18 to 20 give some examples of recent mixed or 'hybrid' approaches to ecosystem services tool use in biosphere reserves.

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**BOX 17.**

**A SNAPSHOT OF CONSERVATION SOCIAL SCIENCE METHODS – MAPPING STAKEHOLDERS PERCEPTIONS**

One aim of the MAB Programme is to give a prominent role to science in all the zones of each biosphere reserve. While the exact sciences are needed to understand the bio-physical world, a mix of exact and social sciences are necessary to understand the interactions between the bio-physical world and human beings.

Ecosystem services tools typically integrate a range of methods. Here, we present a few that facilitate decision-making, and that can help understand and **map stakeholder perceptions**. This is key in biosphere reserve management, as the different stakeholders are those who shape conservation on a daily basis. Stakeholders, such as local communities, scientific experts and decision-makers, are also the ones who design and implement biosphere reserve management.

**An interview** is an interchange between two or more people in which one of them attempts to elicit information or expressions of opinion or belief from the other person(s) (Young et al., 2018).

**Focus group discussion (FGD)** is a method in which a group of individuals is assembled to discuss a specific topic, with the aim of drawing out complex personal experiences and personal actions, beliefs, perceptions and attitudes of participants through moderated interactions (Nyumba et al., 2018).

**The Nominal Group Technique (NGT)** is an interactive group decision-making method primarily targeted at gathering consensus. Participants are requested to provide information silently and individually to questions asked by a moderator. The moderator collates all the information and creates a list of unique items, which the participants are later asked to prioritize following a collective discussion (Hugé and Mukherjee, 2018).

**Q methodology** is a method to understand the main perspectives or opinions on a topic. Respondents are asked to rank a set of items that prompt a subjective opinion (e.g. from 'most agree' to 'most disagree'). It then uses multivariate data reduction techniques to synthesize all the rankings into a typology of perspectives about the issue under consideration (Zabala, Sandbrook and Mukherjee, 2018).

**The Delphi** method is a group-based, anonymous and iterative technique with controlled feedback. It is traditionally aimed at gathering consensus on a complex topic from a group of experts (Mukherjee et al., 2015).

**Multi-criteria decision analysis (MCA)** is a method to support decision-making that explores the balance between the pros and cons of different alternatives to accomplish a specific goal. It assesses the performance of alternatives across criteria, and therefore assists in framing decision problems, exploring trade-offs, formulating a decision and testing its robustness (Adem Esmail and Geneletti, 2018).

**Serious games** are games designed for a primary purpose other than pure entertainment. They may be applied to natural resources and can be useful in developing empathy and helping to understand other stakeholders better.

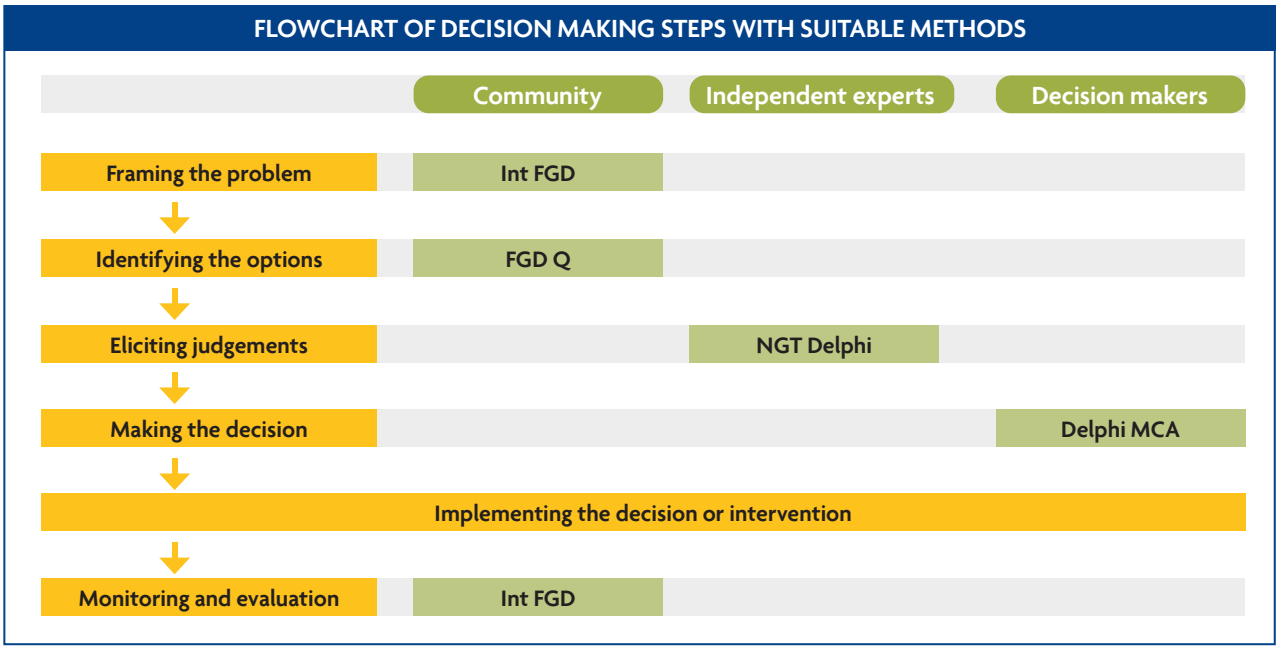
**Scenarios** use rich pictures to bring different generations together to draw and understand changing landscapes and imagine a shared future.

**Citizen science and community-based monitoring**, for example regarding water quality (turbidity, pH, T°, dissolved oxygen, etc.), creates empowerment and connection, and yields data in often data-poor environments.

These methods all have a different focus and can be used at different stages in the decision-making process, involving different stakeholder categories, as illustrated for some of the methods in **Figure 33**.

**FIGURE 33.**

**FLOWCHART OF SUITABLE JUDGEMENT ELICITATION METHODS FOR USE IN CONSERVATION DECISION-MAKING**




*Note:* Int = Interview; FGD = Focus group discussion; Q = Q methodology; NGT = Nominal group technique; and MCA = Multi-criteria decision analysis.
*Source:* adapted from Mukherjee et al. (2018).

**BOX 18.**

**COMBINING TESSA, NGT, Q METHODOLOGY AND MULTI-CRITERIA DECISION ANALYSIS IN PENDJARI BIOSPHERE RESERVE, BENIN**

Pendjari Biosphere Reserve lies in northern Benin, West-Africa. It harbours unique biodiversity (such as West Africa's only remaining major lion population) and provides multiple ecosystem services to the surrounding communities and beyond. The site is part of a larger transboundary natural area including Arly Biosphere Reserve in Burkina Faso and W Biosphere Reserve in Benin, Burkina Faso and Niger, collectively termed the WAP complex. A recent (2018) change in management (from a governmental agency-led participatory management to a private-public partnership) has led to new challenges as well as opportunities.

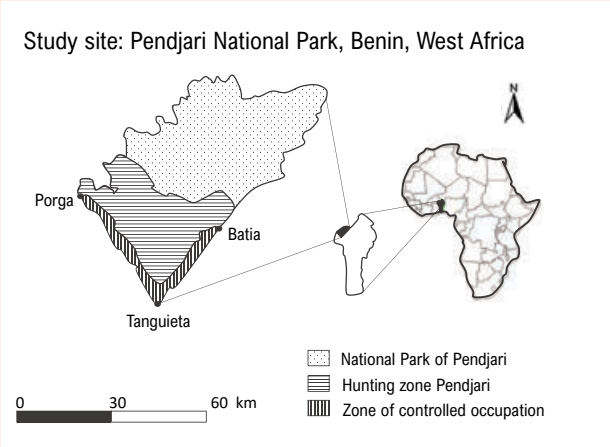
The TESSA application allowed for identification of trends in ecosystem service provision based on local stakeholder perceptions.

The Q methodology application highlighted two main discourses regarding management of Pendjari Biosphere Reserve (Janssens, 2019): Conservation for nature's sake focusing on the limitation of anthropogenic activities in favour of biodiversity conservation; and Conservation for human use, agreeing that there is a need for conservation but even more so for viable alternatives to people's current livelihoods.

The TESSA tool (see also **Box 16**) was applied in Pendjari Biosphere Reserve to map local communities' perceptions regarding trends in ecosystem services availability. The Nominal Group Technique (NGT) was used to facilitate community discussions which were structured with the help of TESSA.

**FIGURE 34.**

**MAP OF PENDJARI BIOSPHERE RESERVE AND LANDSCAPE OVERVIEW**

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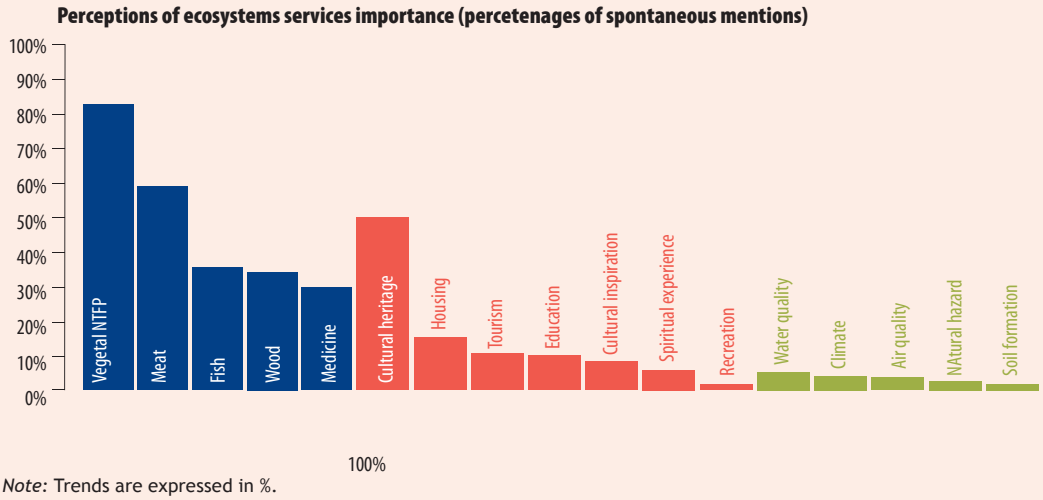
*Source:* Janssens (2019).

**FIGURE 35.**

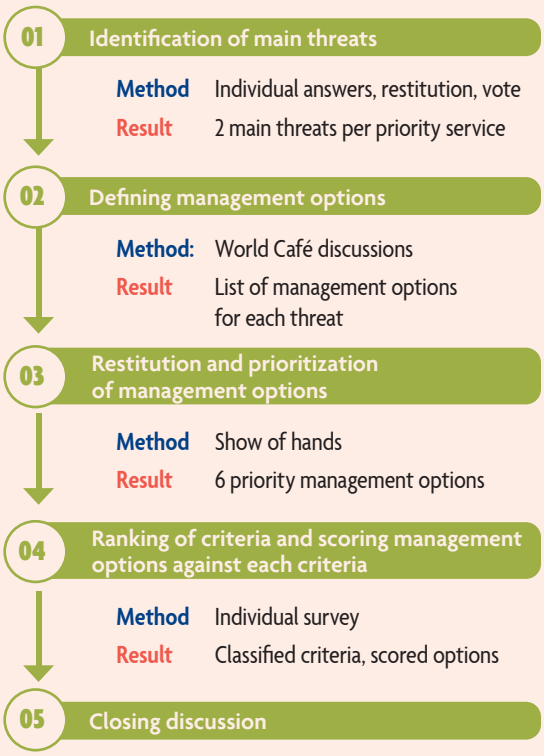
**TRENDS IN ECOSYSTEM SERVICES PROVISION OVER THE PAST FIVE YEARS IN BIOSPHERE RESERVE-FRINGING COMMUNITIES, BASED ON A TESSA-INSPIRED NOMINAL GROUP TECHNIQUE APPROACH**




*Note:* Trends are expressed in %.
*Source:* Goad (2019) and EVAMAB research.

The combination of Q methodology, TESSA and NGT allowed the research team, the local stakeholders and the reserve managers to obtain an overview of the main perspectives regarding management of Pendjari Biosphere Reserve, and to gain a better understanding of changes in local ecosystem services provision.

**FIGURE 36.**
**STEPS DURING THE STAKEHOLDER WORKSHOP TO SUPPLY THE MULTICRITERIA DECISION ANALYSIS**




The results served as the basis for conducting an adapted Multicriteria Decision analysis through a stakeholder workshop. The different steps followed during the workshop are summarized in **Figure 36**.

The final objective was to collectively rank management options for the threats identified for each priority ecosystem service. Relevance criteria used for ranking the management options were acceptability, social impact, maintenance of the addressed ecosystem service, technical and financial feasibility, synergies (on other services or threats) and proven effectiveness. Results are summarized in **Table 8**.

**FIGURE 37.**
**VOTING FOR MAIN THREATS PER PRIORITY SERVICES (STEP 1)**

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**TABLE 8.**
**RESULTS OF THE STAKEHOLDER WORKSHOP PARTICIPATORY EXERCISE**

| Priority ES | Threat to the ecosystem service (step 1) | Priority management measures (steps 2 and 3) |
|---|---|---|
| **Food from agriculture** | Unsustainable agricultural practices | Promote and adopt organic agriculture |
| | Unequal distribution of land | Develop and enforce land use and land tenure plans |
| | Deforestation | Sustainable land use practices |
| **Water for domestic use** | Pollution due to agricultural effluents | Organic agriculture |
| | Lack of water | Connect villages to water network |
| | Non-functioning pumps | Training and regular maintenance of pumps |
| **Tourism (and its benefits for local communities)** | Bad state of the roads | Maintenance of roads |
| | Low-quality hotel infrastructure | Encourage private management of hotels |
| | Perception of insecurity in the whole region | Strengthen positive communication |

*Note:* For each priority ecosystem service, the main threats and adapted priority measures were collectively selected.

**BOX 19.**
**COMBINING DELPHI AND Q METHODOLOGY IN DIMONIKA BIOSPHERE RESERVE, REPUBLIC OF THE CONGO**

Dimonika Biosphere Reserve is located in the south-west of the Republic of the Congo (Congo-Brazzaville) and consists of a highly biodiverse patchwork of equatorial rainforest ecosystems. It represents a social-ecological system in which diverse stakeholders (ranging from local communities to logging companies, and small-scale and large-scale gold miners) must co-manage the forest in the context of a fragile state. The combination of a Delphi survey and a Q methodology application yielded management-relevant information that can inform future management decisions (e.g. by focusing first on areas/topics where there is consensus among stakeholders) and help identify more complex challenges that require a long-term approach. Furthermore, the Q methodology enables the identification of positions associated with particular stakeholders.

**FIGURE 38.**
**KEY MANAGEMENT CHALLENGES FACING DIMONIKA BIOSPHERE RESERVE (BASED ON THE FREQUENCY OF DELPHI RESPONDENTS' MENTION OF THE RESPECTIVE CHALLENGES)**


*Source:* Van Roy (2019) as part of EVAMAB research.

**BOX 20.**
**COMBINING TESSA, NGT AND Q METHODOLOGY IN THE SINE-SALOUM DELTA BIOSPHERE RESERVE, SENEGAL**

The Sine-Saloum Delta is a biosphere reserve consisting mainly of mangrove forests and creeks, located in western Senegal. The area provides ecosystem services to a wide range of communities.
The Q method allowed for the identification of three main discourses regarding biosphere reserve management:

- 'The official discourse' shows that current mangrove management is fragmented, and that communities need to act to ensure the planned management to work uniformly and effectively'.
- 'Happy villagers' states that village level co-management works, although some imbalances need to be corrected'.
- 'Unhappy villagers' states that mangrove management is not working, that things need to change, but that it is not up to the communities to act (Arumugam et al. (2020) as part of EVAMAB research).

This Q study was complemented by a TESSA-inspired Nominal Group Technique application which followed the steps shown in **Figure 41**.

**FIGURE 39.**
**SCHEMATIC REPRESENTATION OF THE THREE IDENTIFIED DISCOURSES REGARDING THE MANAGEMENT OF DIMONIKA BIOSPHERE RESERVE**


*Source:* Thibaut Vendervelden.

**FIGURE 40.**
**LOCATION OF THE REPUBLIC OF THE CONGO, AND PICTURE OF DIMONIKA VILLAGE**

*Source:* Thibaut Vendervelden.

**FIGURE 41.**
**STEPS OF THE NOMINAL GROUP TECHNIQUE, AS PERFORMED DURING A SERIES OF WORKSHOPS IN THE SINE-SALOUM DELTA, SENEGAL**


*Source:* Van Roy (2019) as part of EVAMAB research.

The NGT applications in different villages included different categories of stakeholders and yielded a prioritized list of alternative, non-mangrove-destructive income-generating activities.

**TABLE 9.**
**LIST OF PRIORITIZED INCOME-GENERATING ACTIVITIES IDENTIFIED BY LOCAL COMMUNITIES FROM VILLAGES IN THE SINE-SALOUM BIOSPHERE RESERVE**

| Ranking based on agreement (number of groups-11) | | Ranking based on importance (number of participants-83) | |
|---|---|---|---|
| Livestock | 10 | Livestock | 57 |
| Crop production | 10 | Crop production | 56 |
| Horticulture | 8 | Horticulture | 35 |
| Planting fruit trees | 5 | Planting fruit trees | 23 |
| Vocational training | 4 | Vocational training | 17 |
| Agriculture | 4 | Agriculture | 16 |
| Harvesting oysters using garlands | 3 | Fish farming | 12 |
| Fish farming | 3 | Harvesting oysters using garlands | 10 |
| Improved & non-destructive fishing methods | 2 | Improved & non-destructive fishing methods | 8 |
| Poultry | 2 | Poultry | 7 |
| Gas/stove/biogas | 1 | Gas/stove/biogas | 6 |
| Village forest | 1 | Village forest | 5 |
| Ecotourism | 1 | Ecotourism | 4 |

*Note:* The ranking is based on agreement (the number of groups that placed the idea among their top five priorities) and based on importance (the total votes received by the idea).

*Source:* Niyomugabo (2018) as part of EVAMAB research.

## MORE INFORMATION

### Quantification of ecosystem services:

- Are ecosystem services adequately quantified? https://besjournals.onlinelibrary.wiley.com/doi/epdf/10.1111/1365-2664.12696.

### Other tool selection approaches:

- Full scientific paper on the tool selection presented in this manual: Ecosystem services assessment tools for African biosphere reserves: A review and user-informed classification www.sciencedirect.com/science/article/abs/pii/S2212041620300218.
- ValuES Methods Navigator www.aboutvalues.net/method_navigator.
- Tools for Measuring, Modelling and Valuing Ecosystem Services: Guidance for Key Biodiversity Areas, Natural World Heritage sites, and Protected Areas (IUCN) https://portals.iucn.org/library/sites/library/files/documents/PAG-028-En.pdf.
- Assessing Ecosystem Services in UNESCO Biosphere Reserves (Concept Paper prepared for the Canadian Commission for UNESCO) https://en.ccunesco.ca/-/media/Files/Unesco/Resources/2019/03/AssessingEcosystem.pdf.

# Chapter 4
# How to value ecosystem services

A-J. Rochette, K. Vanderhaegen, S. Van Passel, H. Azadi, S. Jacobs and B. Verbist

Contents



Buffaloes drinking in Pendjari Biosphere Reserve, Benin © L. Janssens de Bisthoven

## RELEVANCE FOR AFRICAN BIOSPHERE RESERVES

- The concept of ecosystem services has helped to concretize **nature's value and benefits to human well-being**. Multidimensional valuations of nature should ideally inform management and policy. The valuation of non-market services is challenging and complex, therefore putting a **monetary value** on ecosystem services makes it easier to highlight the importance of these services to decision-makers.
- Economic valuation seeks to produce, in monetary terms, public expectations for environmental changes. Ecosystems and their related services have an **economic value for society** as people gain value from their actual or potential use as well as a resource value for non-use purposes such as altruistic motivations, legacies and stewardship.
- It is important for biosphere reserves managers and stakeholders to understand the **scientific foundations of the socio-economic integrity of ecosystem services** in a way that captures the complexity of the valuation concept. The social and economic value of ecosystem services is measurable, relevant to managers, and can be understood and supported by the public. It is even more relevant in biosphere reserves where conservation and development are integrated for sustainable development, and where economic activities are inherent to biosphere reserves.
- A **variety of valuation methods** exist, each with its advantages and limitations. Some methods may be more suited for capturing the values of particular ecosystem services and value types than others. Economic valuation methods are presented in this chapter together with case studies in African biosphere reserves.
- **Payments for ecosystem services (PES)** are presented as an example of an economic tool able to enhance conservation outcomes, when installed with care for existing power and governance structures and mechanisms, and taking into account social equity. This chapter presents some case studies of PES in biosphere reserves; however, these payments are not a universal solution for conservation and should be considered carefully.

**Chapter 3** introduced tools for the rapid assessment of ecosystem services.
One way to assess ecosystem services is to assign them values. This chapter elaborates on the different valuation methods.

# WHY VALUE BIODIVERSITY AND ECOSYSTEM SERVICES?

## Full valuation of ecosystem services for a better human and nature balance

Humans have **direct impacts,** both positive and negative, on the health and functioning of ecosystems (**Figure 42**).

**FIGURE 42.**
**HUMANS HAVE DIRECT IMPACTS ON ECOSYSTEMS WHILE BENEFITING FROM THEM**

**Functioning ecosystems provide a wide range of benefits including ecosystem goods and services.**



**We often undervalue the benefits of ecosystem services, which typically leads to higher impacts on biodiversity (increased degradation) and reduced benefits from ecosystem services.**


**If we fully understand the value of ecosystem services, we can incorporate this value into our everyday lives. This approach increases the likelihood of decreased impacts on, and increased benefits from, biodiversity and ecosystems.**

*Source:* Adapted from SCBD (2019).
Illustration: Mado Berthet, RBINS.

# VALUING ECOSYSTEM SERVICES: DIFFERENT VALUE DIMENSIONS AND COMPLEMENTARY METHODS

As outlined in **Chapter 1**, the word 'value' has different meanings and can refer to intrinsic, relational and/or instrumental values. This multidimensional valuation of nature should ideally inform the management and policy of African biosphere reserves. Indeed, decision-making relies, to a great extent, on the instrumental values of nature's contributions to people; however, the intrinsic and relational values of nature are also essential as they embody people's sense of identity and spirituality.

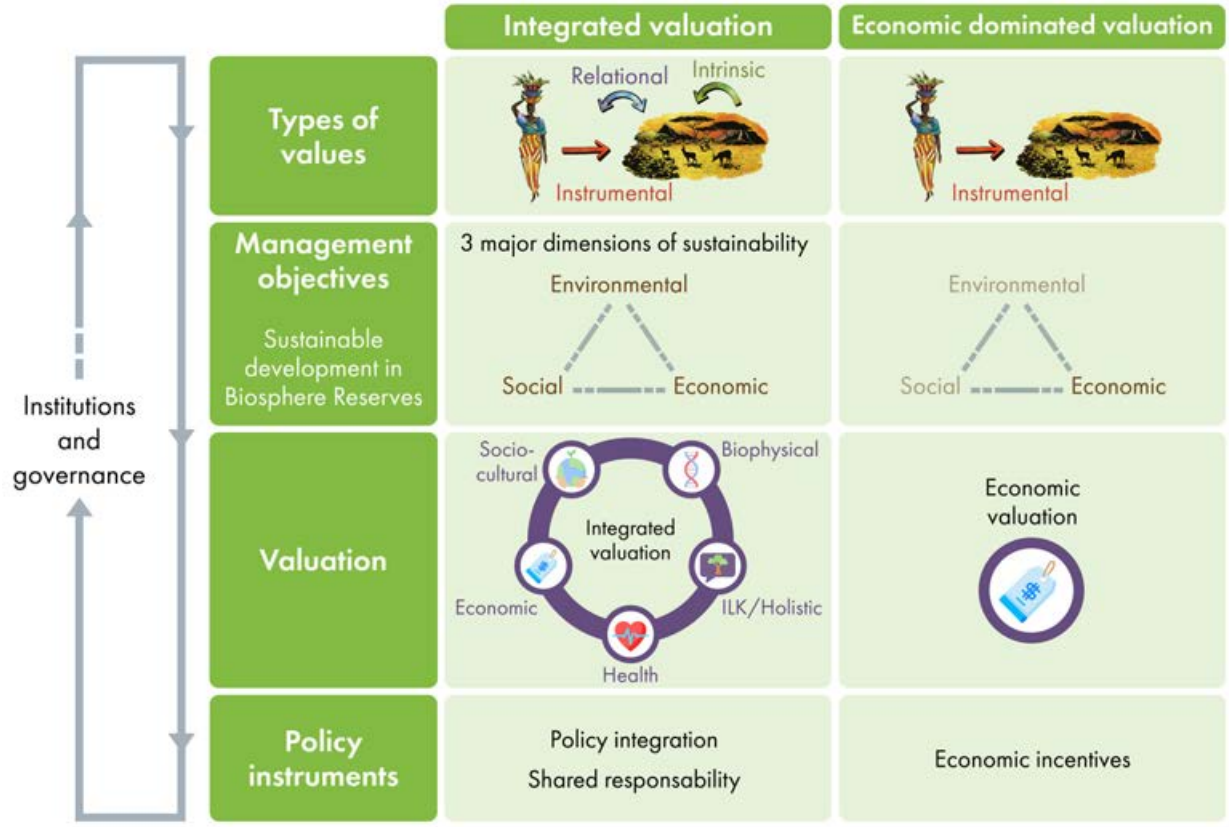
It is important to note that no single valuation method is able to capture the full spectrum of values of biodiversity and the services it provides. Existing methods are complementary and should be selected with care to integrate the different value dimensions of all stakeholders into environmental decision-making (Jacobs et al., 2018).

Focusing only on one dimension (e.g. the economic valuation derived from a utilitarian perspective) furthers the instrumental vs. intrinsic dichotomy. To encompass various dimensions that assess the interdependence between nature and societies, a plural approach is recommended, one that includes biophysical, health, sociocultural and holistic approaches.

This approach is illustrated in **Figure 43**. The left-hand column refers to diverse valuation, which acknowledge the existence of a diversity of values and valuation approaches, while the right-hand column presents a purely economic valuation approach. The former should allow for the development of conditions for the design of more comprehensive and deliberative policy support tools and instruments.

In order to promote sustainable development, decision-making processes impacting the management of biosphere reserves would benefit from addressing the values of biodiversity and ecosystem services through plural approaches, which means having appropriate methods and tools for valuation.

**FIGURE 43.**
**FRAMEWORK COMPARING INTEGRATED VALUATION WITH A PURELY ECONOMIC VALUATION APPROACH**




*Note:* ILK = Indigenous and local knowledge.
*Source:* adapted from Pascual et al. (2017), Elsevier Creative Commons

## Conducting a valuation study: A means to an end

Assessing the values of biodiversity and ecosystem services is not a goal in itself, it is a means to an end. It is therefore essential to identify the issue that valuation is intended to address, and to retain this focus throughout the assessment process. In order to include multiple values in a coherent and operational framework targeting societal impact, the valuation should be part of a broader adaptive valuation process, continually engaging with an inclusive team of stakeholders ranging from practitioners to scientists.

The different steps of an ecosystem services valuation study can be summarized as follows (see **Figure 44**):

- **Purpose definition** – clearly identifying the purpose of valuation is key.
- **Scoping process** – before choosing valuation methods, scoping is essential to understand the stakes, interests, power, influence and dependency of the different actors, and to communicate a shared understanding of the scope of the valuation. The process makes explicit both the position and mandate of the people involved in the process and the available human and financial resources for the valuation.
- **Valuation** – valuation methods are selected and applied based on the two first steps, and cover diverse value dimensions.
- **Integration** – the result, as well as the uncertainties and risks of valuation, are integrated into an adequate format for the purpose of valuation (see **Chapter 5** for more on possible integration means).

Valuation should not be understood as a single, discrete step in a research or assessment process, but rather as a deeper and more continuous process. Values are recognized, elicited, measured or co-created throughout all these steps (Jacobs et al., 2020).

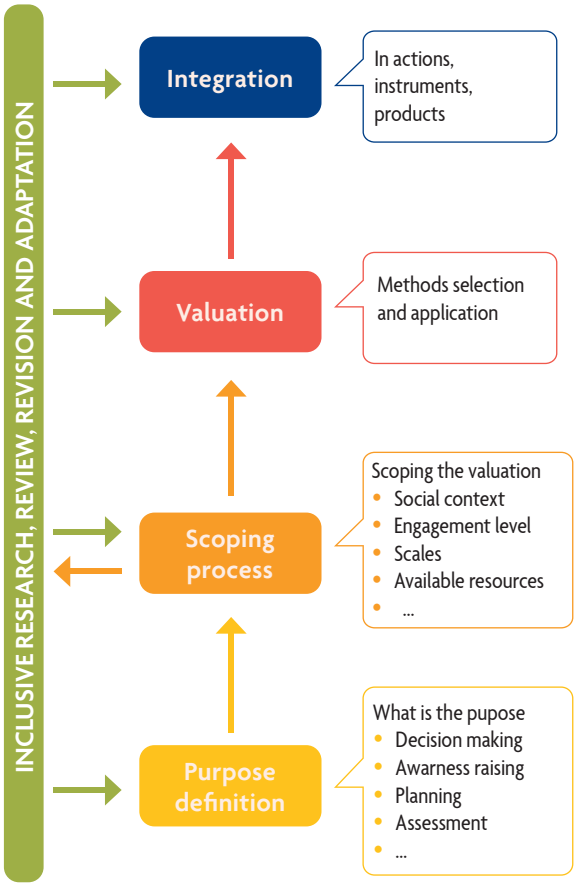
## Types of valuation methods

Depending on the purpose of valuation (see the first step of **Figure 44**), a multi-method approach may be required to fully assess the values of biodiversity and ecosystem services. Most valuation methods are inherently multidimensional and draw on multiple data sources to provide integrated assessments of values (Díaz et al., 2015).

**Table 10** provides an overview of the types of methods that exist, the types of values they can assess and some examples of methods.

The ecosystem services assessment tools presented in **Chapter 3** can incorporate various types of methods. **Box 17** (in **Chapter 3**) also provides an overview of methods that can be used to collect, analyse and synthesize stakeholders' perceptions regarding valuation.

**FIGURE 44.**
**STEPS OF AN ECOSYSTEM SERVICES VALUATION STUDY**




*Note:* adapted from Jacobs et al. (2016), Elsevier Creative Commons

**TABLE 10.**
**OVERVIEW OF TYPES OF VALUATION METHODS, THE VALUES THEY ADDRESS AND EXAMPLES**

| Types of methods | Types of values | Examples |
|---|---|---|
| **Biophysical methods** | • Intrinsic<br>• Instrumental | • Environmental modelling<br>• Ecosystem services mapping |
| **Cultural and social methods, including local knowledge-based methods** | • Intrinsic<br>• Instrumental<br>• Relational | • Cards game method (see **Box 28**)<br>• Narrative method<br>• Participatory method mapping<br>• Photo-elicitation survey |
| **Economic methods** | • Instrumental<br>• Relational | • Benefit transfer<br>• Travel-cost method<br>• Cost-based methods |
| **Public health assessment methods** | • Instrumental<br>• Relational | • Risks assessment<br>• Dose-response relationships |

*Source:* adapted from UNESCO (2020) and IPBES (2020).

# FOCUS ON ECONOMIC VALUATION METHODS

The concept of ecosystem services has helped to concretize nature's value and benefits to human well-being. Putting a monetary value on ecosystem services is a direct means to communicate the importance of these services to decision-makers. However, such valuations can also be quite reductionist and anthropocentric, as shown in **Figure 43**, taking away from the intrinsic or relational value of nature and showing nature from a purely instrumental perspective (McCauley, 2006).

The rest of this chapter aims to provide guidance on these monetary aspects. It is important to remember, though, that such methods only form part of the plural valuation process. The methods presented here use an anthropocentric instrumental approach and should not be used exclusively without considering the relational and intrinsic values of nature, as presented earlier, as these have a crucial influence on people's reasons for maintaining biodiversity.

# WHY GIVE AN ECONOMIC VALUE TO ECOSYSTEM SERVICES?

## What are the pros and cons of economic valuation?

Assigning a monetary value to nature and ecosystem services is subject to debate, as illustrated by this non-exhaustive list of pros and cons of **economic valuation (EV)**, compiled from the EVAMAB Ethiopia workshop in 2019 and literature sources.

**TABLE 11.**
**PROS AND CONS OF THE ECONOMIC VALUATION OF BIODIVERSITY AND ECOSYSTEM SERVICES**

| PROS (strengths and opportunities) | CONS (weaknesses and threats) |
|---|---|
| Valuation can help to increase knowledge and encourage conservation. EV demonstrates the value/ importance of ecosystems and supports appreciation and awareness of ecosystem services. | Assigning an economic value to nature reduces it to its instrumental/utilitarian value, neglecting any intrinsic value. |
| EV helps to clarify who gains and benefits from ecosystem services. | The valuation process is **complex**. |
| EV can provide useful information about changes to welfare resulting from ecosystem management actions. | Valuation techniques have **limitations** that are as yet unresolved. |
| Knowing the value of biodiversity and ecosystem services promotes their effective management, which can include economic incentives (e.g. in systems of payment for ecosystem services). | EV may increase the **gap between suppliers and beneficiaries** as they do not always speak the same (economic) language. |
| Most people understand values expressed in monetary units, and the **simplicity** of monetary values allows for **comparability**. | In some cases, putting an economic value on things can **backfire**, resulting in negotiation/sale where such approaches are unwanted. |
| Since money is a well-known common unit of account, expressing relative preferences in terms of monetary values may provide useful information to **policy-makers** and serve as an advocacy tool to convince them to take action. | Some ecosystem services are easier to value and valorize than others (e.g. carbon vs. biodiversity; provisioning vs cultural), while others **are more difficult**. |
| Monetary values are often needed to **attract funds** and investments, which can result in job creation. | EV might not always assess properly the difference in quality of ecosystem services for **beneficiaries closer or further away** from the resource. |
| Ecosystem services are often taken for granted and considered as 'free'. Valuation can alter this view and illustrate the **importance and scarcity** of ecosystem services. | EV could lead to competing interests and **unequal power balances** between beneficiaries (e.g. commercial vs. traditional fishermen). |

| PROS (strengths and opportunities) | CONS (weaknesses and threats) |
|---|---|
| Valuation of ecosystem services can help improve national **accounting systems**. | Different valuation methods will lead to **different results** and might – if the discrepancy is too big – lead to different/wrong policy decisions. |
| EV can help promote sustainable **allocation of resources** (e.g. supporting decision-making between competing users and different land use types). | **Difference in values** (e.g. of USD) in different countries can drive, for example, carbon payments to the cheapest country rather than lead to an increase in ecosystem services (e.g. in casu tree planting) in all countries. |
| EV can help **map unfairness/poverty/inequality** issues, as ecosystem services are closely interlinked with poverty alleviation. | **Tipping points in the delivery of ecosystem services**[1] will likely not correspond to tipping points in individual preferences expressed through Willingness to Pay studies, or tipping points in the livelihoods of communities. |
| Valuation can help identify where **intervention is needed** (e.g. in the case of decline in ecosystem services) through a decrease in values. | EV tends to underestimate ecosystem services, sometimes significantly. |
| EV can **connect people** and stimulate discussion, multidisciplinarity and interdisciplinarity (e.g. between biologist-economists and scientists-environmentalists-investors). | **Volatility in prices** for ecosystem services might be very high, which might lead ecosystem services providers to consider other land use options but more private income (although prices are more volatile than ecosystem services). |
| EV can help to **diversify** economic activities. | EV can push people with an intrinsic reason to conserve ecosystems towards a weaker external motivation (money). |
| EV can help resolve conflicts between wildlife and local people (e.g. design of compensation schemes). | Risk of **corruption**. |
| EV can help **maximize the profits** and benefits from nature. | Some groups have the **power to abuse** EV methods (e.g. public investments in infrastructure rather than rehabilitation of the uplands). |
| EV provides **information to policy-makers** about the loss/gain of welfare resulting from the degradation/improvement of ecosystem services. | Valuation results will be heavily **dependent on social, cultural and economic contexts**, the boundaries of which may not overlap with delineation of the relevant ecological system. |
| EV can help make show how human decisions would affect ecosystem service values, and expressing those value changes in units (e.g. monetary), enabling their **incorporation into public decision-making** processes. | Many EV efforts focus on **particular parts** of ecosystems or species, which while effective at one level, lack the scope to control the pressure of commodity markets for land resources surrounding them. |
| EV can help demonstrate the importance of services that are often under- or not valued because they are **not related to existing markets** (only a small subset of ecosystem services is priced and incorporated into transactions as commodities or services). | EV raises the risk of **justifying some unsustainable practices** because the assessed economic value of ecosystem services in the same area is lower. For example, what if intensive agricultural land or mining is more profitable than forest? |

*Source:* EVAMAB team.

1 'A tipping point is defined [...] as a situation in which an ecosystem experiences a shift to a new state, with significant changes to biodiversity and the services to people it underpins, at a regional or global scale' (Biodiversity Information System for Europe, 2020).

## When can economic valuation be useful?

Examples where economic valuation can be of use include the following.

- **For raising awareness and interest** about biodiversity and ecosystem services in general:
  - to generate information about the benefits people living in and around a biosphere reserve receive from the ecosystem, and their value, in order to advocate for its protection by providing scientifically robust data to recognize the value of conservation and to enable better management; and
  - to support a pre-feasibility study for securing sustainable financing for an area based on the benefits it provides to people locally and globally.

- **For demonstrating the importance of a site** that is threatened:
  - when ecosystems providing key ecosystem services are being affected (e.g. wetlands being drained, mangroves being cut down, headwater forests being degraded); and
  - to raise awareness about the magnitude of specific services relative to other services provided by human-built capital.

- **To document specific policy options** by assessing changes in policy:
  - for land use planning in the buffer zone, using land use scenarios and their impacts to assess changes;
  - to provide useful information about changes to welfare that will result from ecosystem management actions (e.g. to demonstrate the local and global benefits of conserving a specific habitat);
  - to understand the changes to economic welfare from small alterations to ecosystems due to logging of trees in a forest, restoration of a polluted pond or the rehabilitation of extraction sites, etc.; and
  - to offer quantitative information to decision-makers on the financial resources that can be generated, to help select rational measures for resource conservation, and to promote the integrity of the ecosystem, the well-being of communities, and the future fair and sustainable development of society.

- **To support the sustainable use and management** of specific resources or areas:
  - to assess how the benefits would differ depending on two future pathways, for example improved conservation of a forest vs. business as usual with over-harvesting and unsustainable logging;
  - to identify and highlight the ecological and socio-economic values of forests to encourage communities to take up sustainable forest management; and
  - to highlight the losses if unsustainable practices continue (e.g. fish species decline owing to overfishing).

- **To establish payment for ecosystem services** schemes, where the right level of compensation should be defined, offered by ES beneficiaries to ES providers, to balance their forgone income when changing practices to ensure the continued or enhanced provision of ES.

- **To raise funds**
  Cases where another approach may be better recommended include the following:
  - when quantifying or monetizing benefits is politically sensitive, for example assigning an economic value to sacred forests;
  - when data limitations or budget, time and/or data constraints are severe;
  - when decision-making regarding natural resources is driven largely by politics; and
  - when assigning a value to selected ecosystem services might trigger predatory behaviour.

*Source:* Azadi, Van Passel and Cools (2020); BirdLife International (2020); CENAGREF (2009); Costanza et al. (2014); EVAMAB (2019).

Aleksandra H Kossowska/Shutterstock.com

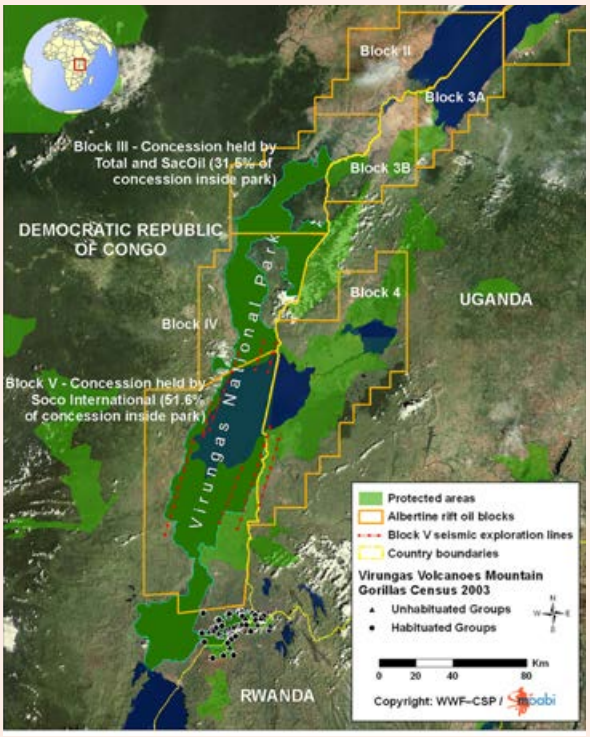
**BOX 21.**

## WHY ECOSYSTEM VALUATION MATTERS: THE VIRUNGA NATIONAL PARK AND NATURAL WORLD HERITAGE SITE (DR CONGO)

In 2007, oil concessions covering 85% of Africa's oldest national park were granted (**Figure 45**). Exploration companies were on the verge of destroying the extraordinary beauty and value of the Virunga National Park, a World Heritage Site situated on the eastern edge of the Democratic Republic of Congo. How could this policy be reversed? One strategy was to convince the DR Congo government that the long-term economic value of the intact biosphere reserve was much higher than the short-term profits from oil exploitation.

UNESCO, WWF and more than 50 other stakeholders undertook the urgent task of estimating the economic value of selected ecosystem services of Virunga National Park. Results, as well as risks inherent to the oil exploration project, were published in a WWF report (WWF/Dalberg, 2013). The results estimated the value of ecosystem services in the park at US$1.1 billion if developed sustainably (see **Figure 46**), with the potential to develop 45,000 permanent jobs. The striking valuation together with global protests forced Total SA and the UK oil company Soco International PLC to withdraw its oil exploration plans. Unfortunately, the threat has not diminished as authorization for oil and gas drilling in Virunga has not been withdrawn. Moreover, the park is also subject to local violence. Armed gangs threaten park authorities and kill rangers and civilians, linked to short-term illegal profiting from charcoal provisioning and other sources of revenue from the park.

**FIGURE 45.**
**MAP OF OIL EXPLORATION LICENSES IN RELATION TO THE VIRUNGA NATIONAL PARK AND RIFT VALLEY LAKE SYSTEM**




*Source:* Protected Area Watch (2019), WWF-CBP

This example shows that although a protected area or biosphere reserve is valuable and (in principle) gazetted as 'protected' for coming generations, the situation may be fragile and can change abruptly. Ecosystem services valuation is one possibility to provide arguments to advocate for conservation under such circumstances.

However, Boeraeve et al. (2015) pointed out, when analysing the Virunga case, that 'subjugating conservation efforts to profit logics downplays the importance of intrinsic, symbolic and other non-economic values of biodiversity'.

**FIGURE 46.**
**OVERVIEW OF VIRUNGA'S CURRENT AND POTENTIAL SOCIAL AND ECONOMIC VALUE**

| Factors | | Current value (US$ million/ year) | Potential value (US$ million/ year) |
|---|---|---|---|
| Direct-use value | Fisheries | 30 | 90 |
| | Tourism | 0 | 235 |
| | Hydro-electric power | 5 | 10 |
| | Other values (incl. pharmacological use, education and research) | 6 | 13 |
| Indirect value | Carbon sequestration and forest conservation | 0 | 55 |
| | Water supply | 1 | 1 |
| | Erosion control | 6.9 | 7.8 |
| Non-use value | Future use of park's resources | 0 | 700 |
| Total value | | 48.9 | 1,111.8 |

*Note:* The current value is based on Virunga's situation during the year prior to the study, which was characterized by intense conflict and instability. The potential value refers to a situation where the park is sustainably managed, where security is guaranteed and an effective law system protects the integrity of the ecosystem.

*Source:* WWF.

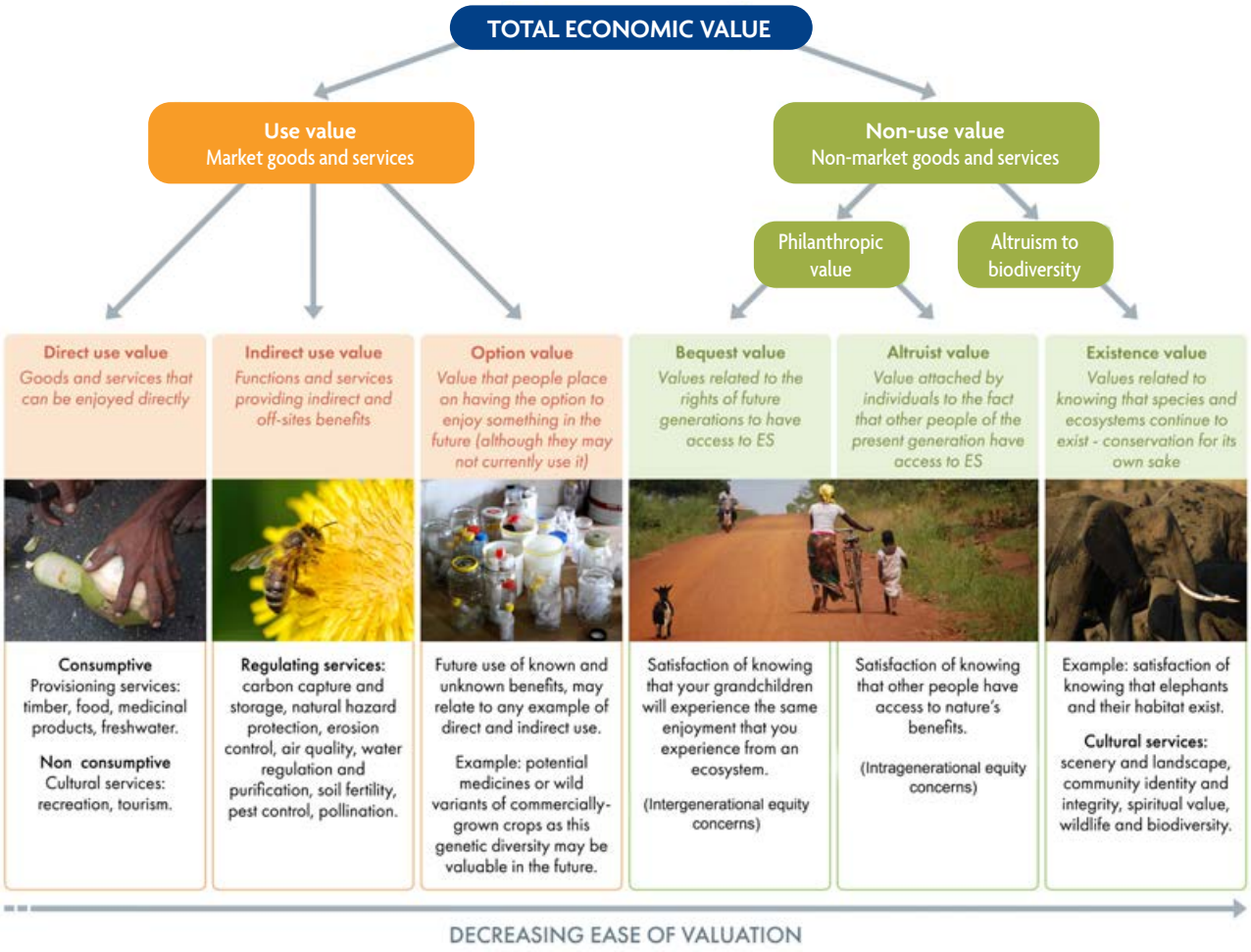
# ECONOMIC VALUATION APPROACHES

## How to give an economic value to ecosystem services

### A range of values

The most widely used valuation framework to assess benefits from ecosystem services is the Total Economic Value (TEV) framework. It considers the different values that can be assigned to biodiversity and ecosystem services, from their intrinsic value (existence value) to their most instrumental value (market goods that can be enjoyed directly).

**FIGURE 47.**
**THE TOTAL ECONOMIC VALUE FRAMEWORK**




Pictures © IRScNB-KBIN T.Hubin, L. Janssens de Bisthoven
*Source:* adapted from Slootweg, 2009; Bryden et al., 2010; European Union, 2015; SCBD, 2019; TEEB 2010B

Non-use values are the most difficult to assess, as they are less tangible and hard to quantitatively assess, while direct use values are the easiest as they may be linked directly to existing market data. The **total economic value (TEV)** of an ecosystem service is the sum of all the relevant values for a good or service. It is a useful approach, but monetary values cannot be determined for all these categories. Valuing only some of the categories is more feasible and may be enough to justify a conservation option over a more resource-exploitative alternative (TEEB, 2010a).

Different values may be relevant to different types of ecosystem service (**Figure 48**).

**FIGURE 48.**
**MOST RELEVANT VALUES FOR DIFFERENT TYPES OF ECOSYSTEM SERVICES**

| Ecosystem service type | Examples | Use value | | | Non-use value |
|---|---|---|---|---|---|
| | | Direct use | Indirect use | Option use | |
| Provisioning | Food, fibre and fuel, biochemicals, natural medicines, pharmaceuticals, freshwater supply | ✓ | | ✓ | |
| Regulating | Air-quality regulation, climate regulation, water regulation, natural hazard regulation, etc. | | ✓ | ✓ | |
| Cultural | Cultural heritage, recreation and tourism, aesthetic values, spiritual value | ✓ | | ✓ | ✓ |
| Supporting | Primary production, nutrient cycling, soil formation | Supporting services are valued through the other categories of ES | | | |

*Source:* adapted from Defra (2007), Crown.

### A range of methods

A variety of valuation methods exist to assess (part of) the economic value of an ecosystem service reflecting their importance for human well-being (see **Table 12**). The most appropriate method(s) should be selected in consultation with experts with experience in environmental economics and may be reliant on various factors:

- The number and type of ecosystem services to include in the assessment – sometimes fully assessing one single key service may be more efficient than partially assessing multiple ones.
- The scope – geographic extent and detail level.
- The aim of the research – what do we want to achieve?
- The available budget.
- The timeframe – is it linked to a particular policy or management decision?
- The skills and capacity to implement such a valuation exercise.
- The cultural context and local sensitivities.
- Data quality and availability – this may influence all other parameters.

These methods fall broadly into three main types:

- **Direct market-based valuation** relies on actual markets and uses market prices to estimate ES values.
- **Revealed preference** is based on observation of individual choices within existing markets. Consumers 'reveal' their preferences by their behaviour and expenses.
- **Stated preference** methods use surveys, questionnaires and interviews to assess individuals' preferences for a given change in a natural resource or environmental attribute.

**TABLE 12.**
**ECONOMIC VALUATION METHODS FOR THE ASSESSMENT OF ECOSYSTEM SERVICES**

| | Method | Approach | Elements of TEV | Ecosystem services valued/ application | Comment/examples | Advantages | Limitations |
|---|---|---|---|---|---|---|---|
| Market-based valuation | **Market Price** | Direct observation in markets | Direct and indirect use | Ecosystem services that are traded in markets (e.g. timber and fuelwood, fish, etc.) | Mainly applicable to the provisioning services (e.g. fish) but also some cultural (e.g. recreation) and regulating services (e.g. pollination) | Market data readily available and robust | • Limited to ecosystem services for which a market exists<br>• Market process can be distorted (e.g. by subsidies)<br>• Biosphere reserve services often not traded in markets |
| | **Cost-based (avoided/ replacement/ restoration costs)** | Cost required to replace with human-made service, restore or avoid loss from damaged ecosystems/caused by the absence of an ecosystem service | Direct and indirect use | • Replacement: ecosystem services where human-made equivalents could provide similar benefits (e.g. defences for coastal protection, expenditure on water filtration for water filtration)<br>• Avoided: ecosystem services that provide protection to infrastructure and other assets | • Replacement: Coastal protection by mangroves, water storage and filtration in forests and wetlands<br>• Avoided: landslide/avalanche protection from forests, wetland protecting against floods | | • Potentially over-estimates actual value if society is not prepared to pay for human-made replacement<br>• Under-estimates value if human-made replacement does not provide all the benefits of the ecosystem service (i.e. biodiversity benefits)<br>• Difficult to relate damage levels to ecosystem services |
| | **Production function** | Value of ecosystem services as input in the production of marketed goods | Indirect use | Ecosystem services that constitute an input to the production of a marketed good | Commercial fisheries supported by nursery areas protected by mangroves, materials used in handicraft production, effects of water quality on agricultural production and forestry output | | • Technically difficult<br>• High data requirements and data on changes in ES and the impact on production often missing |
| Revealed preference | **Hedonic pricing** | Influence of ecosystem services on the price of marketed goods | Direct and indirect use | Generally refers to changes in accommodation or land prices that reflect the value of local environmental features – applies to ecosystem services that contribute to attributes appreciated by potential buyers | Air quality, presence of water, scenic beauty, cultural benefits | Based on market data, so relatively robust figures | • High data requirements<br>• Limited mainly to services related to property<br>• Technically difficult |
| | **Travel cost** | Travel costs to access a resource: how much people are willing to pay to travel to a destination (travel expenses, entrance fees and time value) | Direct and indirect use | All ecosystem services that contribute to recreational activities – only for sites used for recreational purposes | Recreation | Based on observed behaviour<br>Particularly suited for biosphere reserves | • Limited to recreational benefits<br>• Difficult to apply when trips are made to multiple destinations |

| | Method | Approach | Elements of TEV | Ecosystem services valued/ application | Comment/examples | Advantages | Limitations |
|---|---|---|---|---|---|---|---|
| Stated preference | **Contingent valuation** | Amount of money individuals are willing to pay or willing to accept regarding changes in ecosystem services (avoid damage or improvement) (questionnaires) | Use and non-use | All | Species loss, air pollution, clean water (e.g. by maintaining a regional forest unharmed) | Able to capture use and non-use values | • Bias in responses<br>• Resource-intensive/expensive<br>• Hypothetical nature of the market |
| | **Choice modelling** | Willingness to pay for preferred ecosystem services from a list of alternatives with varying degrees of ecosystem services ( questionnaires) | Use and non-use | All | Species loss, protected areas, air, pollution, clean water | | Similar to contingent valuation above |
| | **Group valuation** | Based on the preference of a group through deliberative processes | Use and non-use | Increasingly used as a way to capture value types that may escape individual based surveys, usually for non-human values or social justice values | Addresses limitations of revealed preference methods such as preference construction during the survey and lack of knowledge among respondents about what they are being asked | | |
| Benefits transfer | **Benefits transfer** | Transfer values estimated from previous research/research at other locations | All | Any ecosystem service when comparison studies available (not a method as such but can be applied to all methods above) | Assessing the value of a forest by applying the measured economic value of another forest of the same type/size, with similar socio-economic conditions | | Can be inaccurate, as factors vary even when contexts seem 'similar'; should be used with caution |

*Note:* For each method, additional information is provided including: the general approach, the elements of the Total Economic Value (TEV) captured, the ecosystem services that are valued and possible applications, some examples and advantages/limitations of the method.

*Source:* EVAMAB team.

## Different methods for different services

All these methods have their pros and cons, and each method may be more suited to capturing the values of particular ecosystem services and value types.

- **Provisioning services** delivering goods that can be sold on a market will be assessed by using the market prices.
- **Regulating and cultural services** will be valued using revealed and stated preferences.

Hybrid approaches may overcome the limitations of certain valuation methods. More than one method may need to be applied in order to estimate the value of different services from a single biosphere reserve (see **Table 13**).

**TABLE 13.**
**MOST RELEVANT METHODS APPLICABLE TO SPECIFIC ECOSYSTEM SERVICES**

| Service | Relevant methods |
|---|---|
| **Food, timber, fuel wood** | Market price |
| **Water filtration and storage** | Replacement cost or production function |
| **Disaster mitigation** | Replacement cost, avoided cost or production function |
| **Support to fisheries** | Production function |
| **Recreation value** | Market prices, contingent valuation, travel cost, hedonic pricing or choice modelling |
| **Visual aesthetics** | Contingent valuation, hedonic pricing or choice modelling |
| **Biodiversity value** | Contingent valuation or choice modelling |

*Source:* EVAMAB team.

**BOX 22.**
**THE ECONOMIC IMPACT OF WATER HYACINTH INFESTATION ON FARMERS: CASE OF LAKE TANA BIOSPHERE RESERVE, ETHIOPIA, USING CONTINGENT VALUATION**

The **Lake Tana Biosphere Reserve** in north-western Ethiopia surrounds Lake Tana, which accounts for 50% of the country's total inland waters (UNESCO, 2020) and is the main source of the Blue Nile river. The area is a hotspot of biodiversity: it is internationally known as an Important Bird Area and is of global importance for agricultural genetic diversity as well as forest biodiversity on the islands in the lake. Moreover, the Lake Tana islands harbour historical and culturally important Ethiopian orthodox churches. Thus, Lake Tana contributes through ecosystem services to the livelihoods and well-being of a large number of people, with more than 2 million living in the biosphere reserve.

**FIGURE 49.**
**MAP OF LAKE TANA AND THE RESULT OF WATER HYACINTH INFESTATION**


© W. Van Oijstaeijen
Map: UNESCO

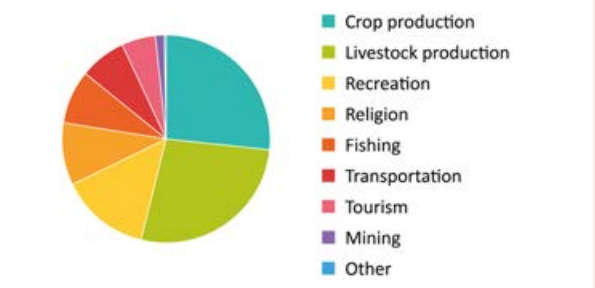
Since 2011, the lake has been threatened by an invasion of **water hyacinth**, the world's worst aquatic weed. The infestation spread rapidly, covering up to around 5,400 ha in 2018 (Gezie et al., 2018), and interferes with local biodiversity, affecting the production of ecosystem services.

Placing an economic value on the impact of the infestation on affected actors is crucial in order to make informed, evidence-based decision-making at higher levels. 98% of respondents of the study described water hyacinth as an obstacle in achieving the full potential of ecosystem services. To determine the economic value of a water hyacinth-free Lake Tana, it was necessary to assess the impact of the infestation on all stakeholders.

Respondents **to a contingent valuation study** stated their willingness-to-pay (WTP), as well as their willingness to contribute in days of labour (WTCL) towards a hypothetical market-scenario of water hyacinth control. For complete eradication – which has become impossible given the gravity of the situation – respondents expressed a willingness to pay the equivalent of **one and a half months of local wages**. These findings express the urgency to adapt management and find solutions, and should be mainstreamed into policy-making.

This study focused on local farming communities (as the priority ecosystem service in the area) and hence only values part of the total benefits. Further research could elaborate on the impact of the water hyacinth infestation on other key stakeholders (e.g. fisheries, hydro-electric plants, etc.).

**FIGURE 50.**
**OVERSIGHT OF ECOSYSTEM SERVICES AROUND LAKE TANA**

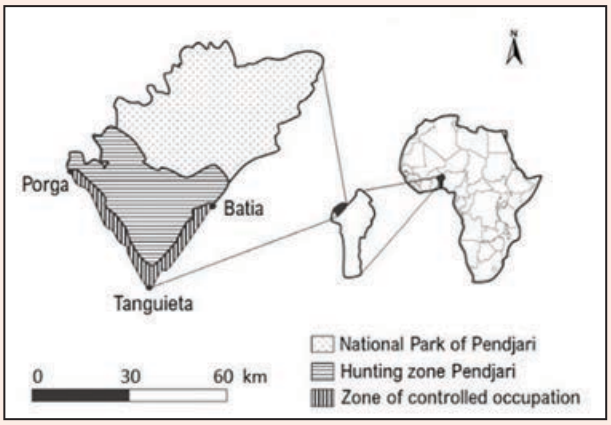



*Source:* Van Oijstaeijen et al. (2019).

**BOX 23.**
**WILLINGNESS TO ACCEPT PROTECTED AREA EXPANSION IN PENDJARI BIOSPHERE RESERVE, BENIN**

The most valued ecosystem services in **Pendjari National Park** (Northern Benin) (see **Box 18**) are food provision from agriculture, water for domestic use and tourism (De Ryck, 2018). Agriculture is the main activity of riverine villages and often the only source of income of the local population. According to the inhabitants of the riparian villages, there is a serious shortage of land. People inhabit the area between the mountain range and the limits of the park and have access to the 'Zone d'occupation contrôlee' (controlled agricultural zone, CAZ) in the transition area of the biosphere reserve. Tourism is well developed in the area and functions as a main focus of the new management authority since 2017, the African Parks Network.

**FIGURE 51.**
**MAP OF PENDJARI BIOSPHERE RESERVE (TOP) AND HABITATION IN THE CONTROLLED AGRICULTURAL ZONE OF PENDJARI BIOSPHERE RESERVE (BOTTOM)**




© L. Janssens de Bisthoven
*Source:* Janssens (2019) (map).

The CAZ is only open to the local population. Originally, agriculture was not permitted in this area, but lack of clarity around this issue resulted in use of the land of the protected area for agriculture. Since the management changed, the border between CAZ and the buffer zone has been clearly marked with poles that are being replaced by a fence in the future. This border is closely monitored and any trespassing leads to imprisonment. People can ask approval to collect Non-Timber Forest Products (NTFP) in the buffer zone but must be accompanied by a park representative.

In a survey, the households of the riparian villages were asked: 'What would you be willing to accept if the controlled agricultural zone was reduced by 25% in order to lessen the human impact on the protected reserve?'

## KEY FINDINGS

- The CAZ is highly valued among the local population, especially by those living close to the fence line and active in crop farming (reflecting their higher park dependency).
- The answers to the survey can be used as a basis for cost-benefit analysis in policy making.
- The population relies heavily on crop farming for their income and potential food shortages are their main concern if the CAZ is reduced in size.

## RECOMMENDATIONS

- Policy-makers should design compensation schemes that encourage sustainable development, contributing to both the welfare of the local population and the conservation of nature for humanity (now and future generations).
- Alternative schemes must be considered that address the population's concerns around food shortages. Alternatives proposed by the study include:
  - innovative solutions to increase farm productivity; and
  - encouraging a transition away from crop farming towards other economic activities. Subsidizing other – less land intensive – activities reduces pressure on biodiversity and reduces the population's dependency on agricultural land.
- Raising awareness about the importance of biodiversity conservation would promote understanding among the local population about why biodiversity is needed (and the consequent need for a fence) and the consequences of their destructive activities.

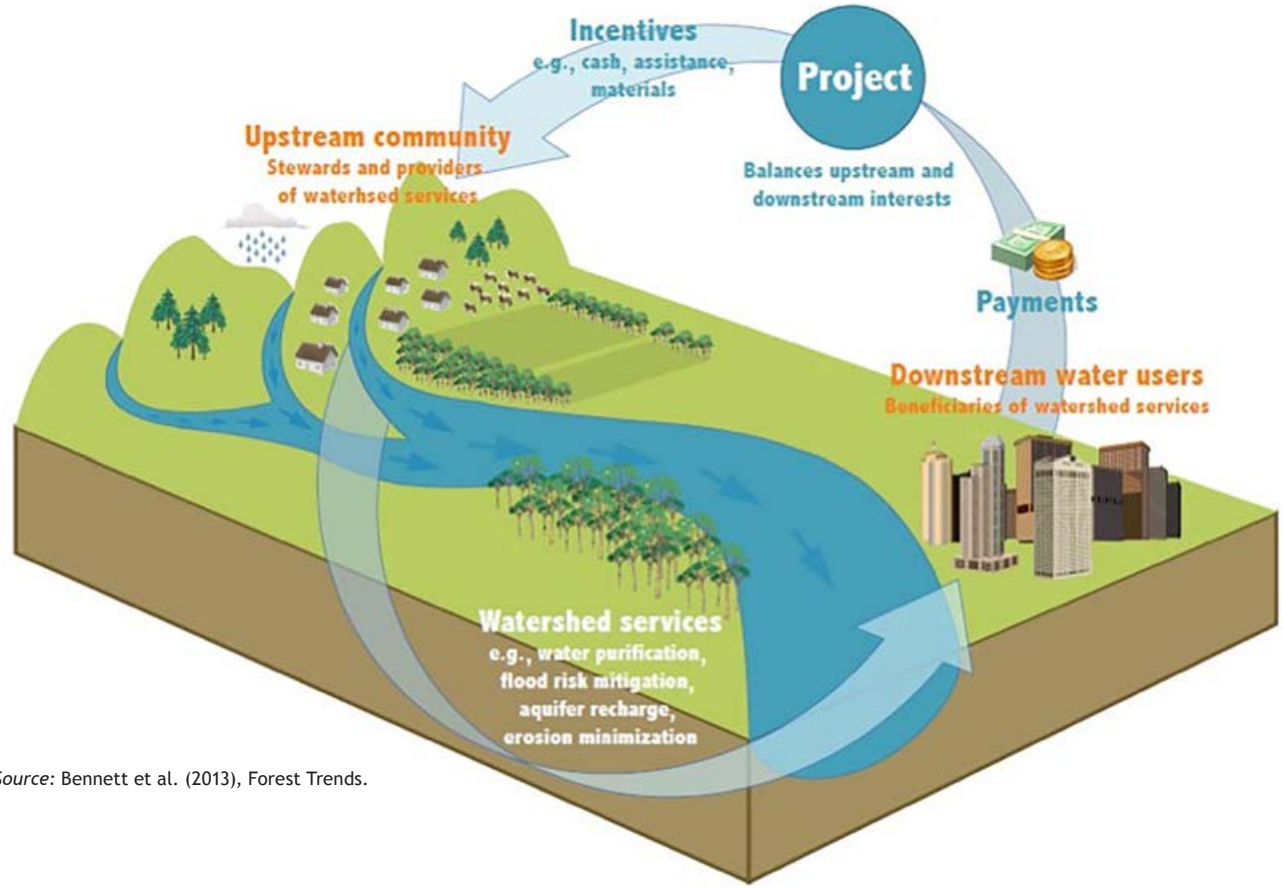
*Source:* CENAGREF (2009); Fabri (2019); Hasaers (2019).

# WHAT ARE PAYMENTS FOR ECOSYSTEM SERVICES (PES)?

Payments for ecosystem services (PES) occur when the beneficiaries or users of a given ecosystem service pay for provision. The basic idea behind this concept is that whoever provides a service should be paid for doing so (Fripp, 2014). As an example, the United Nations' Reducing Emissions from Deforestation and Forest Degradation (REDD+) programme has proposed to channel hundreds of millions of dollars through PES schemes for forest emissions reductions (Leimona et al., 2019).

In the example below, the buyers are downstream water users, benefiting from services provided by the providers, the upstream community, who secure watershed services such as water purification through their management of the land. In most PES schemes, there is also a broker or intermediary that brings together the different stakeholders, clarifies the underlying logic of a possible PES scheme and makes sure that key principles such as FPIC (Free, Prior and Informed Consent) are upheld.

**FIGURE 52.**
**EXAMPLE OF PAYMENTS FOR ECOSYSTEM SERVICES IN A WATERSHED**




*Source:* Bennett et al. (2013), Forest Trends.

*'Among traditional conservation strategies such as protected areas and community conservation, innovative instruments such as Payment for Ecosystem Services (PES) schemes have been increasingly promoted to incentivize conservation and sustainable resource management. PES programmes are at the centre of the contemporary conservation agenda, supported by donors (e.g. Norwegian government, World Bank), intergovernmental policy bodies (e.g. Convention on Biological Diversity), governments (e.g. Costa Rica, Mexico, Ecuador, South Africa, Vietnam, China), the private sector (e.g. Danone water, Ecotourism Kenya), and nongovernmental conservation organizations (e.g. Conservation International, the World Wildlife Fund).'*
*Pascual et al. (2014)*

*PES is 'a voluntary transaction where a well-defined ecosystem service (or a land use that is likely to secure that service) is being bought by at least one ES buyer from at least one ES provider, if and only if the ecosystem service provider secures ecosystem service provision.'*
*Wunder (2005)*

## Different scales of PES schemes for different ecosystem services involving different actors

Payments for Ecosystem Services (PES) operate as incentive-driven programmes and projects intended to protect or provide sustainable flows of ecosystem services. They can refer to **small local projects** targeting specific species (e.g. the sale of permits for sustainable selective hunting of a turkey in Guatemala to fund habitat conservation and support local livelihoods), **as well as substantially larger projects** both in geographic and monetary terms (e.g. the US$1 billion investment of the Norway Environment Ministry to the Brazil Amazon Fund to fund programmes encouraging afforestation and reducing deforestation) (Chan et al., 2017).

## Different types of PES schemes

PES schemes are based on a variety of governance systems and may be classified as follows (Goldman et al., 2008; Koedam, Di Nitto and Hugé, 2018; UNEP, 2011):

- **Private arrangements** are self-organized private deals where beneficiaries of ecosystem services contract directly with service providers.
- In **government-driven** schemes, the government pays land or resource managers to enhance ecosystem services on behalf of the wider public.
- **Hybrids of the above two types** draw on both government and private funds. For example, municipal governments, environmental NGOs, private firms and local water users can collaborate over a scheme where beneficiaries of clean water pay into a trust that funds watershed restoration projects to enhance the quality and quantity of water delivery.

The examples in **Table 14** illustrate some of these differences.

**TABLE 14.**
**EXAMPLES OF PES SCHEMES**

| Example | Who | What |
|---|---|---|
| **Kibale Forest Wild Coffee (Uganda)** | S: Farmers<br>B: Uganda Coffee Trade Federation | **Biodiversity conservation:** communities are committed to conservation practices that mitigate the threat to biodiversity in both the core area and the buffer zone. The scheme provides a self-sustaining incentive for biodiversity conservation in agricultural landscapes.<br>This private venture involving the Uganda Coffee Trade Federation (succeeded by the Kibale Forest Foundation) and residents of six villages is located on the north-eastern border of the Kibale National Park. Farmers get paid through premium prices for their coffee. |
| **Upper Tana–Nairobi Water Fund (Kenya)** | S: Communities<br>I: The Nature Conservancy<br>B: A public utility company | **Watershed services:** a public-private partnership where the public utility company contributes to an endowment fund, the income from which is invested in conservation work downstream. Users of water raise resources to support watershed and other sustainable land management practices that benefit upstream local communities and improve the quality and reliability of water delivered downstream. |
| **Trees for Global Benefit (Uganda) (see Box 26)** | S: Small-scale landholder farmers<br>I: Ecotrust NGO<br>B: Resellers and direct buyers | **Climate services** with livelihood and biodiversity conservation benefits: this programme works with small-scale landholder farmers, rewarding them for increasing carbon stocks on their land through tree-planting as part of the Plan Vivo voluntary carbon scheme. Income from the sale of carbon credits goes directly to participating households if the trees are well-maintained. |
| **Wildlife Lease Programme (WLP) (Kenya)** | S: Pastoral landowners<br>I: Conservation NGOs<br>B: Public institutions (World Bank, Government of Kenya) | **Biodiversity and wildlife tourism-based PES:** pastoral landowners in the south of the Nairobi National Park are paid annually in return for managing land for wildlife and livestock grazing and avoiding fencing, quarrying, crop cultivation, and the sale or sub-division of land. This approach follows a 'publicly funded' model. |

*Note:* 'Who' column: 'S' = seller, 'I'= intermediary, 'B' = buyer.
*Source:* EVAMAB Team with examples from FAO (2016), Osano de Leeuw and Said (2017).

## PES SCHEMES MUST CONSIDER FACTORS RELATED TO SOCIO-ECONOMICS, GOVERNANCE AND POWER

Caution should be exercised when entering into PES schemes, as such schemes are often the result of complex negotiations between diverse actors and can result in a number of trade-offs (Merlet, Van Hecken and Rodriguez-Fabilena, 2018). Moreover, the outcome of these negotiations is often driven by motivational and socio-political dynamics, with often deep-seated power asymmetries. The better these factors are understood and taken into account, the higher the chance of success of any PES scheme. Therefore, PES schemes must be established by professionals with sufficient experience and should have sufficient anchorage in local and supralocal governance structures and mechanisms.

Further analysis and better engagement are required between the social and ecological science communities, in order to understand the relationships and trade-offs among efficiency, equity and ecological outcomes. Caution should be exercised in relation to equity-blind PES schemes, which overlook these relationships as a result of a primary and narrow focus on economic efficiency. Factors such as the increasingly multidimensional view of social equity for conservation must be taken seriously — not least because of the important causal links between equity and ecological outcomes (Leimona et al., 2019). Although experience shows that seemingly inequitable approaches to conservation can sometimes meet environmental objectives, the contexts for conservation are changing, with increasing appreciation of the complexities of social–ecological systems.

Social equity can be characterized by four conditions (Leimona et al., 2019) :

**Procedure** the degree of involvement and inclusiveness in rulemaking and decisions around land management or conservation programmes;

**Distribution** the distribution of costs, benefits, burdens and rights derived from land management or conservation actions or programmes;

**Recognition** the respect for knowledge systems, values, social norms, and the rights of all stakeholders in the design and implementation of conservation programmes; and

**Context** the surrounding social conditions (e.g. power dynamics, gender and education) that influence the actors' ability to gain recognition, participate in decision-making and lobby for fair distribution.

The social equity outcomes bear risks and opportunities which will respectively influence negatively or positively the ecological outcomes which PES schemes should achieve.

The guidance in this manual represents a first step to better understanding the many aspects linked to PES. In view of real-world scenarios, this guidance might seem oversimplified and we advise to consult further specialized literature (see 'More information' at the end of the chapter).

## HOW TO SET UP REWARD MECHANISMS FOR ECOSYSTEM SERVICES?

There is a saying that success is where preparation and opportunity meet. **Opportunities** in terms of global and local reward systems for the provisioning of ecosystem services **do exist and many if not all biosphere reserves have the potential to benefit from them** (e.g. the carbon market, see **Box 24**).

**BOX 24.**
**THE VOLUNTARY CARBON MARKET**

The official carbon market – that encompasses the Clean Development Mechanism (CDM and CDM-PoA) – is complemented by a lesser-known voluntary carbon market, which can be more easily implemented. The voluntary carbon market kept growing over the years. Volumes of carbon are sold as offset issuances and retirements (issuances are offsets available for sale and retirements are offsets that can no longer be resold). Average voluntary carbon offset prices ranged in 2018 between US$3-$6/$tCO_{2e}$ but top prices could reach US$70/$tCO_{2e}$ (Hamrick and Gallant, 2018). The higher prices could generally be obtained when in addition to carbon, other ecosystem services (such as biodiversity) were enhanced or when certain development goals can be achieved at the same time.

However, in order to seize opportunities and achieve a sustainable reward mechanism, thorough preparation is indispensable. **Figure 53** shows the essential steps to follow.

**FIGURE 53.**
**ESSENTIAL STEPS FOR THE DEVELOPMENT OF PES SCHEMES**


*Source:* Defra, *Crown*.

## 01. Identify sellable ecosystem services and prospective buyers and sellers

In the past, the starting point for many nature conservationists was the wealth of ecosystem services provided by their reserve. However, not all of these services could be sold. To avoid disappointment, it is best to establish first a sense of prospective buyers and then work backwards to delivery of ecosystem services. In the case of biosphere reserves, the entire area cannot be marketed – nor is this desirable. For example, it would be difficult to sell carbon credits of a biosphere reserve where part of the site is a protected area. The non-protected surrounding area, however, would qualify.

**FIGURE 54.**
**RIVER MANAFWA AFTER A RAINSTORM AT THE MOUNT ELGON BIOSPHERE RESERVE, UGANDA**

©Koen Vanderhaegen

**FIGURE 55.**
**WILD MUSHROOMS FOUND DEEP IN THE MOUNT ELGON BIOSPHERE RESERVE FOREST**

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3rdtimeluckystudio/Shutterstock.com

## 02. Establish PES scheme principles and resolve technical issues

After the identification of all key ecosystem services (including a.o. clean water, non-timber forest products, ... Provided by the biosphere reserve, information should be gathered on trends regarding their provision. This will facilitate the defining of current trends without intervention (business-as-usual scenario) and hypothetical scenarios depending on the definition of the intervention/scheme (strategic planning). Both are critical to assess the additionality in ecosystem service provisioning the future project could generate and the reward that could be obtained by this. E.g. an extrapolation of the current trends in increasing sediment loads in the rivers along the foot slopes of Mt. Elgon such as river Manafwa together with the purification costs of drinking water for the nearby city of Mbale could define a business-as-usual scenario for the local water purification company who could be a potential buyer in a payment for watershed services scheme. Different interventions involving combinations of conservation practices in the upper slopes area (e.g. the creation of riparian buffer strips, soil conservation practices on fields, ...) and possible compensation modes and amounts for the participating farmers (direct, in a fund, cash, labour, in kind) were assessed (Geussens et al., 2019). For some smaller interventions no compensation was needed as the local intrinsic benefits were perceived as sufficient. Larger interventions e.g. involving a large amount of labour did not come cheap.

Besides improvement in awareness and the urgent need to take action, this step acts as a good opportunity to involve all stakeholders and will be critical for initiating long-term monitoring of ecosystem services. Hypothetical project scenarios, as mentioned above, are actually co-designed action plans and a form of tactical planning. All levels of stakeholders should be involved from the national to the local level, e.g. with the individual participating farmers such as done in the Trees for Global Benefits project (ECOTRUST, 2016). Collaboration with higher authority levels is needed to eventually adapt or accommodate initiatives to pre-existing governance programmes, while 'red lines' to safeguard local priorities/objectives must be drawn, and clear responsibilities and roles of the various stakeholders defined.

A **socio-economic valuation** can also be conducted, and the delivery of marketable ecosystem services under the future project quantified and translated into a socio-economic return. Ideally, the project should become viable without donor money. In addition, a fair benefit-sharing system must be worked out prior to implementation. Key questions include 'What are buyers prepared to pay?' and 'For what amounts are local ecosystem service providers prepared to change their behaviour?' The PES scheme should also be transparent and conditional. If the service is not delivered, payment is not due. **FPIC (Free, prior and informed consent)** is a key principle, as PES is by definition a voluntary scheme.

**Technical issues** might arise relating to how ES are being measured or how PES payments are carried out. For example, benefits from marketed ecosystem services might be compensated under the form of revolving funds, in-kind rewards such as tools or labour, direct payments, investments at community level or combinations of these and more. **Figure 56** provides an example of how a sustainable working relationship between actors can be established.

For some ecosystem services such as some cultural services or wildlife habitats, where the market is small or in-existent, **other reward mechanisms** could be considered. These could include land tenure rights, sustainable livelihoods, agricultural extension, protection and access to sacred sites for cultural rituals, and risk reduction (e.g. in relation to landslides in Mount Elgon Biosphere Reserve).

An **assessment** needs to be made up front to ascertain key areas/places of value and related risk mitigation plans. It is essential to have in place a plan in the event of **physical risks** such as natural disasters (fires, floods, landslides, etc.), **reduced budgetary support** from national or local governments or donors, and unrest due to a change in the political situation. In addition to management plans to cope with such risks, a small share of the funds/revenues could be set aside as a **buffer fund**.

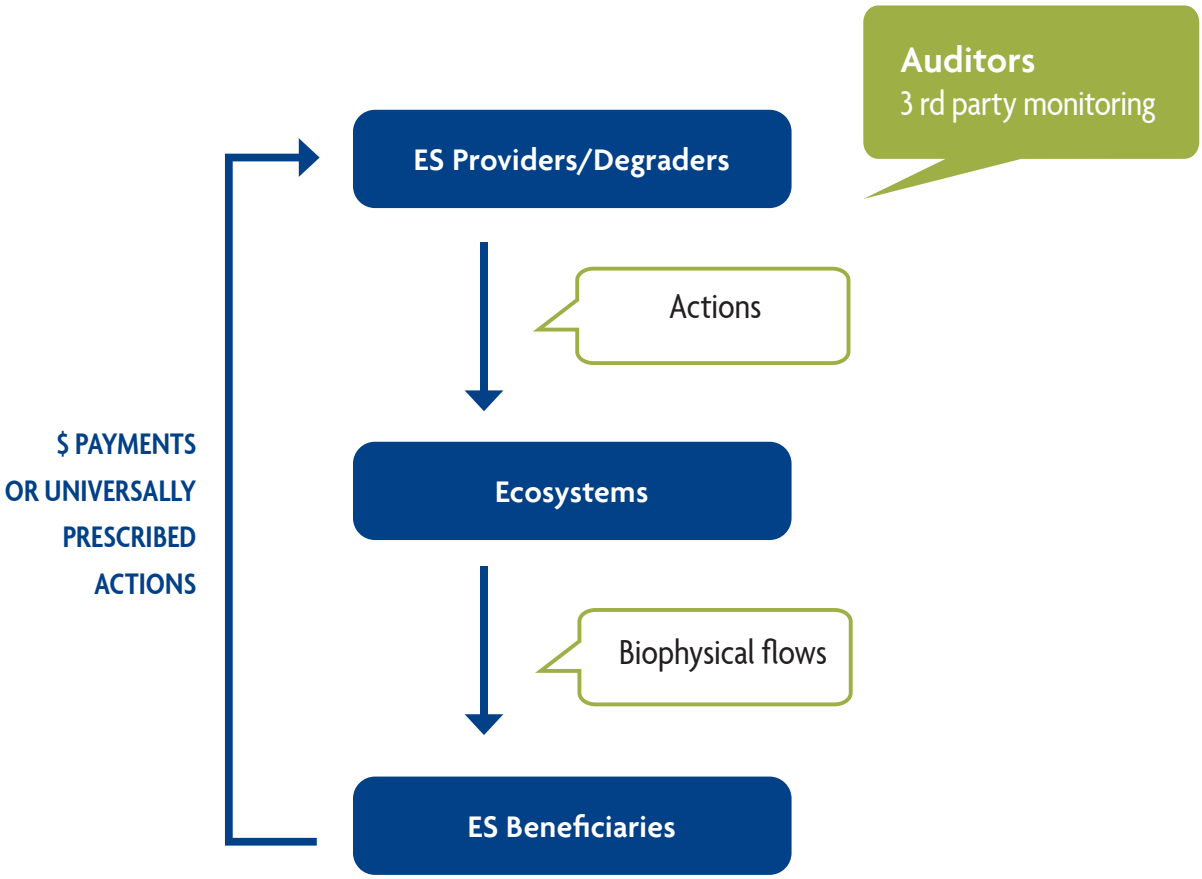
Preparations need upfront investments. It is therefore essential to **make sure you have a budget**. Help from donors is often a welcome support at this stage, as some monetary rewards such as from carbon offsets might take years to arrive. **Funds from donors** can be a valuable support during this start-up phase. Potential donors could be a combination of:

- international organizations/funds for nature conservation (e.g. IUCN, WWF, CEPF, WCS);
- national development agencies (e.g. GIZ, AFD, SNV, NORAD);
- regional bodies (e.g. water companies, agricultural businesses, tourism sector); and
- university research projects.

The technical preparation stage also includes the setting up of teams for daily operations (e.g. bookkeeping, data management, reporting), monitoring and extension services, and for marketing. If the marketing of certified ecosystem services credits (e.g. Verified Emission Reductions) is an objective, then the selection of a third party verification body will be necessary (e.g. Plan Vivo, Rainforest Alliance, **Figure 56**). The cost of validation and verification will be carried by the project.

Partnerships will generally be necessary. Organizations active in the surrounding area of the biosphere reserve (e.g. NGOs) may already have been involved in local development actions and/or PES schemes, and could have valuable expertise to offer. They might also be willing to cooperate and co-invest if outcomes are beneficial for both.

**FIGURE 56.**
**THIRD-PARTY MONITORING CAN LEAD TO CERTIFIED ECOSYSTEM SERVICES CREDITS WHICH CAN BE SOLD AT HIGHER PRICES**




*Source:* adapted from Chan et al (2017).

## 03. Negotiate and implement agreements

Stakeholders active in the broader region of the biosphere reserve often have conflicting goals and management ideas. These need to be mapped to identify potential win-win situations or trade-off (more information on stakeholder engagement can be found in **Chapter 5**). Potential stakeholders may include MAB managers, community representatives, NGOs active in the region, (local) universities, research institutes and government representatives. Collaboration with groups already active in PES schemes can involve sharing of valuable information and lessons. Universities or other research institutes could share available baseline data, start-up research on ecosystem services and so on, all of which is crucial during the preparatory phase. A sound scientific basis will help take the right decisions during the project design phase and will be necessary to convince investors.

## 04. Monitoring, reporting and verification (MRV)

As most PES schemes will be conditional, there is a need for monitoring, reporting and verification of the scheme and associated processes to make sure that the services are actually delivered. A scheme also needs to be set up, to make sure that payments or rewards in kind, depending on what was agreed will be paid. The monitoring should preferably be using simple but effective indicators to keep the costs of the PES-scheme low. This is an area where universities and research organizations could also step in to help design an appropriate scheme.

## 05. Opportunities for multiple PES

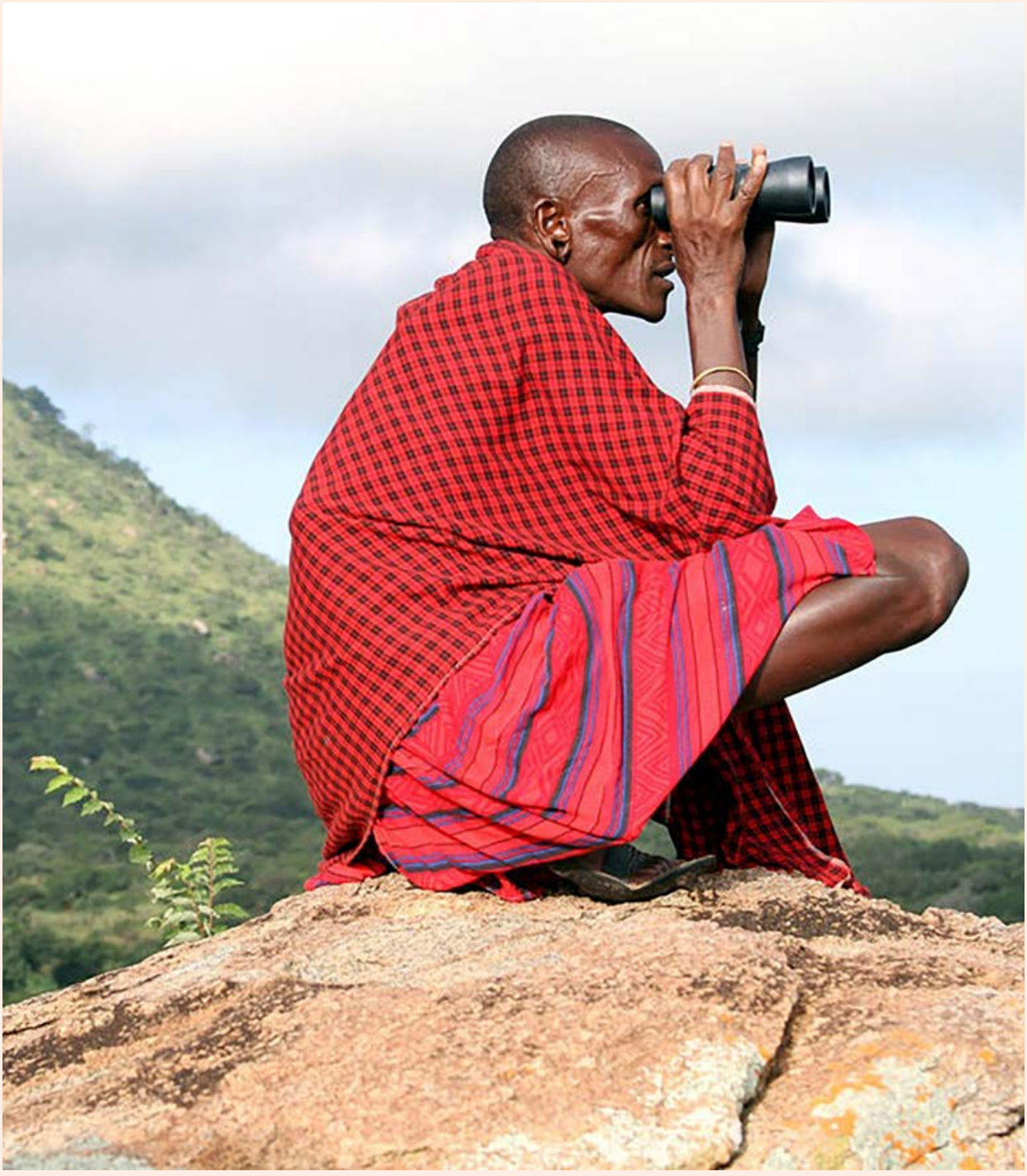
PES markets and schemes work at different scales depending on the ecosystem services (e.g. global for carbon, local for water or eco-tourism). However, biodiversity is such a specific service that the best way to preserve it is to bundle it with other ecosystem services, emphasizing that adding biodiversity to a carbon scheme, for example, can increase the potential rewards.

**BOX 25.**

**EXAMPLE OF LOCAL PES IN TANZANIA: THE SIMANJIRO PLAINS**

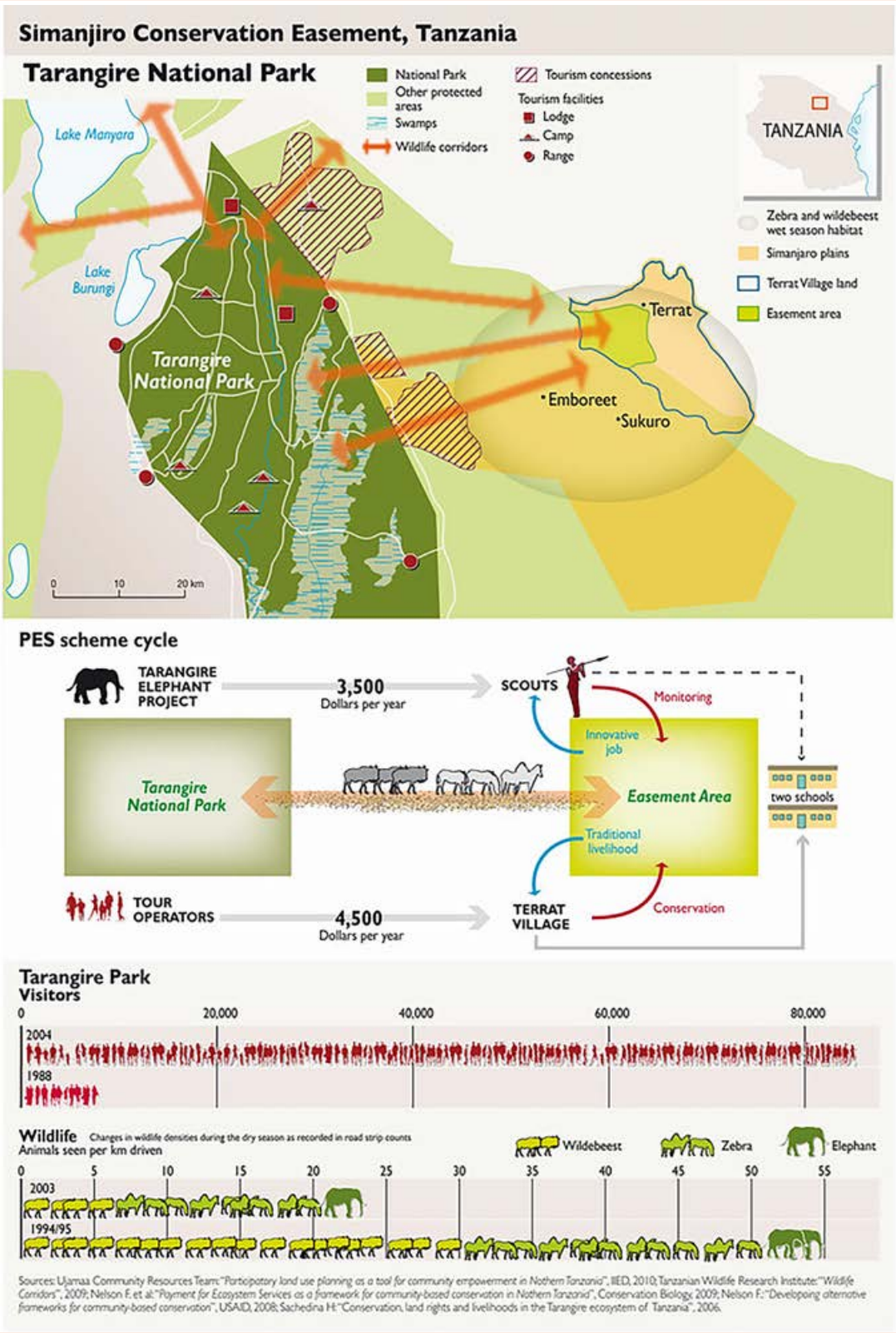
The Simanjiro plains (outside Tarangire National Park, Tanzania) are among the most important wildlife areas in Tanzania, providing a key wet season calving and grazing habitat for thousands of wildebeest, zebra and antelopes which spend the dry season in the national park.

Social changes and immigration, however, have provoked a shift from traditional pastoralism in the Simanjiro plains among native Maasai herders to permanent settlements and farming. To reverse this trend and conserve the plains a local PES scheme, Conservation Easement, was set up with the neighbouring Terrat and Sukuro villages. In return for maintaining the plains as livestock pasture and prohibiting permanent settlements and farming, the villages are paid an annual lease fee by a consortium of tourism companies. The villages also provide a number of game scouts who work to prevent illegal wildlife use and charcoal production, and who collect data on wildlife numbers and movements.



© Jessica Bruder

**FIGURE 57.**
**SIMANJIRO CONSERVATION EASEMENT**




*Source:* GRID-Arendal (2013).

The project has existed for over ten years and has proven to be a successful means to integrate external conservation interests and local land use concerns in a way that benefits both pastoralists and wildlife.

*Source:* Dorobo Fund (2018).

**BOX 26.**
**EXAMPLE OF A GLOBAL PES IN MOUNT ELGON BIOSPHERE RESERVE, UGANDA: TREES FOR GLOBAL BENEFITS**

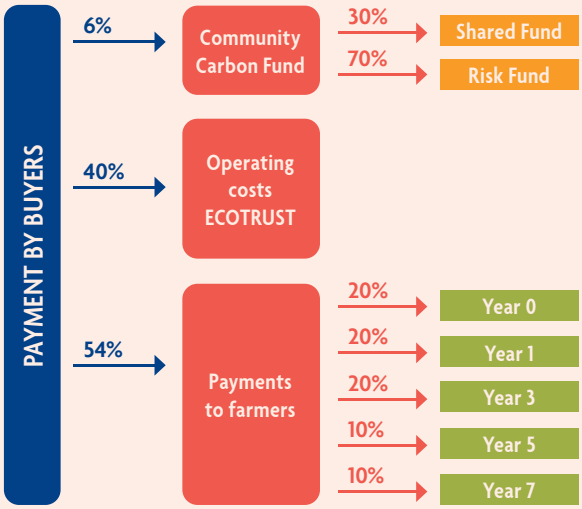
Trees for Global Benefits is an example of a successful carbon project implemented in the transition zone of **Mount Elgon Biosphere Reserve**. This agroforestry PES project, led by the Ugandan NGO ECOTRUST, launched in 2003 in Western Uganda, was implemented in the biosphere reserve in 2013, and has been ongoing ever since. The project is responsible for the sequestration of about 2 megatons of $CO_2$. About 6,000 small farmers are involved in planting and maintaining trees on their lands. In return, they are financially rewarded with a share of the income from certified carbon credits generated by them and certified by the Plan Vivo Foundation. In addition to mitigating climate change through carbon sequestration the project also provides many other co-benefits. The trees (native or naturalized species) help to conserve local biodiversity, reduce soil erosion and landslide risk, protect crops (by creating a cool microclimate, protecting against hail and sun, recycling nutrients, etc.), provide firewood and relieve pressure on the nearby buffer zone and core area of the Mount Elgon Biosphere Reserve. **Figure 58** illustrates the payment scheme of Trees for Global Benefits.

In order to remain viable, the project has diversified its activities to include the distribution of improved cook stoves and water purification systems.

The involved farmers are invited twice a year to a workshop where extension training is given on key topics such as silvicultural practices, the project process cycle, payment calculations, complementary economic activities, and so on. These occasions also provide an opportunity to offer and receive feedback.

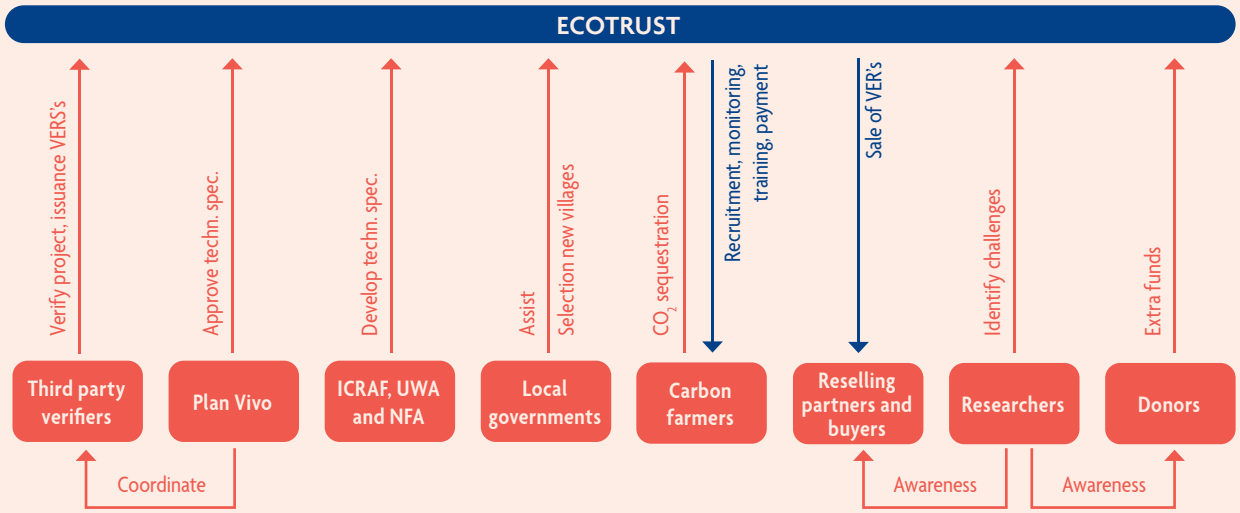
Buyers include resellers such as COTAP, ZeroMission or U&We, and direct buyers (Ugandan and foreign companies). The project also receives funds from a variety of donors (CARE, IUCN, UNDP, UNEP and USAID).

**FIGURE 58.**
**OVERVIEW OF THE PAYMENT SCHEME**




*Source:* Baeten (2018).

**FIGURE 59.**
**INTERACTION BETWEEN ACTORS**




*Note:* VER = verified emission reduction, UWA = Ugandan Wildlife Authority, NFA = National Forest Authority.
*Source:* Baeten (2018).

*Source:* www.planvivo.org/project-network/trees-for-global-benefits-uganda.

**BOX 27.**

**FARMERS' PERSPECTIVES ON PES IN MOUNT ELGON BIOSPHERE RESERVE, UGANDA**

Payments for Ecosystem Services (PES) is a market-based policy tool that is increasingly being recommended for effective and sustainable management of watersheds, especially for sub-Saharan Africa, where soil and watershed degradation are currently very severe. The design of PES projects is challenging and insights into the local context are indispensable.

Using a choice experiment, this study investigated the perspectives of farmers on the design of a PES programme in the Mount Elgon region in Uganda. The results pointed to a strong willingness among farmers to participate in a PES contract. The majority of farmers were willing to adopt different conservation measures, even in the absence of compensation; while a minority of farmers were strongly averse to buffer strips along the river and required significant compensation.

Farmers were found to have strong preferences for individual over communal compensation. Additional in-kind rewards in the form of labour assistance or tools appeared to increase the willingness to accept a contract.

The findings indicated that PES is a promising avenue for improved watershed conservation in the Mount Elgon region; and that individual compensation, differentiation and specific targeting of such programmes may benefit their cost effectiveness (Geussens et al., 2019).

**FIGURE 60.**

**EXAMPLE OF CHOICE CARD USED TO INVESTIGATE THE PERSPECTIVE OF FARMERS IN THIS STUDY**

| CARD 4 | Contract A | Contract B | No Contract |
|---|---|---|---|
| 1. Distance to river banks to be protected |  5 M |  20 M | I choose not to enter any contract and to keep my current farming methods |
| 2. Contour trenches and grass bunds |  HALF OF FIELDS |  NONE OF FIELDS | |
| 3. Soil conserving agricultural practices (minimal tillage, mulching ...) |  NONE OF FIELDS |  HALF OF FIELDS | |
| 4. Yearly compensation |  360.000 UGX |  90.000 UGX | |
| 5. Mode of compensation |  INDIVIDUAL |  50/50 | |
| 6. Assistance in implementation |  LABOUR BUT NO TOOLS |  NO LABOUR AND NO TOOLS | |

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**BOX 28.**

## PLAYING BEFORE PAYING? A PES SIMULATION GAME FOR ASSESSING POWER INEQUALITIES AND MOTIVATIONS IN THE GOVERNANCE OF ECOSYSTEM SERVICES

**By Gert Van Hecken, UAntwerpen, Belgium**

One risk of market-based conservation instruments such as Payments for Ecosystem Services (PES) is the reproduction of existing social inequalities. Any examination of PES should therefore assess how these schemes are constructed and negotiated between different actors, with an explicit focus on their varying social positions, value frameworks and conflicting or collaborative relations.

More 'conventional' participatory methods (e.g. based on workshops, interviews, focus groups), as presented in **Box 17**, might not always sufficiently capture the many social-economic as well as livelihood struggles that local land users face in their daily lives, and which greatly influence their decision-making processes around land use change and deforestation.

Such methods also do not adequately reveal how decision-making and practices are embedded in and shaped by local, power-laden institutional arrangements. Traditional methods might also be insufficient to produce the types of 'knowledge encounters' necessary for stimulating open debate in which all involved actors (not only farmers or local land users, but also researchers, and NGO staff) engage in a questioning and deconstruction of their own worldviews and (implicit) assumptions, while recognizing alternative ways of knowing and doing, with the intent of offering a platform to collaboratively construct and discuss alternative socio-environmental perceptions and practices.

In order to address these issues, a 'PES simulation game' can be used as an alternative methodology to enhance understanding of complex negotiations between diverse actors involved in ecosystem services governance.

The game allows participants to adopt the roles of farmer households, mimic historical processes of agrarian change and social differentiation, simulate a range of potential alternative practices, and create space to collectively reflect on often hidden motivational and socio-political dynamics triggered by policy tools like PES.

Multiple iterations and applications of the simulation game in a Nicaraguan context (the buffer zone of the Indio-Maíz Biological Reserve) demonstrated its potential. The game created a collective learning platform where different perspectives from various actors (including the researchers themselves) could be compared, where links to real-life situations could be made, and where alternative views could be openly discussed and jointly interpreted.

When NGO practitioners and researchers played the game, they were able to observe, first-hand and in real time, how farmers' production decisions are constrained by broader structural-historical processes in which they are embedded. These processes are often overlooked or disregarded from an 'outsider' perspective. Playing the game with local groups encouraged the NGO and researchers to be humbler when comparing their (theoretical/policy-informed) knowledge to farmers' deeply ingrained knowledge on human-nature relations, and also encouraged the involved researchers and practitioners to pay more attention to the importance of mutual relations based on empathy. The latter point often emerged in post-game feedback sessions as a crucial condition for creating meaningful and respectful collaboration with local land users.

The game also offered new entry points for discussion of sensitive issues related to power differences in local communities, such as land grabbing by richer farmers. Ultimately, the game provided a platform and an impetus for discussions among (NGO) practitioners and land users about why unequal power relations are so persistent and difficult to challenge, but also stimulated reflections on possible alternative strategies to transform them (for more details, see Merlet et al., 2018).

**FIGURE 61.**

**THE PES SIMULATION GAME PLAYING BOARD WITH FOUR FARMER HOUSEHOLD PARTICIPANTS; FARMERS INVOLVED IN THE INDIO-MAIZ BIOLOGICAL RESERVE, NICARAGUA, PLAYING THE SIMULATION GAME**

© Pierre Merlet

**BOX 29.**

## CO-INVESTMENT IN ECOSYSTEM SERVICES: GLOBAL LESSONS FROM PAYMENT AND INCENTIVE SCHEMES

**By Meine van Noordwijk, World Agroforestry (ICRAF)**

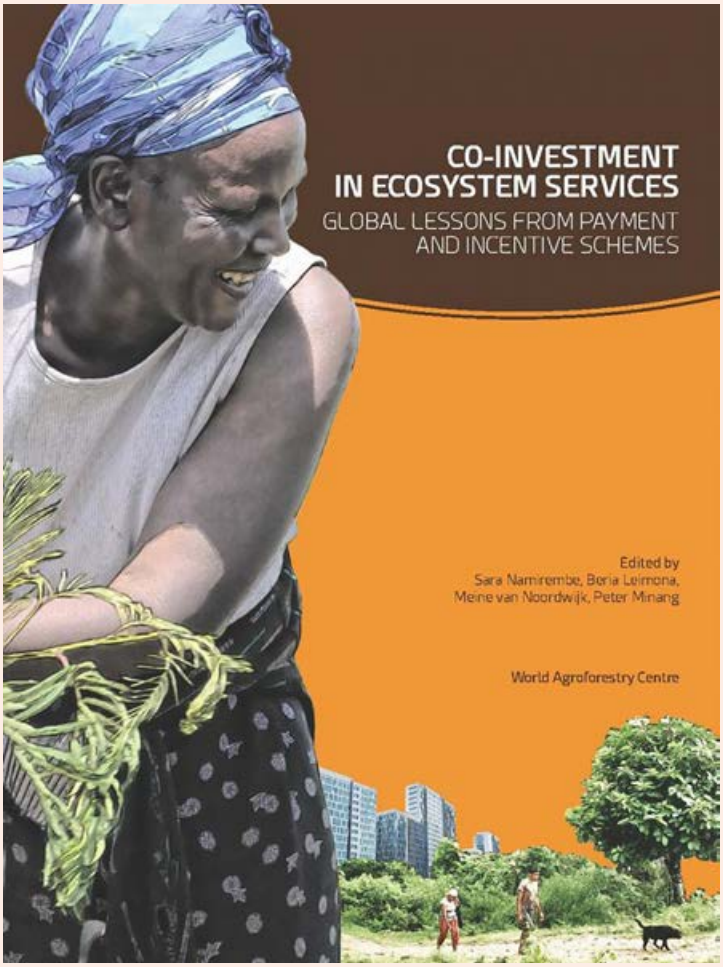
As explained in this chapter, PES is usually defined and analysed as a voluntary and conditional market transaction between 'buyers' and 'sellers', with benefits to both parties. Otherwise, they could easily walk away from the agreement. However, reality often differs from the definition, and often for good reasons.

Beyond market-based 'efficiency', perceptions of 'fairness' are at least as important (Van Noordwijk, 2012). The schemes that have a positive track record focus not just on financial transfers and market negotiations but also on expressions of shared responsibility and investments towards more sustainable forms of land use. Such arrangements have been named 'co-investment in environmental stewardship' and were found to dominate PES in an African context (Namirembe et al., 2014). A recent overview of cases mostly in Africa and Asia concluded that a purely economic perspective on 'rationality' in PES misses out on important social, ecological and governance aspects (Leimona et al., 2019). In practice, the majority of funding for PES is still 'public' funds mandated through policy decisions, rather than voluntary payments from the beneficiaries of direct ecosystem services.

Market transactions are a form of exchanging property rights. A major challenge in PES is the lack of clarity and contested nature of property rights over land and resources, even without PES complicating claims over who owns which trees, land or water and deserves rewards. A softer approach to resolving environmental issues may have more chance of success.

Conditionality (you get what you pay and pay what you get) is important for market-based transactions. With the exception of carbon stocks, the monitoring of actual ecosystem services has to deal with many sources of variation (including climate), which make it hard to prove change unless long-term records are viewed. 'Stewardship' is a term that suggests management in response to uncertain events, but with a long-term goal. Investment in positive change is more interesting than recurrent payments for services received, and this makes an 'investment' framing more attractive. Shared responsibility for investments as well as for the benefits that can be achieved reflects a common but differentiated responsibility for stewardship.

A recent analysis for Costa Rica (UNEP, 2011) suggested that PES in that country was a success because of flexibility in how it was explained and understood at different scales, with use of economic language at some levels, and a language of social and responsibility at another. PES as a terminology has found its place in resource governance, but a more nuanced understanding is needed to make it work over the long term.




The publication Co-investment in Ecosystem Services: Global Lessons from Payment and Incentive Schemes, published by the World Agroforestry Centre:

- provides new insights that support development practitioners with appropriate leverage points, so that they may increase the potential of payment for ecosystem service (PES) schemes to deliver the desired outcomes;
- stimulates debate among scientists and analysts about PES as a theory of change in the developing world context and where new models or knowledge are needed; and
- recommends appropriate interventions for policy-makers to apply PES as a tool for sustainable land governance and management in contexts where poverty is rampant, business activity is low and environmental funds need to be better targeted to provide ecosystem services.

The publication is available online at www.worldagroforestry.org/sd/environmental-services/PES.

# MORE INFORMATION

## Online courses

- Valuing Nature: Should We Put a Price on Ecosystems? (University of Exeter, United Kingdom)
  www.futurelearn.com/courses/valuing-nature-should-we-put-a-price-on-ecosystems.

- Secretariat of the Convention on Biological Diversity (SCBD). 2019. *Biodiversity valuation e-learning course*
  https://scbd.unssc.org/course/index.php?categoryid=7.

## (Economic) valuation of biodiversity and ecosystem services

- Quantifying and valuing ecosystem services. S. Namirembe, B. Leimona, M. van Noordwijk and P. Minang (eds), *Co-investment in Ecosystem Services: Global Lessons from Payment and Incentive Schemes*. Nairobi, World Agroforestry Centre (ICRAF)
  www.worldagroforestry.org/sites/default/files/chapters/Ch4%20ES%20Quantification%20and%20Valuation_ebookB-DONE2.pdf .

- Pabon-Zamora, L., Bezaury, J., Leon, F., Gill, L., Stolton, S., Grover, A., Mitchell, S. and Dudley, N. 2008. Nature's Value: Assessing protected area benefits. J. Ervin (ed.), *Quick Guide Series*. VA: The Nature Conservancy.

- The Economics of Ecosystems and Biodiversity:

  - TEEB. 2010a. *The Economics of Ecosystems and Biodiversity for Local and Regional Policy Makers*
    www.teebweb.org/publication/teeb-for-local-and-regional-policy-makers-2.

  - TEEB, 2010b. *The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations*. London/Washington, DC, Earthscan.
    http://www.teebweb.org/ourpublications/teeb-study-reports/ecological-and-economic-foundations.

- Webpage of the IPBES on different values and valuation approaches
  https://ipbes.net/diverse-values-valuation.

- A website about ecosystem valuation for non-economists who need answers to questions about the benefits of ecosystem conservation, preservation or restoration www.ecosystemvaluation.org (some examples of economic valuation in biosphere reserves can be found in Appendix 1).

- Ecosystem services valuation database
  www.es-partnership.org/services/data-knowledge-sharing/ecosystem-service-valuation-database.

- Guidance – Enabling a Natural Capital Approach (ENCA)
  www.gov.uk/guidance/enabling-a-natural-capital-approach-enca.

- About specific valuation techniques:

  - Market-based techniques
    www.cbd.int/doc/meetings/im/rwim-wafr-01/other/rwim-wafr-01-2-market-price-based-methods-en.pdf.

  - Production function
    https://oppla.eu/sites/default/files/uploads/methodfactsheetproduction-function-approach.pdf.

  - Fact sheets on multiple methods:
    - Comparison of economic valuation methods
      https://planbleu.org/sites/default/files/upload/files/FactSheets_methods_EN.pdf.

    - Introductory guide to valuing ecosystem services
      https://ec.europa.eu/environment/nature/biodiversity/economics/pdf/valuing_ecosystems.pdf.

    - The economics of valuing ecosystem services and biodiversity
      http://africa.teebweb.org/wp-content/uploads/2013/04/D0-Chapter-5-The-economics-of-valuing-ecosystem-services-and-biodiversity.pdf.

## About PES

- *Co-investment in Ecosystem Services: Global Lessons from Payment and Incentive Schemes*. World Agroforestry Centre www.worldagroforestry.org/sd/environmental-services/PES.
- *Payments for Ecosystem Services (PES): A Practical Guide to Assessing the Feasibility of PES Projects (CIFOR)* https://doi.org/10.17528/cifor/005260.
- *Payments for Ecosystem Services: A Best Practice Guide*. London, Defra www.gov.uk/government/publications/payments-for-ecosystem-services-pes-best-practice-guide.
- *Beyond Market Logics: Payments for Ecosystem Services as Alternative Development Practices in the Global South* https://onlinelibrary.wiley.com/doi/epdf/10.1111/dech.12546.
- More information about the monitoring, reporting and verification of PES schemes can be found in *Monitoring for Performance-based PES: Contract Compliance, Learning and Trust Building* www.worldagroforestry.org/sites/default/files/chapters/Ch5%20MonitoringPerformancePES_ebookB-DONE2.pdf.

## Other studies of PES schemes in biosphere reserves or in Africa

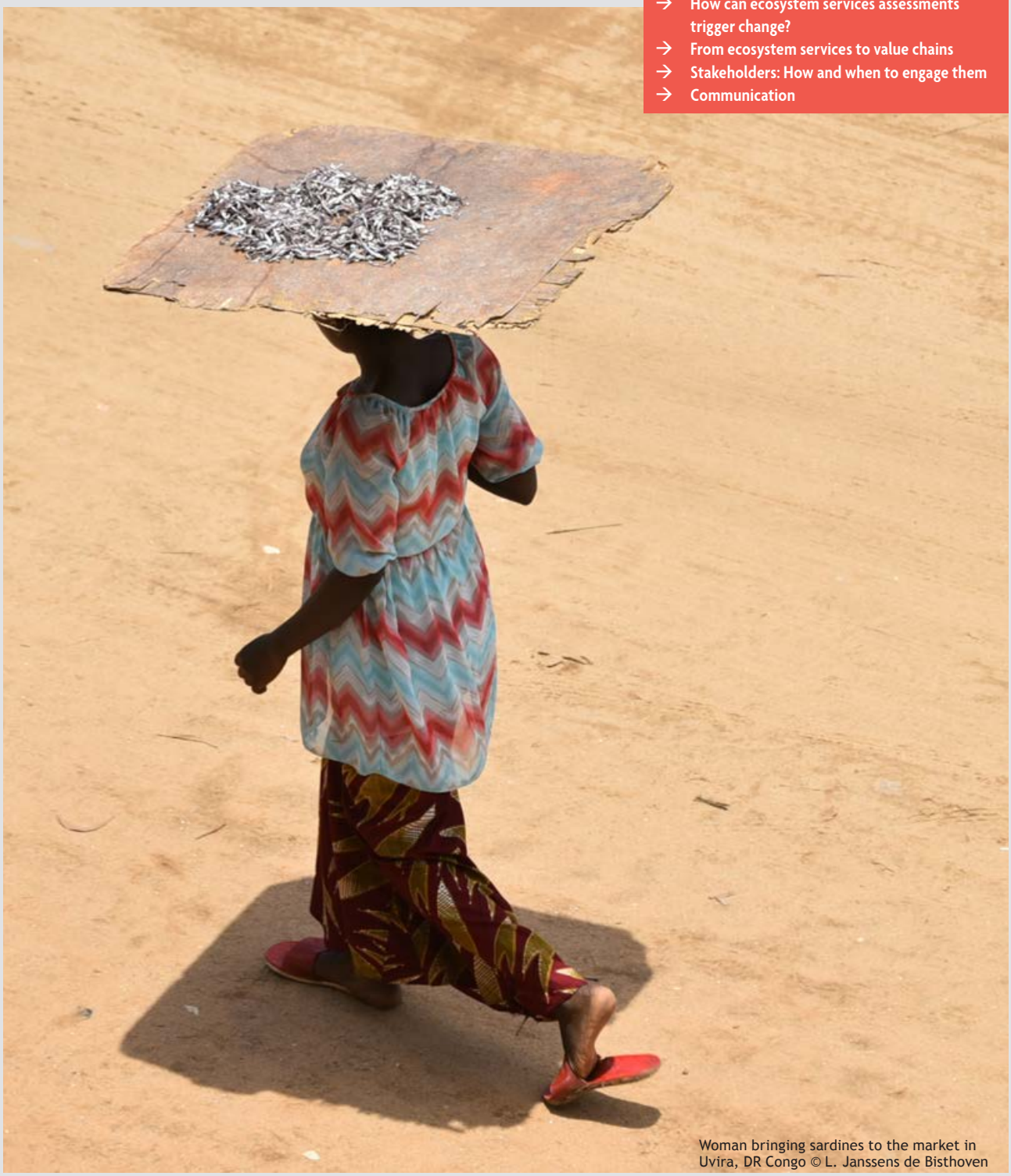
- *Case Study: Biodiversity- and Wildlife Tourism-based Payment for Ecosystem Services (PES) in Kenya* www.worldagroforestry.org/sites/default/files/chapters/Ch9%20Biodiversity-andWildlife_eBookB-DONE2.pdf.
- Case studies of water-related PES schemes in East Africa www.worldagroforestry.org/sites/default/files/chapters/Ch8%20Case%20studies%20of%20Water_ebook-DONE2.pdf.
- García-Amado, L. et al. 2013. Motivation for conservation: Assessing integrated conservation and development projects and payments for environmental services in La Sepultura Biosphere Reserve, Chiapas, Mexico. *Ecological Economics*, Vol. 89, No. 12, pp. 92-100 www.sciencedirect.com/science/article/abs/pii/S0921800913000633.
- García-Amado, L. et al. 2011. Efficiency of Payments for Environmental Services: Equity and additionality in a case study from a Biosphere Reserve in Chiapas, Mexico. *Ecological Economics*, Vol. 70, No. 12, pp. 2361-2368 www.sciencedirect.com/science/article/abs/pii/S0921800911002916.
- Loasiza, T., Nehren, U. and Gerold, G. 2015. REDD+ and incentives: An analysis of income generation in forest-dependent communities of the Yasuní Biosphere Reserve, Ecuador. *Applied Geography*. Vol. 62, pp. 225-236 www.sciencedirect.com/science/article/abs/pii/S0143622815001034.
- Brimont, L. and Karsenty, A. 2015. Between incentives and coercion: The thwarted implementation of PES schemes in Madagascar's dense forests. *Ecosystem Services*, Vol. 4, pp. 113-121 https://doi.org/10.1016/j.ecoser.2015.04.003.

# Chapter 5
# From ecosystem services assessment to actual change

A-J Rochette, J. Hugé and L. Janssens de Bisthoven

Contents





Woman bringing sardines to the market in Uvira, DR Congo © L. Janssens de Bisthoven

**RELEVANCE FOR AFRICAN BIOSPHERE RESERVES**

- While the concept of ecosystem services, which links biodiversity to human well-being, is well-known, its translation into actual management decisions remains uneven. Information gathered through ecosystem services assessments ideally needs to be used to inform decisions that will impact these services and their management in a positive manner. However, assessment is only a means to an end, and should form part of a whole process designed to **engage stakeholders** throughout, with the final objective of **producing an outcome** that can be synthesized for the sustainable management of biosphere reserves.
- This outcome will only be reached if **changes** (in behaviour, management, governance, etc.) occur as a consequence of the ecosystem services assessment. Key elements that induce changes are **scoping, continuous stakeholder engagement and communication**.
- **Stakeholder engagement** is not only regarded as an essential element in environmental management and decision-making, it is also considered critical in the context of ecosystem services. Stakeholder participation in research can enhance the credibility of information, in relation to the scientific adequacy of technical evidence and arguments. The experiential knowledge brought to the table by stakeholders (local or indigenous knowledge) is likely to lead not only to 'better' information and knowledge about the social and economic importance of ecosystem services, but also to much richer knowledge and **stronger ownership and impact**.
- Communication is not an afterthought. Efforts should be made throughout the process to understand who might have a stake in the area of focus (positively or negatively), and what approach may work best to engage with them. This chapter summarizes **communication methods** best suited for different targets audiences in biosphere reserves, and presents field examples of **stakeholder involvement in research**.

# HOW TO ACHIEVE ACTUAL CHANGE

## Empowering governance

Before local work in biosphere reserves can start, national and regional governance should be in place to create a conducive and empowering environment for environmental legislation, data sharing, cooperation between local authorities, policy integration and coherence, coordination, administrative capacities and consistency and quality of enforcement, coherent and coordinated scientific support and research, and incentives for businesses to develop a green economy.

This means that the national governments (and their sub-national bodies) need to integrate the goals of biodiversity and climate change from multilateral environmental agreements (MEA), such as the Convention on Biological Diversity (post-)Aichi targets, the Sustainable Development Goals, the Paris agreement on climate change and the African Union's Agenda 2063, into their national strategies and development plans (see **Box 3**). Moreover, governments, through their parliaments, need to adapt the fiscal and jurisdictional environment to be able to adopt and implement those policies as part of a legal and stable framework. This demands sustained mainstreaming efforts across sectors, which requires significant additional capacity-building for civil servants, policy-makers and decision-makers. Moreover, existing scientific and multi-disciplinary talents need to be harnessed and motivated through officially backed networks and forums to implement these policies and plans in order to effectively promote a better understanding of the ecosystem services in biosphere reserves and their utility for poverty alleviation, social and gender equity, and sustainable development.

# HOW CAN ECOSYSTEM SERVICES TOOLS CONTRIBUTE TO BETTER BIOSPHERE RESERVE MANAGEMENT?

If the ecosystem services concept is to support the sustainable management of biosphere reserves, there needs to be a *systematic, robust and credible assessment* of the state and trends of these services (Bagstad et al., 2013). Such an assessment will allow managers to evaluate threats endangering key ecosystem services in biosphere reserves, and to develop *actions* to counter negative trends. It will also help communicate the added value of biosphere reserves to a wide range of stakeholders.

Information gathered through an ecosystem services assessment ideally informs decisions that will impact ecosystem services in a positive way. However, assessment is only a means to an end, and should form part of a whole process designed to engage stakeholders, with the final objective of strengthening the sustainable management of biosphere reserves. Biosphere reserves need to be future proof, in order to achieve '*improved outcomes for ecosystem services and human well-being*'.

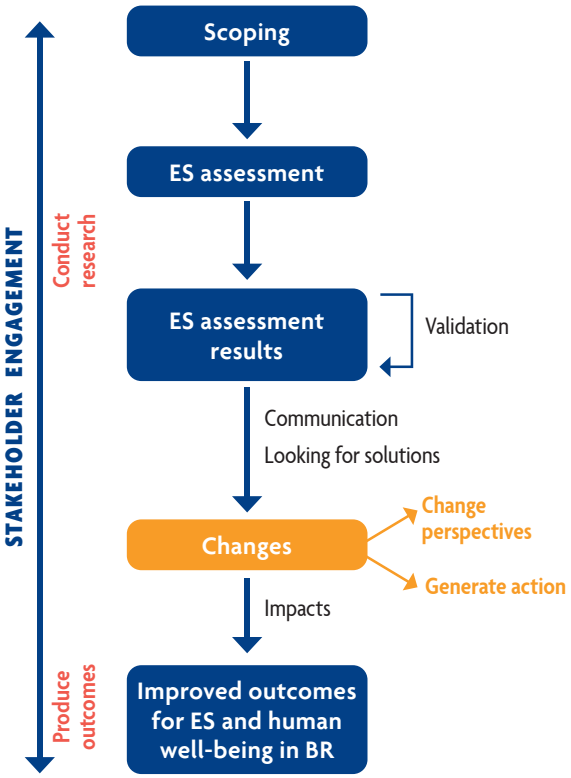
Ecosystem services information can impact decision-making. Ecosystem services tools are particularly useful for changing perspectives and generating action.

The path towards making management decisions for ecosystem services consists of five main steps (Martinez-Harms et al., 2015):

1. Identify the problem in its social–ecological context.
2. Specify the objectives and associated performance measures.
3. Define alternative management actions and evaluate the consequences of those actions.
4. Assess trade-offs and prioritize alternative management actions.
5. Make management decisions.

'Improved outcomes for ecosystem services and human well-being in biosphere reserves' can only be achieved if changes occur as a consequence of the ecosystems services assessment. Key elements to induce changes are scoping, continuous stakeholder engagement and communication (**Figure 62**).

**FIGURE 62.**
**PROCESS OF ACHIEVING OUTCOMES ON THE BASIS OF ECOSYSTEM SERVICE ASSESSMENT**




**How were you able to put the concept of ecosystems services into practice?**

'Knowledge sharing to better manage the biosphere reserve. The concept of ecosystem services can enable us to diversify approaches for effective conservation, and also to be friendly to the communities and nature. Once there is trust and transparency, those systems work. For example, based on the knowledge that ecosystem services can be used for the effective conservation of the park, we are now able to convince local communities to protect them.'

***Biosphere reserve manager***

# HOW CAN ECOSYSTEM SERVICES ASSESSMENTS TRIGGER CHANGE?

Ecosystem services assessment tools focus mainly on changing perspectives and generating action.[1]
However, the opportunity to influence decisions may only arise within short time windows (Rose et al., 2017) (see **Box 30**).

## Ecosystem services assessments change perspectives

The use of ecosystem services assessments can result in the following shifts in perspectives:

- People increasingly realize that there is a strong connection between people and nature.
- People become aware of, understand and discuss biodiversity and ecosystem services.
- People recognize the multiple values of ecosystem services.
- People start to look at nature differently.
- People acknowledge the vulnerability of ecosystem services provision, and hence the vulnerability of their livelihoods if no action is taken.
- People show willingness to contribute to finding solutions.

## Ecosystem services assessments generate action

The use of ecosystem services assessments can generate various types of action:

- The inclusion of evidence-based information on ecosystem services in decision-making happens by way of:
  - plans and policies that take impacts on biodiversity and ecosystem services into account with a view to establishing new policy and finance mechanisms (Ruckelshaus et al., 2015);
  - local development plans/management plans that focus on how to maintain and improve the stocks and flows of ecosystem services (once identified through the assessment);
  - improvements in biosphere reserve zonation and regulations that are fine-tuned to maintain and improve the stocks and flows of ecosystem services; and
  - mainstreaming in local bylaws, as a wide range of stakeholders becomes aware of the value and importance of biodiversity and ecosystem services.

- The commitment of key stakeholders is strengthened through the participatory nature of the ecosystem services assessment.

- The use and management of ecosystem services is changed and become more sustainable.

- The ecosystem services assessment contributes to greening the local economy (see **Box 31**).

1 See the framework proposed by Ruckelshaus et al. (2015) for further information.

*'The ecosystem services concept helps to bring all stakeholders together. Where I come from, when we think of the ecosystem services approach, we think of farmers, pastoralists, those who are doing the mining, the national park itself, operators, the communities who benefit from tourism. We need to have an ecosystem services approach so that all of us can work together; you can't work in isolation.'*

**Senior Assistant Conservation Commissioner Dr Noelia Myonga Lake Manyara National Park (Lake Manyara Biosphere Reserve manager, Tanzania)**

*'The concept of ecosystem services allows states to implement commitments made at the Rio Summit on Sustainable Development, and to have tools that lead us towards something concrete. This approach allows states to realize the economic potential of ecosystem services. This potential can be used for local development or the development of the area.'*

**Member of CEEAC**

*'People tend to appreciate and realize how important ecosystem services are as far as improvement of their livelihoods is concerned. The ecosystem evaluation approach is good to help decide among us the different competing users, and whether to do project A or project B.'*

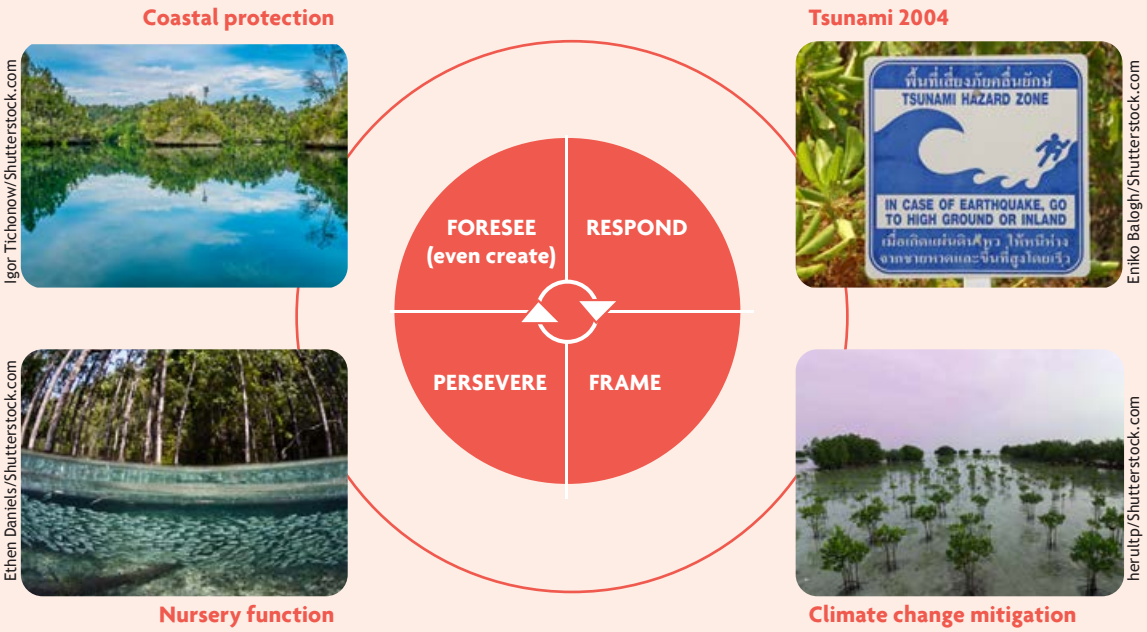
**Scientist**

**BOX 30.**
**WINDOWS OF OPPORTUNITY AND HOW TO USE THEM**

Ecosystem services assessments ultimately aim to influence decisions, and hence are designed to have a real-world impact. However, the opportunity to influence management decisions may only arise within short time windows (Rose et al., 2017). An ecosystem assessment exercise may therefore have a negligible or a huge influence depending on when it is presented. These 'windows of opportunity' are sometimes predictable, but are often hard to anticipate. Rose et al. (2017) describe four ways to respond to windows of opportunity and increase the likelihood of knowledge uptake: 1) foresee (and create) emergent windows, 2) respond quickly to opening windows, 3) frame findings in line with appropriate windows, and 4) persevere in closed windows.

**Figure 63** illustrates the cycle for responding to policy windows using the example of mangrove conservation and management. The 2004 Asian tsunami was an unexpected event that showcased the role played by mangroves as bio-shields protecting coastal communities. The framing of mangroves as carbon sinks is assuming increasing importance in times of global climate change. Long-term foresight regarding the role of mangroves as coastal protection has also made it easier to react to policy windows when they open. However, for some mangrove functions, such as their role as nurseries for fish, policy windows remain elusive (Koedam, Di Nitto and Hugé, 2018).

**FIGURE 63.**
**RESPONDING TO POLICY WINDOWS FOR MANGROVE CONSERVATION AND MANAGEMENT**




*Source:* Koedam, Di Nitto and Hugé (2018), Elsevier Creative Commons.

**BOX 31.**
**THE CONTRIBUTION OF THE GREEN ECONOMY TO BIOSPHERE RESERVES**

A focus on ecosystem services as part of the ongoing conservation debate can contribute to a transition towards a greener economy.

According to the United Nations Environment Programme (UNEP), a green economy is an economy that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy is low carbon, resource efficient and socially inclusive (UNEP, 2011). UNEP's Green Economy Initiative (GEI) is designed to assist governments in 'greening' their economies by reshaping and refocusing policies, investments and spending towards a range of sectors, such as clean technologies, renewable energies, water services, green transportation, waste management, green buildings and sustainable agriculture and forests (UNEP, 2019). The 'green economy' narrative is directly relevant for biosphere reserves.

The project 'Green Economy in Biosphere Reserves (GEBR): A means to biodiversity conservation, poverty reduction and sustainable development in sub-Saharan Africa' was implemented in the **Bia Biosphere Reserve (Ghana)**, the **Omo Biosphere Reserve (Nigeria)** and the **East Usambara Biosphere Reserve (Tanzania)**, and focused on the provision of alternative income-generating activities, while reducing the pressure of local communities on forests, lands adjacent to the biosphere reserves and other vital ecosystem services. Specific alternative livelihood activities designed to generate a green economy were designated for each site, such as sustainable palm oil production, apiculture (beekeeping), mushroom farming, the domestication of smaller animals (e.g. snails and grasscutters), fish farming, sugarcane farming, butterfly farming, local crafts (e.g. basket making and mats) and eco-tourism.

Specific approaches that can contribute to a greener economy in biosphere reserves are as follows:

- Work to better understand the potential of existing ecosystem services for the sustainable development of local communities.
- Install payment for ecosystem service (PES) schemes (see Chapter 4).
- Incorporate environmental externalities into business plans.
- Follow the precautionary principle.
- Apply 'the polluter pays' principle.
- Include local communities in the local and global economy and all development strategies and action plans.
- Implement alternative livelihoods as an alternative to illegal activities.
- Ensure National Biodiversity Strategies and action plans (and similar plans) include a section on the green economy.
- Mainstream biodiversity into economic sectors.
- Mainstream the economy into biodiversity and conservation.
- Involve the private sector in conservation.

It is important, however, to note that the 'green economy' concept can provoke controversy, especially with regard to ecological and social trade-offs. This suggests that limits and social standards may be required (Heinrich Böll Stiftung, 2012).

More information on GEBR is available at www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/man-and-biosphere-programme/networks/afrimab/gebr-project.

## FROM ECOSYSTEM SERVICES TO VALUE CHAINS

Decisions regarding how best to promote and develop the different values (ecological, economic, social and cultural) of identified ecosystem services into value chains will be strongly dependent on the local context and existing development plans.

A variety of approaches exist that may cover diverse topics (see **Box 31**). For example, an **integrated water management plan** could be developed to ensure a more equal sharing of water resources among the different beneficiaries of ecosystem services (e.g. food from agriculture, cattle grazing, tourism, drinking water and biodiversity conservation).

Alternatively, the cultivation of **wild edible mushrooms** could be transformed into small businesses, through credits, equipment, market analysis, business plans and capacity building, with a view to sustainably harvesting or cultivating and processing the mushrooms for own consumption and the market (see **Figure 64**).

**FIGURE 64.**
**CULTIVATING MUSHROOMS IN THE AFRICAN GREAT LAKES REGION**


*Source:* Kiyuku, Dibaluka and Degreef (2020); Mwinyi Waziri et al. (2020).

The **ecosystem service value chain analysis** (ESVCA) framework (Rawlins, De Lange and Fraser, 2008) aims at facilitating and analysing ecosystem services value chains. It is based on a study about flood attenuation services in South Africa and may help uncover ways to develop such value chains related to or derived from ecosystem services in biosphere reserves. The framework applies many aspects discussed in this manual, such as stakeholder analysis, focus groups, problem tree analysis and rapid assessment tools (see **Chapter 3**).

Traditionally, **value chain analyses** trace the value added at each step in the life cycle of a particular good or service, from production/harvesting through to final consumption or utilization and waste disposal (Baleta and Pegram, 2014; Kaplinsky and Morris, 2000). At present, the incorporation of ecosystem services thinking into value chain assessments is still in its infancy. As a result, complex system dynamics make provisioning and some regulating services more amenable to detailed analysis because of the relative ease in determining multiple intermediate services (i.e. services that only provide benefits to humans indirectly) (Fisher, Turner and Morling, 2009; Johnston and Russell, 2011).

The **ESVCA process cycle** is divided into five steps (see **Figure 56**):

1. **Conceptualisation**. Delimiting the scope of the problem involves defining the physical extent of the study area, the relevant stakeholders and the particular ecosystem services of interest. The assessment tools described in **Chapter 3** may contribute strongly to this step and to step 2.

2. **Expert workshops**. This step involves hosting one or more expert workshops with participants from academic and professional backgrounds in the relevant science (e.g. mycology, geomorphology, environmental modelling, ecological economics, hydrology, etc.). The specific objectives of the workshop are to: a) identify and describe ecosystem services that occur in the study area, and b) develop causal loop diagram(s), similar to the 'problem tree', where problem causes and effects are interlinked in a visual manner.

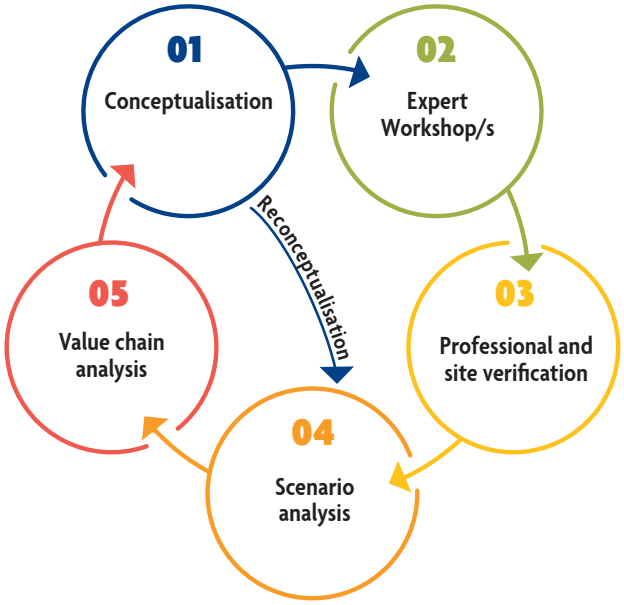
3. **Professional and site verification**. In this step, an open dialogue is propagated around the realism and accuracy of the diagram produced in the workshop, in order to facilitate the relevant knowledge inputs necessary to define each variable, the relationships between services and the units of measurement.

4. **Scenario analyses**. A particular system change or disturbance is identified, and the resultant impacts throughout the system are methodically analysed to scrutinize the accuracy of the model and address the problem statement. Each scenario either simulates a potential opportunity or challenge that directly or indirectly affects the provision of a particular ecosystem service.

5. **Value chain analysis** (eventually resulting in a reconceptualisation linking back to step 4). Finally, the workshop participants analyse several possible value chains of the socio-ecological system considered and indicate which elements in the diagram have been mobilized to this end. The discussion focuses on the demand side, identifying causal pathways and leverage points to attain the objective of increasing the value of identified ecosystem services. The process explores potential management options for each of the scenarios to provide future planning opportunities to improve positive impacts or mitigate negative impacts on the provision of ecosystem services.

Concrete examples for each step of the process, applied to flood attenuation services in South Africa, may be found in Rawlins et al. (2018).

**FIGURE 65.**
**THE PROCESS CYCLE OF ECOSYSTEM SERVICE VALUE CHAIN ANALYSIS (ESVCA)**




*Source:* Rawlins, De Lange and Fraser (2018).

# STAKEHOLDERS: HOW AND WHEN TO ENGAGE THEM

Biosphere reserve management and decision-makers need to create a safe context or safe space where local people, including all social, gender and age groups, can air their opinions about management decisions concerning the area in which they live or on which they depend, in relation to water allocation, hunting or fishing quotas, community co-management and other issues. This is especially the case in biosphere reserves where various stakeholders participate in management of the area.

In the context of conservation and management of protected areas, the term 'stakeholders' refers to people that have a stake in something. This can be defined according to several criteria, such as their **interest** in the topic (e.g. water, conservation, integrated management), as well as their potential or real **influence** on the processes under consideration.

Mapping of stakeholders or stakeholder analysis is an important step that must be undertaken **prior to any other assessment**, because any ecosystem services assessment will refer to possible changes and actions at the level of stakeholders.

Several methods exist to map stakeholders, but the **power (influence) – interest grid** is one of the most visual and explicit (See Thompson (2020). It plots different stakeholders across the four quadrants of a figure while relating them to each other. It also suggests approaches such as 'keep them satisfied', 'manage them closely' and so on.

This kind of exercise can be conducted in a focus group setting or a workshop. However, it is important to be conscious of the composition of the stakeholder group. If the hierarchy gradient is very wide, people with less 'power' will also be less inclined to express themselves in a group setting, since the 'power dynamics' will prevail. This is particularly true for women and marginalized groups.

Next to the degree of power and interest (e.g. expressed with a score system or – and + signs), stakeholders should be listed according to their affiliation, role, sector, expectations from the project, internal or external position to the project, gender and so on. **Box 32** provides an example of a stakeholder analysis.

**BOX 32.**
**STAKEHOLDER ANALYSIS: LAKE MANYARA BASIN (TANZANIA)**

© L. Janssens de Bisthoven

A stakeholder workshop was organized in **Lake Manyara Biosphere Reserve, Tanzania** in 2015. One of the objectives was to perform a stakeholder analysis to better understand the complex social-ecological system of the Lake Manyara basin, in particular regarding water use and management.

The analysis listed 31 stakeholders with a stake in water management in the area, as well as their interest, activities and/or area of focus. **Table 15** provides an extract from the analysis.

The initial list of stakeholders was then classified into four categories, and the power-interest grid was applied.

This exercise enables collective discussion about the role of each stakeholder, highlights key stakeholders, and helps determine how best to involve and communicate with each of these groups throughout the project. For example, those placed in the top-right quadrant (High interest/high power) should be fully engaged in the project.

**TABLE 15.**
**STAKEHOLDER ANALYSIS CONDUCTED DURING A STAKEHOLDER WORKSHOP IN LAKE MANYARA**

| Stakeholder | Interest, activities and area of focus |
|---|---|
| **Ujamaa-CRT** | Land use, pastoralists, land use rights, land protection |
| **Trias NGO** | Sustainable natural resources, small-scale farmers |
| **Mviwata (farmers org.)** | Small-scale farmers |
| **Monduli district** | Administration planning land aspects and natural resources |
| **TANAPA (Tanzania National Parks)** | Conservation of Lake Manyara and associated biodiversity; improving the livelihoods of surrounding communities in support of conservation |
| **Royal Belgian Institute of Natural Sciences** | Communication at the science-policy interface; translating aquatic science into socio-economic relevance; linkages with the vice president's office |
| **Nelson Mandela Institute African Sc and Tech** | Academia for society; translating the management of water resources and biodiversity into benefits for communities |
| **Internal drainage basin water board** | Water management and allocation; abstraction from bore holes; furrows (irrigation) |
| **Tour operators** | Tourists within and outside the national park |
| **Pastoralists** | Land use, land rights, land protection (Datonga, Sukuma, Masaai) |
| **Farmers (small-scale)** | Rice, banana, maize, beans, vegetables, fruits, sugar cane |
| **Farmers (large-scale)** | Rice, sugar cane, maize, beans |
| **Mto Wa Mbu cultural tourism programme** | Walking around villages (homesteads, dancing, cooking, etc.), walking safaris, community support, cultural tourism |
| **Ngorongoro conservation Area Authority (NCAA)** | Springs, forest water catchments, multiple land uses (e.g. visiting the crater for salt licking) |

**TABLE 16.**
**POWER-INTEREST GRID APPLIED TO THE STAKEHOLDERS IN LAKE MANYARA**

| High interest/low power | High interest/high power |
|---|---|
| Universities, hunting companies, tour operators, pastoralists, small-scale farmers, fishermen, middlemen | Trias NGO, Mviwata, TANAPA, Ujamaa-CRT, Monduli district, Internal drainage basin water board, regional commissioners, large-scale farmers, Mto wa Mbu, wards, NCAA |

| Low interest/low power | Low interest/high power |
|---|---|
| World Vision NGO | Districts |

## Why is involving stakeholders important?

There are two reasons why stakeholder participation is important.

First, involving stakeholders **impacts the relationships between stakeholders** in many ways. The mere fact of interacting and getting to know each other and the diverse interests and issues at stake, is a key first step in moving towards effective, socially robust conservation. Engaging with stakeholders on a specific topic, such as mapping the ecosystem services in a specific area, or playing a game to illustrate the power balances or benefits related to these services, has both direct and indirect impacts on stakeholders and their mutual relations.

Such collective exercises can build awareness, acceptance, trust, ownership, societal support and mutual understanding, and promote peace and conflict mitigation as part of a continuous learning process.

Second, involving stakeholders **allows for the collection of a range of useful knowledge, information, traditional beliefs and knowledge, scientific facts and figures**. These can provide new insights into power balances, help identify knowledge gaps, determine priorities for scientific research, and help identify conflicts, common interests and possible synergies, as well as possible solutions (which can be discussed and voted upon through a multicriteria decision analysis).

However, when engaging with stakeholders, it is essential to remember the following:

- Be clear about the objective of the venue, event, seminar, workshop and focus group.
- Explain these objectives in a clear and transparent way.
- Avoid the creation of false or unrealistic expectations (e.g. 'after the workshop you will all have a better life').
- Acknowledge complexity and conflicts and analyse them without prior judgement.
- Be well aware of the prevailing governance structure or map it in a stakeholder analysis.
- Avoid polarization, but promote common understanding through 'neutral grounds or language' such as the DPSIR framework (see **Box 13**).
- Ensure moderation is performed by a third party accepted as sufficiently neutral and objective.
- Disseminate the workshop report to all those involved.
- Undertake follow-up to avoid 'one shot actions'.
  A subsequent workshop can aim to:
  - deepen the subject;
  - fine-tune the results;
  - add some stakeholders;
  - work out a timeline with milestones to achieve clear goals;
  - encourage stakeholders with decision and management power to commit themselves; and
  - devise a strategy to locate resources to achieve the more ambitious changes.

**BOX 33.**

**ENGAGING LOCAL STAKEHOLDERS IN ASSESSMENT OF THE SUPPLY AND USE OF ECOSYSTEM SERVICES IN THE DJA BIOSPHERE RESERVE, CAMEROON**

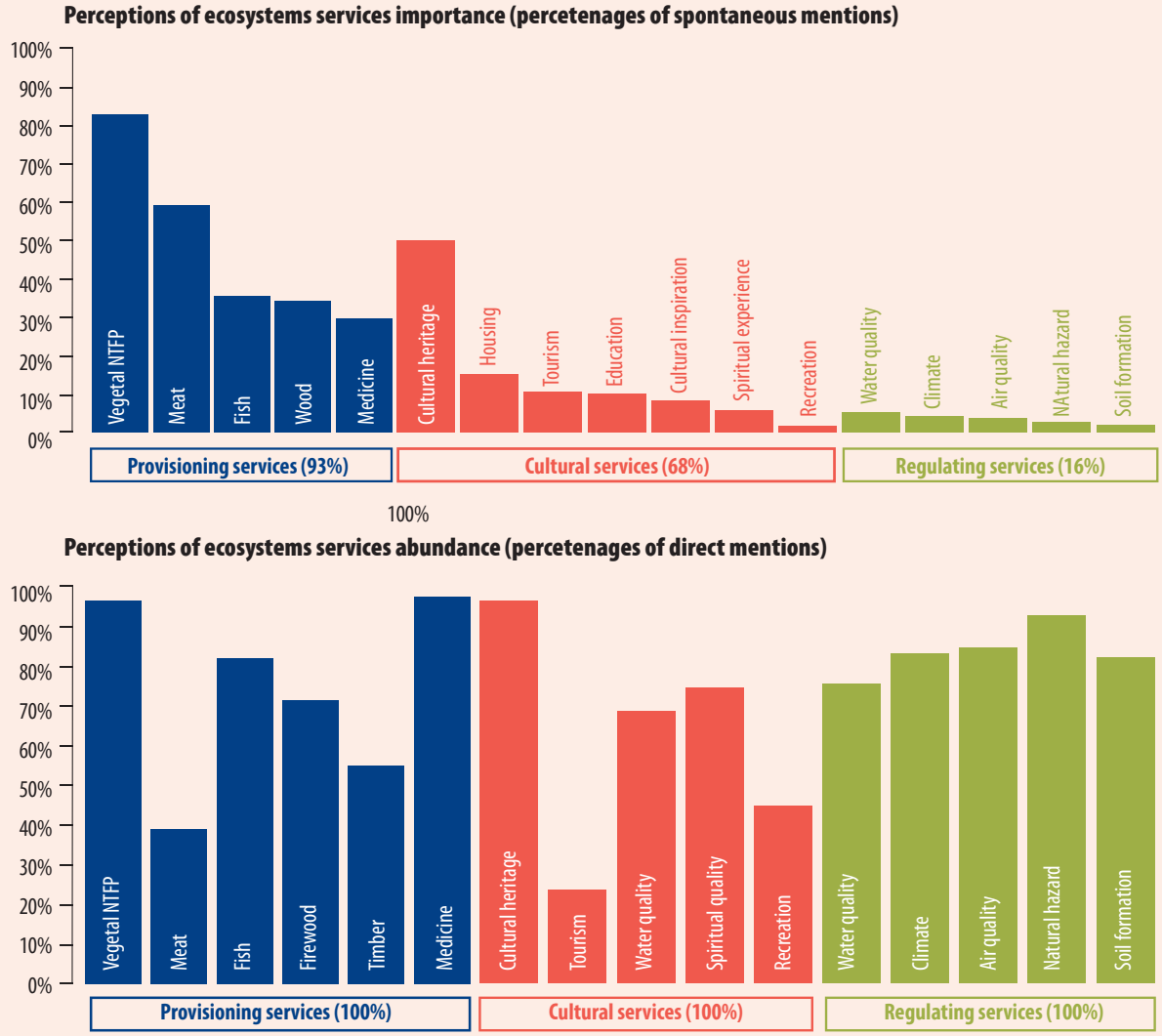
**By S. Lhoest (University of Liège, Gembloux Agro-Bio Tech, Belgium)**

The Dja Biosphere Reserve is situated in the dense forest ecosystems of the Guineo-Congolian Region in Cameroon, Central Africa. Efforts to engage with local stakeholders through 225 individual interviews in the Dja area have elicited perceptions of the importance and abundance of ecosystems services, their supply and use (Lhoest et al, 2019). Complementary participative field monitoring and interviews were used to determine the ecosystem services for which supply was perceived as the most variable, namely bushmeat, firewood, timber and all cultural services (Lhoest et al., 2020).

This assessment focused on local populations as direct beneficiaries of ecosystem services, and engaged with the wide range of local forest stakeholders including: local populations, logging companies, the Ministry of Forestry and Wildlife, community forest entities, NGOs and the associative sector, universities, consultants and researchers. This approach was essential to ensure the social inclusiveness and political legitimacy of the findings and conclusions. Participative and social approaches also support awareness raising and training of local stakeholders about the challenges of social-ecological system management.

Broad stakeholder engagement also allowed for the identification of conflicts and discussion about diverse ways to resolve them. In the Dja Biosphere Reserve, rural populations frequently expressed negative attitudes about the state and conservation in the context of unemployment and high poverty. They considered themselves to be the best potential protectors of nature, but also needed job opportunities (e.g. through the private sector in logging and mining companies) and alternatives to bushmeat in order to generate income, such as ecotourism or the development of a supply chain for fish and non-timber forest products (NTFP). Local communities have also demanded recognition of their user rights to forest resources – an issue that must be considered as part of management of the biosphere reserve. Promoting innovative livelihood-based initiatives for the autonomy of rural communities is acknowledged as a priority for reconciling nature conservation, food security and sustainable forest use.

**FIGURE 66.**
**PERCEPTIONS OF FOREST ECOSYSTEM SERVICES SIGNIFICANCE AND ABUNDANCE IN THE DJA AREA, CAMEROON**

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## Which stakeholders should be involved?

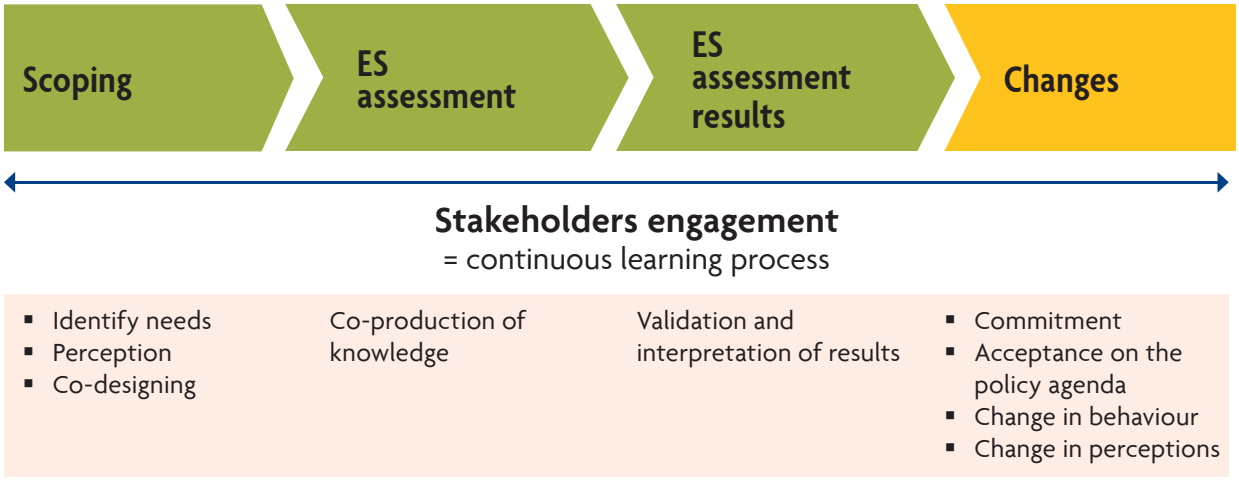
- Most of the important stakeholders will be 'local', but will come from a slightly wider circle than those directly involved. They can be grouped under community leaders (including women, youth, religious and customary), local government, NGOs and entrepreneurs.
- Remote stakeholders outside the boundary of the biosphere reserve that have an impact within the boundaries of the site should be included.
- At the national level, a long list of ministries and departments may need to be considered. These may be reachable collectively through the national MAB Committee.
- Members of Parliament, journalists and business platforms should be involved.
- Depending on the context, regional bodies may be interested and supportive, as well as global organizations (international, NGO) and potential bilateral donors and investors.

Efforts should be made throughout the process to understand who might have a stake in the area of focus (positively or negatively), and which approach may work best to engage them in the proceedings (see **Figure 67**).

**BOX 34.**
**CO-PRODUCTION OF KNOWLEDGE**

Co-production of knowledge refers to the contribution of multiple actors and their many and various sources of knowledge and capacities to address complex problems (Djenontin and Meadow, 2018). The management of biosphere reserves, which are social-ecological systems in which people and nature are closely linked, benefits from diverse views and types of knowledge. A co-production approach is essential when assessing ecosystem services, as the value of these services will depend on the collective perceptions, use and knowledge of a wide range of stakeholders. Multiple ecosystem services assessment tools focus on co-production, and are explicitly participatory and inter and transdisciplinary. **Box 17** (in **Chapter 3**) proposes various stakeholder engagement methods to facilitate this co-production in practice. The present manual can also be seen as the result of a process of co-production of knowledge.

**FIGURE 67.**
**STAKEHOLDER ENGAGEMENT THROUGHOUT THE ENTIRE ECOSYSTEM SERVICES ASSESSMENT PROCESS**



# COMMUNICATION

## How to communicate and with whom?

Communicating the key results and conclusions of ecosystem services assessments is of crucial importance to achieving real change and impacts. Whether targeting decision-makers to ensure they consider ecosystems services in plans and policies, or local communities to raise awareness or suggest alternative management options, messages should be carefully tailored to their audience (e.g. clearly explaining benefits) and communication tools should be selected carefully to effectively reach the target public.

**What** to communicate and **to whom** will depend on the results of the stakeholder analysis. How to communicate will depend on the profile of the stakeholders and their interest in the issues at stake (see **Table 17**).

Local communities and youth are key to biosphere reserve engagement and management. The following ideas may be used to communicate the values of ecosystem services to this target group:

- Use local media (e.g. radio shows).
- Collaborate with natural history museums, schools and scientists (link field visit knowledge with museum knowledge).
- Contact UN Goodwill Ambassadors.
- Create activities for Biosphere Reserve Celebration Day (if one exists).
- Link sport competitions to ecosystem services.
- Organize field visits for local communities to allow them to see the core areas of biosphere reserves.
- Give awards for the greenest village, the zero-fire village, etc.
- Establish a link with education (e.g. the Burkina Faso programme 'One school, one forest').
- Support local champions (change makers).
- Develop local brands.
- Use mobile telecommunications operator networks to convey messages regarding ecosystem services, especially to isolated areas.
- Use traditional events (e.g. Christmas, the end of Ramadan) as opportunities to reconnect urban visitors with their home villages in terms of linking people and nature.
- Use tales, drama, dance and music to communicate information about ecosystem services.

**TABLE 17.**
**COMMUNICATION METHODS BEST SUITED FOR DIFFERENT TARGET AUDIENCES IN BIOSPHERE RESERVES**

| Target audience | Interest in ecosystem services provided by the biosphere reserve | Use of the ecosystem services assessment study | Communication tools |
|---|---|---|---|
| **Local community** | Extractive use, recreational use, harvesting, derived economic benefit (e.g. tourism) | Increase in knowledge about the value of ecosystem services, demonstrate need for and benefits of sustainable use of natural resources | Local outreach, e.g. community education campaign, community meetings, local news story, local radio |
| **NGOs** | Conservation, poverty reduction, social and economic development | Provision to all parties of the same data on which to come to a consensus about the economic benefits and losses of biosphere reserves | Policy brief and full report, presentation, side event at regional or international conservation meeting, short film |
| **Decision-makers** | Possibly very low interest, lack of awareness of uses and services provided and associated economic benefits | Increase in awareness of the economic use of the ecosystem,<br>describe national and local economic benefits associated with protecting ecosystems and the potential costs/ economic loss of degraded ecosystems | Presentation, maps, policy brief, poll results, individual meetings, short film, story placement in high-profile media |
| **Multilateral/bilateral donors** | Possibly low, focused on development agenda | Increase in awareness of the link between biosphere reserves, poverty reduction and social and economic development | Policy brief, presentations at high-level international meetings, individual meetings, international high-profile media |

*Source:* adapted from Hamrick and Gallant (2018).

**BOX 35.**
**POLICY BRIEFS ADDRESSING ECOSYSTEM SERVICES IN PENDJARI BIOSPHERE RESERVE AND LAKE TANA BIOSPHERE RESERVE**

Two policy briefs were produced within the framework of the EVAMAB project (see **Figure 68**). The objective of such documents is to convey a simple message and to present results in a synthetic and visual way. The first brief was created to raise awareness about the importance of key ecosystem services in Pendjari Biosphere Reserve. It was distributed to local research and development partners and disseminated during a stakeholder workshop with representatives from NGOs, park management authorities, scientists and so on. The second brief aimed at illustrating the economic impact of water hyacinth infestation on farmers in Lake Tana Biosphere Reserve. It was shared among stakeholders involved at different stages of the research project and local authorities (**Figure 68**).

**FIGURE 68.**
**POLICY BRIEFS ON KEY ECOSYSTEM SERVICES IN PENDJARI BIOSPHERE RESERVE AND THE ECONOMIC IMPACT OF WATER HYACINTH INFESTATION ON FARMERS IN LAKE TANA BIOSPHERE RESERVE**



*Source:* Copyright AJ Rochette.
The policy briefs can be accessed here www.archives.biodiv.be/evamab/docs/publications/copy_of_peer-reviewed.

## Short versus medium/long term

While journalists and politicians react to immediate issues that are gaining traction, 'slower variables' of education, trust building, respect, recognition and partnerships are key to success over the longer term. It is therefore important that short-term issues support the changes needed for the longer term.

# MORE INFORMATION

## Additional resources linked to environmental governance

- Examples proposed by the *European Committee of the Regions* report in 2017
  https://cor.europa.eu/en/engage/studies/Documents/Environmental-governance.pdf.
- Jones, T. 2002. Policy coherence, global environmental governance, and poverty reduction. *International Environmental Agreements: Politics, Law and Economics,* Vol. 2, pp. 389–401.
- Fundamental principles of good environmental governance
  https://globalpact.informea.org/sites/default/files/documents/International%20Environmental%20Governance.pdf.

## Stakeholder engagement

- The *Biodiversa Stakeholder Engagement Handbook* is a non-academic practical guide for researchers planning and carrying out research projects. It is designed to assist research teams in identifying relevant stakeholders to engage with in order to enhance the impact of their work www.biodiversa.org/702.
- *Valuing Nature: Assessing Protected Area Benefits A Quick Guide for Protected Areas Practitioners*
  www.researchgate.net/publication/236262751_Valuing_Nature_Assessing_Protected_Area_Benefits_A_Quick_Guide_for_Protected_Areas_Practitioners.

# APPENDIX 1

# Some examples of economic valuation conducted in biosphere reserves

## Market price

- Analysis and resolution of protected area–people conflicts in Nanda Devi Biosphere Reserve, India www.geocities.ws/srkottapalli/ksrao/maikhurietal2000-agf.pdf.
- Assessing the Ecosystem Services Value of Can Gio Mangrove Biosphere Reserve: Combining Earth-Observation- and Household-Survey-based Analyses www.researchgate.net/publication/257346300_Assessing_the_Ecosystem_Services_Value_of_Can_Gio_Mangrove_Biosphere_Reserve_Combining_Earth-Observation-_and_Household-Survey-based_Analyses.
- Nontimber forest product extraction, utilization and valuation: A case study from the Nilgiri Biosphere reserve, *southern India* https://link.springer.com/article/10.1007/BF02871715.

## Contingent valuation method

- Economic valuation of water in a natural protected area of an emerging economy: Recommendations for El Vizcaino Biosphere Reserve, Mexico www.redalyc.org/pdf/339/33926985005.pdf.
- What are we missing? Economic value of an urban forest *in Ghana* www.sciencedirect.com/science/article/abs/pii/S221204161300048X.
- Recreation Value of Hara Biosphere Reserve using Willingness-to-pay method https://ijer.ut.ac.ir/article_19_a80b3fb1df7a8627d905cc84cf4343c1.pdf.

## Opportunity cost and alternative cost methods

- Valuing ecological functions of biodiversity in Changbaishan Mountain Biosphere Reserve in Northeast China https://www.academia.edu/6311064/Valuing_ecological_functions_of_biodiversity_in_Changbaishan_Mountain_Biosphere_Reserve_in_Northeast_China

## Travel cost approach

- Biodiversity and the tourism value of Changbai Mountain Biosphere Reserve, China: A Travel Cost approach https://core.ac.uk/download/pdf/14998179.pdf.
- The economic benefits of whale watching in El Vizcaíno Biosphere Reserve, Mexico www.redalyc.org/pdf/111/11145317006.pdf.

## Choice modelling

- Tourists' and Locals' Preferences Toward Ecotourism Development in the Maya Biosphere Reserve, Guatemala www.researchgate.net/profile/Robert_Hearne/publication/225458535_Tourists'_and_Locals'_Preferences_Toward_Ecotourism_Development_in_the_Maya_Biosphere_Reserve_Guatemala/links/5540f2450cf2322227314ccf.pdf.
- Valuing biodiversity attributes and water supply using choice experiments: A case study of La Campana Peñuelas Biosphere Reserve, Chile http://repositorio.uchile.cl/bitstream/handle/2250/120380/Valuing%20biodiversity.pdf?sequence=1.
- The valuation of forest carbon services by Mexican citizens: The case of Guadalajara city and La Primavera biosphere reserve https://kar.kent.ac.uk/33304/7/ArturoRegionalEnvironmentalChange.pdf.
- Non-market economic valuation of the benefits provided by temperate ecosystems at the extreme south of the Americas http://repositorio.uchile.cl/bitstream/handle/2250/120384/Non-market-economic-valuation%20of-the-benefits-provided-by-temperate-ecosystems-at-the-extreme-south-of-the-Americas.pdf%3Bjsessionid%3D686FBF311A239338472D9A04004862DB?sequence%3D1.

## Mixed approach

- Coupling spatial analysis and economic valuation of ecosystem services to inform the management of an UNESCO World Biosphere Reserve (Manicouagan-Uapishka World Biosphere Reserve, Canada) https://journals.plos.org/plosone/article/file?type=printable&id=10.1371/journal.pone.0205935.
- Valuation of the Mangrove Ecosystem in Can Gio Mangrove Biosphere Reserve, Vietnam www.iucn.org/backup_iucn/cmsdata.iucn.org/downloads/04_can_gio_mangrove_valuation.pdf.
- Quantifying the potential of restored natural capital to alleviate poverty and help conserve nature: A case study from South Africa https://repository.up.ac.za/bitstream/handle/2263/5813/Blignaut_Quantifying%282006%29.pdf?sequence=1.

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## Guidance for the Assessment of

# Ecosystem Services in African Biosphere Reserves

A WAY FORWARD TO SUSTAINABLE DEVELOPMENT

Ecosystem services link biodiversity conservation to human development. The ecosystem services concept aligns with the vision and mission of the UNESCO Man and the Biosphere programme, which aims to combine conservation of ecosystems and sustainable development. The wellbeing of local populations is often directly dependent on ecosystem services. Access to the benefits from nature contributes to poverty alleviation. Therefore, a better knowledge and integration of ecosystem services in the management of Biosphere reserves will contribute to their conservation and sustainable development.

What are ecosystem services? How can they contribute to the sustainable management and development of African Biosphere Reserves? What tools exist to assess their value? How to engage stakeholders throughout the ecosystem services assessment process?

These are the questions this new manual addresses, by combining theory, practical methods, key results from the EVAMAB research project, and good practices from African Biosphere Reserves. The purpose of this manual is to present a user-friendly 'package' or guidance to decision-makers, managers and stakeholders of African Biosphere Reserves, and beyond in order to better harness the potential of ecosystem services for conservation and sustainable development.

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