

# 1 THE VALUE OF NATURE FOR LOCAL DEVELOPMENT

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**This report** is aimed at policy makers involved in local and regional policy and public management. It **showcases how decision makers can promote local development by explicitly considering nature and the services it provides for human well-being**. This chapter explains what nature provides us (section 1.1), why nature's benefits are not fully recognized (1.2), and what can be done about it at the local level (1.3). It

describes how ecosystems provide different types of services and what happens if development efforts only consider a few of them (1.4). We also explore how biodiversity and ecosystems are impacted by climate change and how a resilient environment can help mitigate the impacts, or adapt to them (1.5). Finally it provides a guide to readers of this report (1.6).

## Key Messages

- **Nature provides more than one solution.** To provide a good quality of life for citizens local governments have many needs to address. Maintaining and enhancing natural capital can significantly contribute to better the provision of municipal services, improve public health and help lower the cost of energy.
- **More than a nice sunset.** Nature is an important asset for local economies and livelihoods. Assessing the services provided by nature – so called ‘ecosystem services’ – can make this asset visible and help to identify cost-effective solutions.
- **Small changes have a remarkable impact.** Poor people, especially in rural areas, rely most directly on nature’s services. Addressing the loss of ecosystem services can significantly contribute to reducing poverty.
- **Just because you don’t see it, it doesn’t mean it isn’t there.** Ecosystem services with high market value tend to be promoted to the detriment of other services, such as flood regulation or water filtration that are less visible but equally important for local development.
- **It’s a matter of priority.** Maintaining healthy ecosystems is more urgent because of global climate change.

“More and more, the complementary factor in short supply (limiting factor) is remaining natural capital, not manmade capital as it used to be. For example, populations of fish, not fishing boats, limit fish catch worldwide.”

Herman Daly, former chief economist with World Bank in 2005

With this report we hope to provide:

1. A **source of inspiration** for improving local development by means of explicitly considering biodiversity and ecosystem services in local decision making. We have collected examples from around the world to illustrate the options and opportunities that can make a difference at the local level.
2. A **how-to guide** and resource kit to **adequately assess and value ecosystem services**.
3. An **overview of how taking the economic value of nature's services into account can help improve** local development while maintaining biodiversity. We highlight potential policy instruments and **decision-making** tools for **public management tasks** at the local level. In six chapters, we outline the potential, the challenges and the institutional prerequisites for explicit consideration of biodiversity and ecosystem services in decision making.

## 1.1 LOCAL DEVELOPMENT'S BIGGEST ASSET

Forested water catchment areas provide water for both drinking and irrigation. Green spaces in cities improve both urban climates and air quality. Mangrove belts secure coastal protection against floods. Unspoilt beaches improve local quality of life and attract tourists. What do these examples have in common? In all of them local policy makers recognize the benefits that natural

assets provide for local development (see Box 1.1).

Typically, **local policy makers have to provide multiple services simultaneously**. These include: public infrastructure; water and waste management; promoting local economic development; education and health care. Their challenge is to maintain and improve

the quality of life for citizens when financial resources and capacities are often severely limited.

The good news is that **nature has a tremendous potential to achieve exactly this**. Protecting natural resources and biodiversity is sometimes perceived as an impediment to local development when, in fact, it could actually enhance it:

- A municipality can save money by securing water

provision, waste-water treatment, and protection against erosion or floods more effectively and efficiently through natural rather than technical solutions.

- In most places in the world, nature is the single most important input to local economies and →*human well-being* providing materials, clean water and good environmental conditions for industry, agriculture and the services sector.

### Box 1.1 Nature provides local benefits at a lower cost than technical solutions

**New York:** By purchasing and restoring the Catskill watershed for US\$ 2 billion, New York has secured its source of drinking water. A comparable pre-treatment plant would have cost US\$ 7 billion (Elliman and Berry 2007).

**India:** Environmental authorities in Jaipur, a city of 3.3 million people, are enlarging urban green spaces as a cost-effective way of reducing surface run-off and replenishing ground water during the monsoon. Water withdrawal from thousands of boreholes has resulted in a serious decline in the water table in the city, and surface run-off caused flooding (Rodell et al. 2009; Singh et al. 2010).

**Australia:** Local authorities in Canberra have enhanced urban quality of life by planting 400,000 trees. Besides making the city greener, the trees are expected to regulate the microclimate, reduce pollution and thereby improve urban air quality, reduce energy costs for air conditioning as well as store and sequester carbon. Combined, these benefits are expected to amount to the equivalent of US\$ 20–67 million for the period 2008–2012 in terms of the value generated or savings incurred to the city (Brack 2002). On [www.treebenefits.com](http://www.treebenefits.com) you can calculate the economic and ecological value of trees.

**Vietnam:** Since 1994, local communities have planted and protected mangroves in northern coastal regions of Vietnam, where more than 70% of the population is threatened by natural hazards (Dilley et al. 2005). Restoration of natural mangrove forests is more cost-effective than building artificial barriers. An investment of US\$ 1.1 million has saved an estimated US\$ 7.3 million a year in sea dyke maintenance (IFRC 2002). During typhoon Wukong in 2000, the project areas suffered significantly less damage than neighboring provinces (Brown et al. 2006).

**Nicaragua:** Large-scale deforestation in Nicaragua is being driven by clearance for livestock grazing. However traditional grazing regimes on deforested land are often unsustainable. In Matiguas, silvo-pastoral systems have been introduced, and degraded pastures planted with improved grasses, fodder shrubs and trees. This improved habitat reduces surface runoff and soil erosion on steep slopes, benefits local wildlife and, crucially, is also able to support a much higher density of cattle per hectare (FAO 2006).

**Burkina Faso:** For decades management strategies in the Sourou Valley wetland focussed on promoting agriculture. IUCN conducted an economic valuation of the products obtained. The assessment revealed that only 3% of the value relate to agriculture while other products generated by the wetland like forest products, fodder, and fisheries accounted for more than 80%; several other benefits provided were not included in the study. Local decision makers are now starting to integrate the valuation of ecosystem services in development plans (Source: Wetland valuation changes policy perspectives, Burkina Faso. TEEB-case, see [TEEBweb.org](http://TEEBweb.org)).

- Keeping and maintaining well-functioning natural ecosystems is the best strategy for local policy makers to deal with future pressures and threats, for example, those linked to climate change.

**We all depend on nature for our well-being.** Ecosystems provide us with food, fresh water, fuel, fibre, fresh air and shelter. → *Biodiversity* is defined as the variety of → *ecosystems* and ecological processes, and the diversity of plant and animal species, as well as different varieties and breeds within each species. It is critical for maintaining the → *resilience* of ecosystems, that is, their ability to function and provide critical services under changing conditions.

Our dependency on nature is sometimes directly visible, as with agriculture, fisheries and forestry. At other times, it is less visible; the water supply of urban areas, the food sold in supermarkets, and the clean air we breathe also relies on functioning ecosystems.

In cities, urban parks and green spaces lower the summer temperature, improve air quality, reduce the amount of flooding after heavy rains, and also significantly

increase the recreational value of city life and the real estate value of adjacent property. In addition, ecosystems and biodiversity provide inspiration and are often an important basis of local culture.

The Millennium Development Goals, agreed upon by world leaders at the United Nations, commit nations to a new global partnership to reduce extreme poverty (see [www.un.org/millenniumgoals/](http://www.un.org/millenniumgoals/)). Without safeguarding ecosystems and biodiversity, several of these goals cannot be achieved (see Table 1.1)

“Poverty is not simply about having a low income: it is multidimensional deprivation – hunger, undernutrition, dirty drinking water, illiteracy, having no access to health services, social isolation, and exploitation” (CPRC 2004:1).

These multiple aspects of poverty are connected to each other and to a range of further political, economic and natural causes. As yet, we know little about how different causes jointly drive poverty in different settings (Agrawal and Redford 2006).

### Box 1.2 The importance of nature’s benefits

Forests resources directly contribute to the livelihoods of 90% of the 1.2 billion people around the world living in extreme poverty (World Bank 2004) and 500 million people depend on coral reefs for their livelihood (Wilkinson 2004). About 80% of the population in developing countries relies on traditional medicine that is mainly derived from herbal plants (WHO 2008). Also, 50% of modern pharmaceuticals are derived from or based on natural compounds (MA 2005). A large number of plant and animal species still lie undiscovered and their potential benefits are yet unknown. These plants and animals may contribute to curing diseases in the future, help to find new materials for industry, or provide solutions for other future problems. There are, therefore, many good reasons to consider nature: economic; cultural; ethical and social.

Increasingly, global environments around the world are at risk of degradation:

- the Millennium Ecosystem Assessment found that 15 out of 24 assessed ecosystem services are being degraded or used unsustainably (MA 2005).
- 52% of global commercial marine fish stocks are fully exploited whilst an additional 17% are overexploited (FAO 2005).
- 20% of coral reefs have been destroyed and an additional 20% are seriously degraded (MA 2005).
- Already one billion city dwellers around the world live without clean water or adequate sanitation, despite this being recognized by the international community as a basic right. Over 2 million children die each year as a result. Currently 700 million people globally live with water stress, meaning the access to water quantity is insufficient. This is expected to increase to about 3 billion people by 2025 (Human Development Report 2006).

**Table 1.1 The Millennium Development Goals (MDG) and ecosystem services**

MDG	Ecosystem services linked to targets
MDG 1: Eradicate extreme poverty and hunger	The availability of food, fuelwood, water and biodiversity directly influences people's minimum standard of living and hence the incidence of poverty and hunger.
MDG 3: Promote gender equality and empower women	The availability of fuelwood and water reduces the burden that falls mainly on women and helps to improve gender equality (see Box 1.3). Women's income is often directly dependent on ecosystem services, for example collection of non-timber forest products.
MDG 4 and 5: Reduce child mortality Improve maternal health	Availability of clean water, clean air, plants for medicinal use, and biodiversity can all reduce the spread of diseases. Healthy ecosystems help to provide all the above.
MDG 7: Ensure environmental sustainability	The natural capacity for wastewater treatment, soil formation and other regulating and supporting ecosystem services help maintain the resilience of ecosystems and biodiversity.

*Source: Adapted from TEEB (2008)*

Nature's benefits are often neglected in policy although the least well-off people in many countries depend substantially on nature's benefits. Ecosystem services account for a large proportion of the goods and services consumed by the rural poor in developing countries. For example, for 480 million people in India, almost half of the population, ecosystem services account for 47% of goods and services consumed. In Brazil, the rural population relies on ecosystem goods and services for up to 90% of their total consumption. This has been calculated as the 'Gross Domestic Product (GDP) of the rural poor'. (TEEB in National Policy, Chapter 3.5).

In a vicious circle, poverty can increase dependence and pressure upon ecosystem services, further speeding up environmental degradation and exacerbating the livelihood situation (Shackleton et al 2008). In consequence, it appears a sound strategy for local policy makers to seek to secure the access to and continued availability of ecosystem services most essential to essential to poor citizens. Efforts against poverty should certainly aim beyond maintaining people's sources of basic subsistence – the issue for local policy makers is to ensure that policies and projects do not unintentionally degrade those ecosystem services which are currently essential for the poor. (Box 1.3).



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## 1.2 A POTENTIAL NOT FULLY RECOGNIZED

Local governments are continually faced with short-term challenges in the delivery of municipal services. There may be immediate political imperatives, or a shortage of financial resources. Environmental concerns are often considered to be unpopular or costly, and the value of nature can be sidelined in policy debates for a variety of reasons:

- **Development strategies focus on economic growth** without recognizing the role of functioning natural systems for local well-being.
- **Services that nature provides are often not visible.** Wetlands are a good example; conserving wetlands appears to provide few benefits and few economic costs are associated with their conservation and loss. Consequently wetlands are converted or degraded in favor of more profitable options such as dams or irrigation schemes. But the problem is not that wetlands have no economic value, but rather that this value – eg waste water purification and water regulation is poorly understood, and frequently overlooked in decision making (Emerton 2005). Local planners are often unaware that many natural solutions are available and are more cost-effective than technical solutions.
- **Competing demands on nature.** While conserving nature in its own right is very important to some people, others consider it to be a luxury. A growing population increases the demand for all kinds of services and this leads to more intensified use of natural ecosystems. Even where populations are not increasing, there are often conflicting interests. Some groups may benefit from cutting a forest while others lose important sources of income. Some interest groups are well-organized and in a position to directly influence policy makers whilst poorer groups are usually not.
- **Time lags.** The loss of biodiversity and the degradation of ecosystems may not have an immediate impact. The rapid increase of urban areas, for example, can result in a slow and prolonged loss of nature's benefits until a critical tipping point is reached. The loss of vegetation that helps stabilize slopes and retain rainwater in soils, is only noticed

### Box 1.3 Poverty, gender, and biodiversity in Africa

- In Zimbabwe 'environmental income' (including forage for livestock production) formed some 40% of total income for the poorest households relative to 29% for more well-off households (Cavendish 2000).
- Women in particular are dependent on a wide range of wild harvested products, from fruits to craft materials, as a source of cash income. For poor women in the northeast of South Africa income from sales of traditional brooms contributed more than 75% of cash income for one-third of households surveyed. In Botswana, for example, basketry (from palm fronds) forms a crucial source of income for thousands of poor women (Cunningham and Terry 2006).
- Open surface water is the major source of drinking water for 29% of Kenyan households, almost all of them in rural areas. Families using untreated surface water are relying completely on the regulating services of ecosystems to provide uncontaminated water in sufficient quantities.
- About 89% of rural Kenyans rely on firewood for their energy needs with more than 80% of households obtaining firewood within a 5-kilometer radius of their home.
- In the desert of Southern Namibia, the pastoral Topnaar people rely on the wild melon as their most important food source during summer months. This plant grows extensively near the river Kuiseb. In recent years, the construction of a dam has significantly reduced the flooding of the river essential for the wild melon. In consequence, harvesting has sharply declined (Mizuno and Yamagata 2005).

*Source: adapted from Shackleton et al. (2008)*

once the vegetation disappears and landslides or flooding occurs. On the other hand, immediate needs are often so urgent that there is little room for long-term considerations. Land conversion or logging creates short-term revenues.

- **Poor understanding of natural cause and effect.** The long-term impacts of destroying ecosystems are sometimes difficult to anticipate. The benefits provided by biodiversity in meeting future developmental challenges are often difficult to apprehend and information is not readily available.
- **Public versus private benefits.** Whilst the return on private investment from exploiting nature is more easily quantifiable, the public benefits are often taken for granted. For example: coastal protection; water regulation; or regional climate regulation.

Furthermore, the local capacity to respond to the value of nature is constrained. **Decision making is often fragmented** and those concerned with natural resources lack power and money in government ministries and departments.

Under the standard economic growth model, incentives are often provided for activities that (unintentionally) lead to destroying ecosystems (see TEEB in National Policy, Chapter 6 on harmful subsidies). Identifying and implementing policies that effectively protect and conserve ecosystems and biodiversity requires the **collaboration of many agencies at different levels** and other stakeholders. If the need for collective action is not understood, coordination becomes a challenge. This is often hindered by the lack of institutional capacity and effective governance mechanisms.

## 1.3 WHAT CAN LOCAL POLICY MAKERS DO?

Environmental governance operates at different scales. International agreements shape many areas of environmental policy. National legislation sets the legal framework for local decision making and issues general directives. However, the decision where to build a new factory, or whether to cut down a forest, is generally made at the local and regional level. It is here that laws are implemented and regional and/or local bodies have discretion.

A large number of officials are involved in local policy decision making: mayors, municipal councilors, planners, and developers. Citizens have roles as advocates, conservationists or protestors. Regulating agencies approve projects or monitor compliance with health standards or environmental regulation, while the legal system plays a role in planning and dispute resolution.

So how can the importance of a well-functioning ecosystem be adequately and effectively considered in decision making? The concept of ecosystem services provides an action-oriented framework that systematically explains the diverse ways that nature contributes to human well-being. By making use of this concept (explained below), local policy makers

can fully utilise nature's assets for local development. They can:

1. Make **good use of available instruments** and procedures: There are a number of assessment procedures and public management tools that can have a direct impact on ecosystem services. These include: Environmental Impact or Strategic Environmental Assessments; Cost-Benefit Analysis for public infrastructure; local and regional tax incentives; spatial planning; regulation of natural resource use such as forestry or fisheries, as well as extension programmes.
2. **Develop local solutions:** Experience around the world has shown that local and provincial laws and policy instruments, alongside local recognition of value, has helped to address biodiversity issues. New instruments to improve biodiversity related decision making include local Payment for Ecosystem Services (PES), Reducing Emissions from Deforestation and Forest Degradation (REDD) pilot scheme and Clean Development Mechanism projects.
3. **Advocate environmental concerns at higher policy levels:** Local and regional levels of government can play important roles in advocacy and

thereby try to influence national level policy making and public attitudes. Thailand, for example, has a community forestry law that has been created

through the initiative of local committees with the support of NGOs (Birner and Wittmer 2003).

## 1.4 ECOSYSTEM SERVICES: AN OVERVIEW

We can distinguish between provisioning, regulating, supporting and cultural services provided by ecosystems (MA 2005). In this section, we identify typical bundles of services in different types of ecosystems.

We then characterise two key features of ecosystem change – trade-offs and tipping points – before considering the social impact of such changes.

### Box 1.4 Different types of ecosystem services

**Provisioning Services** are ecosystem services that describe the material or energy outputs from ecosystems. They include food, water and other resources.

1. **Food:** Ecosystems provide the conditions for growing food. Food comes principally from managed agro-ecosystems but marine and freshwater systems or forests also provide food for human consumption. Wild foods from forests are often underestimated.
2. **Raw materials:** Ecosystems provide a great diversity of materials for construction and fuel including wood, biofuels and plant oils that are directly derived from wild and cultivated plant species.
3. **Fresh water:** Ecosystems play a vital role in the global hydrological cycle, as they regulate the flow and purification of water. Vegetation and forests influence the quantity of water available locally.
4. **Medicinal resources:** Ecosystems and biodiversity provide many plants used as traditional medicines as well as providing the raw materials for the pharmaceutical industry. All ecosystems are a potential source of medicinal resources.



**Regulating Services** are the services that ecosystems provide by acting as regulators eg regulating the quality of air and soil or by providing flood and disease control.

5. **Local climate and air quality regulation:** Trees provide shade whilst forests influence rainfall and water availability both locally and regionally. Trees or other plants also play an important role in regulating air quality by removing pollutants from the atmosphere.
6. **Carbon sequestration and storage:** Ecosystems regulate the global climate by storing and sequestering greenhouse gases. As trees and plants grow, they remove carbon dioxide from the atmosphere and effectively lock it away in their tissues. In this way forest ecosystems are carbon stores. Biodiversity also plays an important role by improving the capacity of ecosystems to adapt to the effects of climate change.
7. **Moderation of extreme events:** Extreme weather events or natural hazards include floods, storms, tsunamis, avalanches and landslides. Ecosystems and living organisms create buffers against natural disasters, thereby preventing possible damage. For example, wetlands can soak up flood water whilst trees can stabilize slopes. Coral reefs and mangroves help protect coastlines from storm damage.
8. **Waste-water treatment:** Ecosystems such as wetlands filter both human and animal waste and act as a natural buffer to the surrounding environment. Through the biological activity of micro-organisms in the soil, most waste is broken down. Thereby pathogens (disease causing microbes) are eliminated, and the level of nutrients and pollution is reduced.





9. **Erosion prevention and maintenance of soil fertility:** Soil erosion is a key factor in the process of land degradation and desertification. Vegetation cover provides a vital regulating service by preventing soil erosion. Soil fertility is essential for plant growth and agriculture and well-functioning ecosystems supply the soil with nutrients required to support plant growth.



10. **Pollination:** Insects and wind pollinate plants and trees which is essential for the development of fruits, vegetables and seeds. Animal pollination is an ecosystem service mainly provided by insects but also by some birds and bats. Some 87 out of the 115 leading global food crops depend upon animal pollination including important cash crops such as cocoa and coffee (Klein et al. 2007).



11. **Biological control:** Ecosystems are important for regulating pests and vector borne diseases that attack plants, animals and people. Ecosystems regulate pests and diseases through the activities of predators and parasites. Birds, bats, flies, wasps, frogs and fungi all act as natural controls.



*Habitat or Supporting Services underpin almost all other services. Ecosystems provide living spaces for plants or animals; they also maintain a diversity of different breeds of plants and animals.*

12. **Habitats for species:** Habitats provide everything that an individual plant or animal needs to survive: food; water; and shelter. Each ecosystem provides different habitats that can be essential for a species' lifecycle. Migratory species including birds, fish, mammals and insects all depend upon different ecosystems during their movements.



13. **Maintenance of genetic diversity:** Genetic diversity is the variety of genes between and within species populations. Genetic diversity distinguishes different breeds or races from each other thus providing the basis for locally well-adapted cultivars and a gene pool for further developing commercial crops and livestock. Some habitats have an exceptionally high number of species which makes them more genetically diverse than others and are known as 'biodiversity hotspots'.



*Cultural Services include the non-material benefits people obtain from contact with ecosystems. They include aesthetic, spiritual and psychological benefits.*

14. **Recreation and mental and physical health:** Walking and playing sports in green space is not only a good form of physical exercise but also lets people relax. The role that green space plays in maintaining mental and physical health is increasingly being recognized, despite difficulties of measurement.



15. **Tourism:** Ecosystems and biodiversity play an important role for many kinds of tourism which in turn provides considerable economic benefits and is a vital source of income for many countries. In 2008 global earnings from tourism summed up to US\$ 944 billion (see Chapter 5). Cultural and eco-tourism can also educate people about the importance of biological diversity.



16. **Aesthetic appreciation and inspiration for culture, art and design:** Language, knowledge and the natural environment have been intimately related throughout human history. Biodiversity, ecosystems and natural landscapes have been the source of inspiration for much of our art, culture and increasingly for science.



17. **Spiritual experience and sense of place:** In many parts of the world natural features such as specific forests, caves or mountains are considered sacred or have a religious meaning. Nature is a common element of all major religions and traditional knowledge, and associated customs are important for creating a sense of belonging.



**For further details on ecosystem services see:** MA 2005; TEEB Foundations Chapters 1 and 2; de Groot et al. 2002.

*Icons designed by Jan Sasse for TEEB*

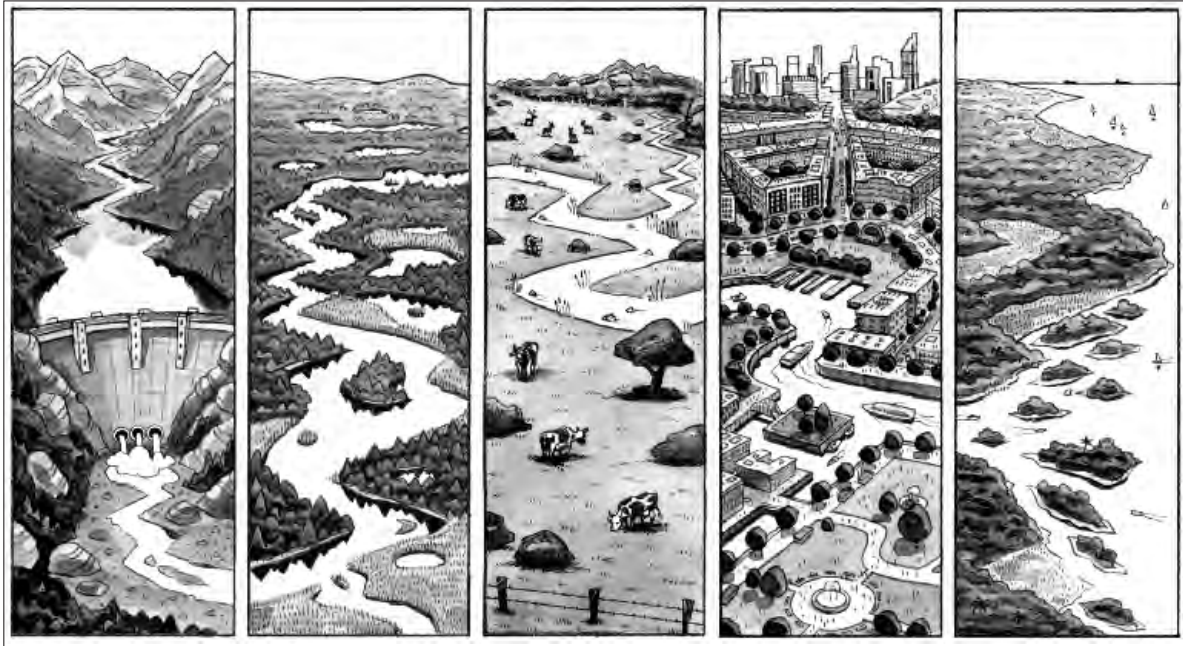
## ECOSYSTEMS PROVIDE MULTIPLE SERVICES

All ecosystems naturally produce multiple ecosystem services. Figure 1.1 illustrates this for different ecosystems: mountains; lakes; grasslands; cities; and coastlines.

## ENHANCING PRODUCTION OFTEN REDUCES OTHER SERVICES

We often promote those provisioning services with high market value to the detriment of other services that are less visible but equally important.

**Figure 1.1 Ecosystems and their services**



A. Mountains

B. Lakes and rivers

C. Grassland

D. Cities

E. Coasts

- A. **In mountainous areas**, watershed protection and prevention of soil erosion are even more important than in flatter areas. These ecosystems are often fragile and therefore degradation can take place more rapidly.
- B. **Lakes** provide fish and water which can be used for irrigation and recreation, and for cooling industrial plants, whilst **rivers** can provide electricity and wash away waste. Floodplains and lakes are often overlooked as reservoirs of fresh water and buffers against floods. They also play an important role in purifying water. However, many of these services are mutually exclusive; a polluted river will contain fewer fish and will not be able to provide clean drinking water.
- C. **Grasslands** support many different wild animals and livestock production. When intact, they protect against soil erosion and land degradation, and they sequester carbon, a service that is especially prominent in peatlands.
- D. Heavily modified landscapes such as **urban areas** can still provide several of the ecosystem services outlined above. Parks can improve a city's micro-climate, offer health and recreational services for residents and provide a habitat for an increasing amount of wildlife that is becoming adapted to living in cities.
- E. **Coastal areas** contain different ecosystems such as mangroves, dunes, coral reefs or tidelands. These ecosystems protect the coastline against storms and flooding, may provide spawning grounds for fish and crabs, and habitats for migrating species. Often they provide other products such as wood, fodder or building materials and play an important role for recreation and tourism. Marine systems are home to fish and many other species.

Illustration by Jan Sasse for TEEB

**Management can influence which services are increased and which are reduced.** Obvious impacts include converting natural areas to roads or housing, or the pollution of air and water by industry. Other changes affecting ecosystem services are less obvious. For example, agricultural potential has, for centuries, depended on clearing land whilst irrigation systems increased yields. As long as ecosystems functioned well and were abundant, yields were the prime concern. Nature provided its other services abundantly and, seemingly, for free.

The figures below illustrate **three different land use intensities** for a forest landscape. A natural forest provides a wide range of different products that can be used by people. This includes timber, fuel, fruits, wild animals, fodder or litter for domestic animals, honey from wild bees, rattan or branches for making

baskets or furniture, medicinal plants and mushrooms. All of these are provisioning services as they provide people with goods.

Additionally, the same forest also ensures water purification, and watershed protection, whilst evapotranspiration results in clouds that can transport rain and therefore maintain rainfall patterns far away. By providing shade, the temperature throughout the forest is moderated and the soil is protected against erosion from heavy rainfall and wind. These are examples of regulating services.

The forest is also home to many wild plants and animals – a habitat service. The diversity of plants and animals ensures that the forest can resist storms or regrow quickly after fire damage.

**Figure 1.2 Land use intensity - A**

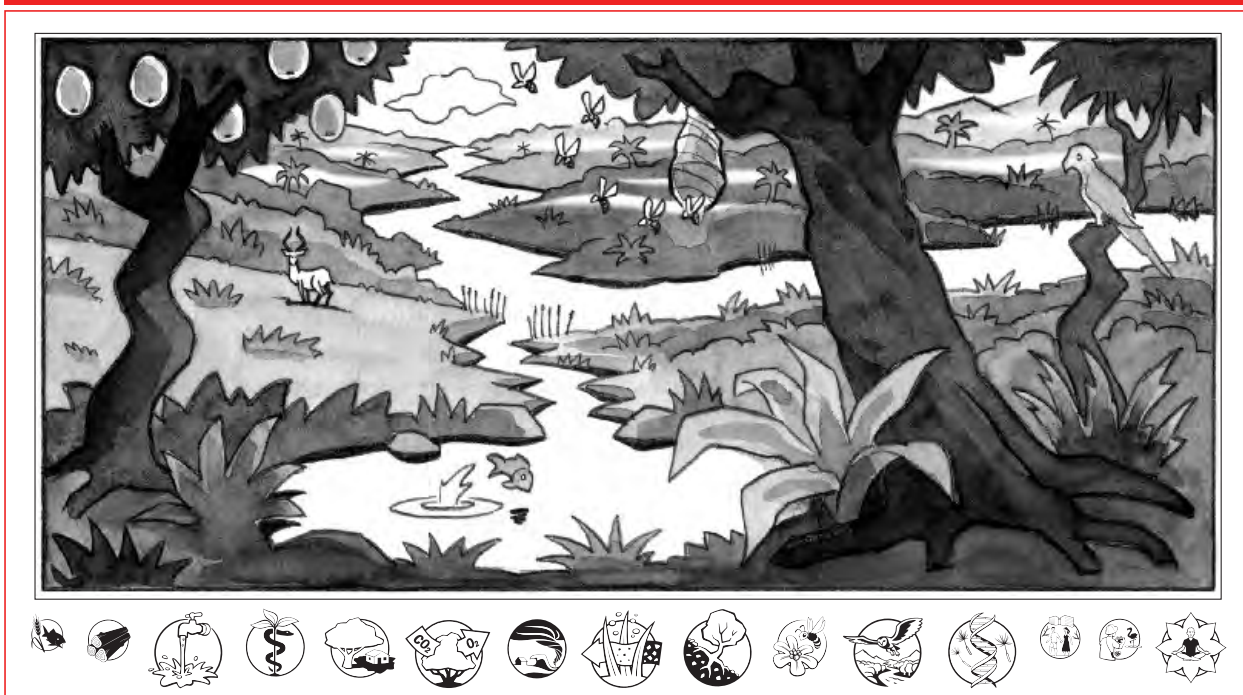


Illustration by Jan Sasse for TEEB

The second illustration shows that clearing part of the forest and draining wetlands for agriculture increases the amount of food produced in the same area. Likewise, if trees are systematically planted, production

is increased eg timber or fruits. However, the amount of other services provided is reduced, and less plants and animals can survive.



Figure 1.2 Land use intensity - B

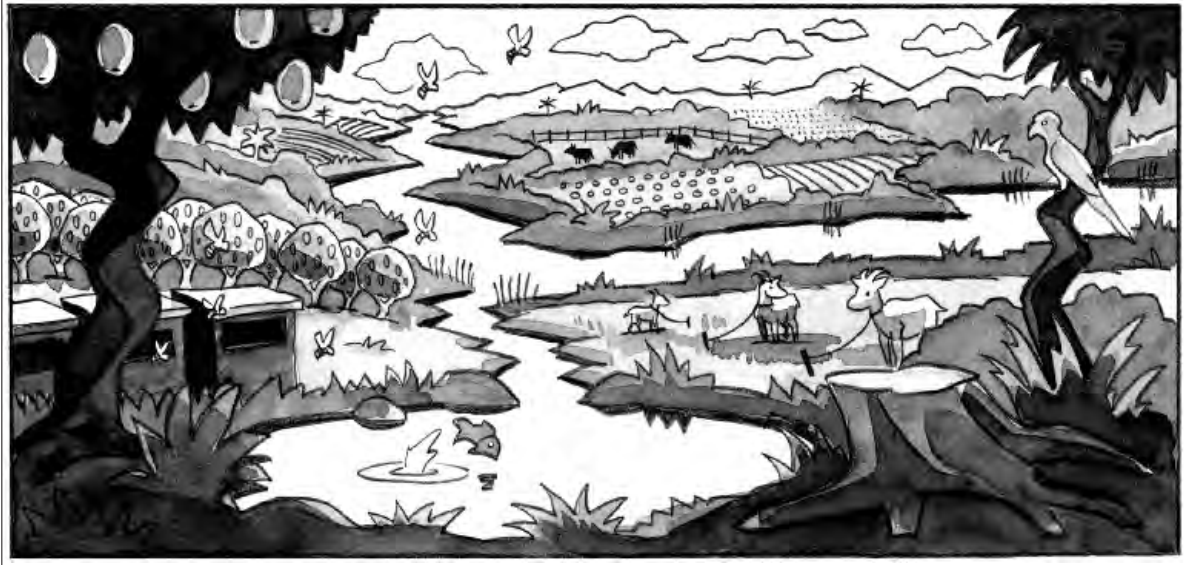


Illustration by Jan Sasse for TEEB

The final illustration shows that if land use practices maximize the yield of single services – in this case forest plantations and intensive agriculture – then other services are often greatly reduced. This can even create negative effects in neighboring areas. If soil is no longer protected by vegetation cover then it might erode into water courses, or be transmitted as dust; runoff from chemical fertilizers

and pesticides can reduce water quality; and if too much forest is cut down, rainfall patterns may change – in extreme cases this can lead to extensive land degradation.

Carbon sequestration might be high in fast-growing forest plantations, however, intensive agriculture releases considerable amounts of carbon.

Figure 1.2 Land use intensity - C

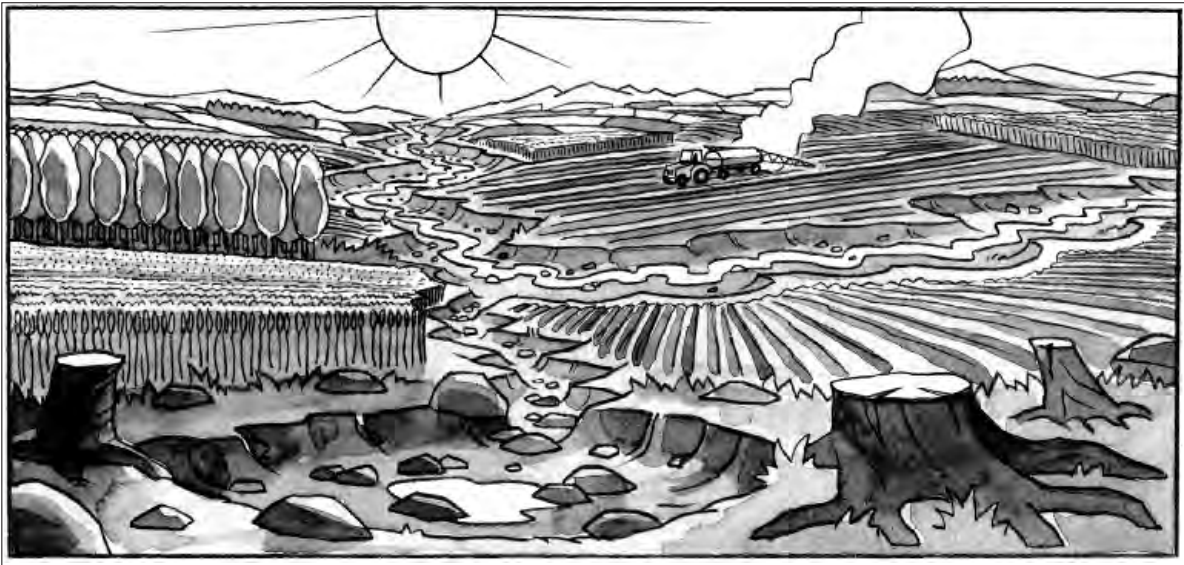


Illustration by Jan Sasse for TEEB

## WHEN ECOSYSTEMS REACH TIPPING POINTS, THEIR SERVICES CAN CHANGE DRASTICALLY

**Ecosystems have a capacity to adapt to change and to recover from disturbance, but when tipping points are reached they can** change character – and **no longer produce certain services**. Ecosystems change naturally due to events like forest fires, diseases or natural climatic variability, all of which can influence ecosystem components and thus the flow of services. However, human impact on ecosystems is now the greatest driver of ecosystem transformation; increasing population density and changing consumption patterns can lead to air, soil and water pollution, the conversion of natural ecosystems for agriculture or mining, for urban expansion or infrastructure development. The introduction of new plant and animal species from other areas plus human-induced climate change can all lead to major changes in ecosystems and the services they provide.

These changes are often gradual, and to a certain extent plants and animals are able to adapt to them. However, if human impact exceeds the capacity of ecosystems to regenerate they can degrade or even collapse and can no longer provide the desired combination or quantity of services.

The **unsustainable use of one service (eg water) can cause the entire ecosystem to degrade leading to the loss of other important ecosystem services**. Once ecosystems are heavily damaged, restoration is very costly and takes a long time, and in some cases is impossible.

Other ecosystems are just as vulnerable. In the Amazon, tropical forest rainfall patterns can change if the forest cover is reduced to a point where not enough moisture is evaporating. The loss of the ‘Amazon waterpump’ would severely affect agricultural production in Argentina, Brazil and the neighboring Andean states – it would also shut down Itaipu, one of the world’s largest hydropower facilities (see TEEB Foundations, Appendix 1).

In many parts of the world rising ocean temperatures have reached a critical point, causing the large-scale

death of coral reefs. Mangroves are also very susceptible to pollution (from industry or shrimp farms) and to reduced freshwater inflow which increases salinity. This causes the loss of habitat for many species and of important services such as coastal protection against storm surges and sea-level rise.

Assessing ecosystem services allows us to recognize the values they provide. However, it does not tell us how ecosystems function, or when tipping points are imminent. This leads to considerable uncertainty about how far we can intensify use before causing irreversible harm. In such situations, **precaution is imperative**. In many cases, a more balanced use leads to more balanced well-being and reduces the risks of serious degradation.

## WHO IS AFFECTED? LOCAL COSTS AND GLOBAL BENEFITS

**Conserving natural capital is often a local task** which can result in considerable financial costs though the benefits are often felt far beyond the local level.

As public goods, many of nature's services such as fresh air and clean water are provided free to everyone. As long as natural ecosystems have been abundant, little thought will have been given to their long-term sustainability. Increasing conversion of land for intensive and specialized uses, however, results in these natural services becoming scarce and therefore more costly to provide.

The reality is that intensive land use that generates commercial outputs results in greater benefits for the owner of the natural resource, compared with improving regulating services such as water provisioning or flood prevention that are freely provided to the public. Agriculture is one example.

The challenge many local decision makers face is that if they conserve nature by using it less intensively, they often provide benefits not only to their own citizens but to others beyond their local community. Watershed protection in uplands, for example, can significantly increase both water quality and quantity far downstream. Again, as long as natural ecosystems are abundant this is not an



issue, but restoring degraded ecosystems can be expensive. Even if the overall benefits may outweigh these costs, there is **often no incentive at the local level to provide services to other communities if they do not share the costs.**

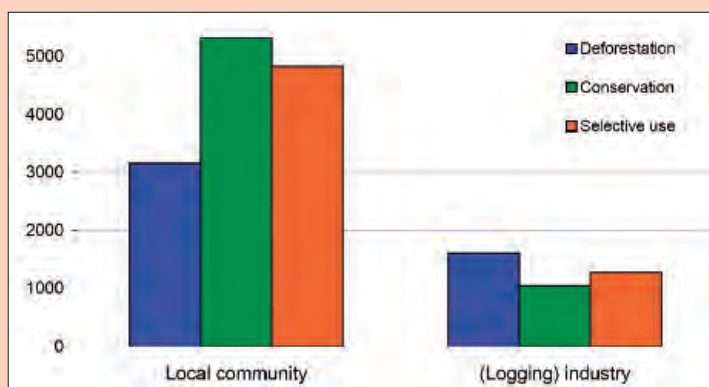
Local communities are best placed to bear the costs for improving conservation as well as ensuring good

development practice, if the benefits provided to the regional, national – or even the global level – are recognized and rewarded. Policy measures and financing programmes are increasingly providing this kind of transfer or compensation. This can create incentives for local authorities who could conserve natural resources if they do not have to bear the costs alone.

### Box 1.5 Comparing different strategies of resource use in Indonesia

Faced with rapid degradation of Leuser National Park, its Scientific Director commissioned a valuation study to compare the impact of different ecosystem management strategies on the province's potential for economic development until 2030.

The study estimated that conservation and selective use of the forest would provide the highest return for the region over the long-term (US\$ 9.1-9.5 billion). Continued deforestation would cause the degradation of ecosystem services and generate a lower overall economic return for the province (US\$ 7 billion).



By analyzing who would benefit and lose in each scenario, the valuation exercise clearly demonstrated that logging the tropical forest not only worked against overall economic growth and development, but provided limited financial gains to a few logging companies at the expense of hundreds of rural forest communities.

Source: Forest valuation stimulates green development policies, Indonesia. TEEBcase based on van Beukering et al. (see TEEBweb.org)

## 1.5 LINKING LOCAL POLICY, ECOSYSTEM SERVICES AND CLIMATE CHANGE

Why should local policy makers invest in ecosystems, if mitigating and adapting to climate change is now the most important global priority? The answer is that **climate change makes investing in nature even more important, urgent and worthwhile.** Climate change is considered to be one of the most important threats to biodiversity, and dealing with the impacts of climate change is becoming a key challenge for local policy makers. Maintaining and improving the functions of healthy ecosystems is a cost-effective strategy in mitigating and adapting to climate change.



### HOW ECOSYSTEMS MITIGATE CLIMATE CHANGE

Atmospheric carbon is sequestered through natural processes; plants and trees take up carbon through the action of photosynthesis whilst the oceans soak up carbon dioxide in a dissolved form.

Ecosystems store an enormous amount of carbon: the atmosphere holds 800 gigatonnes of carbon; vegetation stores 550 gigatonnes, or nearly 70% of

atmospheric carbon; soils store up to 2,300 gigatonnes, nearly three times more than that of atmospheric carbon; and the oceans store around 38,000 gigatonnes, nearly 20,000 times the amount of atmospheric carbon (Houghton 2007). Peatlands are the most space-efficient carbon storage of all ecosystems; they cover only 3% of the terrestrial earth surface yet store 550 gigatonnes of carbon (Parish et al. 2008). The carbon stored in terrestrial ecosystems is released when ecosystems are destroyed or converted, for example into farmland, or when peat is extracted for horticulture. Currently land use is causing the loss of about 1.5 gigatonnes of carbon a year (Houghton 2007). **Avoiding the degradation and conversion of natural ecosystems therefore contributes to climate change mitigation.**

## HOW ECOSYSTEMS HELP US TO ADAPT TO CLIMATE CHANGE

Maintaining nature's capacity to provide products such as food, fuel and fibre and to mitigate impacts of extreme events is critical for adapting to climate change not only because of the multiple benefits for human well-being but also because it offers cost-effective solutions.

The cost for developing countries to adapt to a 2°C warmer climate is estimated to be in the range of \$70 billion to \$100 billion a year for the period 2010 to 2050. Securing infrastructure, protecting coastal zones, managing water supply and flood protection account for the bulk of the expected costs. Managing water supply and flood protection offer the greatest potential for reducing costs (World Bank 2010).

Investing in green infrastructure, like parks, wetlands and forests can provide multiple services for climate change adaptation such as help protect urban areas during heat waves and **drain storm water**. This has been strategically integrated in urban planning for **flood management** in Curitiba, Brazil and Miami, USA (TEEBcase in Chapter 6). Protecting forests also helps to secure **water supply** and to control **floods and erosion**. Quito (Box 8.3, TEEBcase) and other cities in Latin America have established water funds, which pay land-users to maintain forests for providing these services (Chapters 8). Certain natural

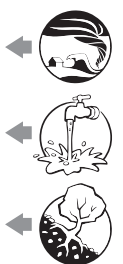
hazards are increasing and are expected to increase in frequency and severity in the coming decades. As the example from Vietnam shows (Box 1.1), mangroves can be more cost-effective than dykes for the **protection of coastal zones**. Green areas help protect urban areas during heat waves. For further examples see Chapter 5.

Changes in temperature and precipitation will also have significant negative impacts on crop yields. **Maintaining genetic diversity** of crops can offer varieties better adapted to future climate conditions. Investing in soil fertility and water retention capacity can likewise increase ecosystems' capacity to continue to provide services under changing climatic conditions and therefore valuable for **food security** (World Bank 2010).

As climate change is expected to increase the pressure on ecosystems, safeguarding them now can considerably lower the risk of their future collapse. Anticipating the impact of climate change has two distinct advantages: protecting ecosystems today is more cost-effective than attempting to repair them after damage has occurred; and improved ecosystems can provide immediate benefits as they deliver multiple services.

## A WINDOW OF OPPORTUNITY

From a policy perspective, the current debate on climate change can provide interesting opportunities. In many countries, strategies to mitigate or adapt to climate change are currently being developed or refined, and this often creates opportunities for policy change and dialogue between different agencies and actors. The investment programs set up in many countries after the financial crisis can create further opportunities to invest in protecting or restoring nature. Emerging carbon markets will also create opportunities for funding.



## 1.6 A 'ROADMAP' TO THE REPORT: A GUIDE FOR DIFFERENT USERS

### WHAT IS IN THIS REPORT?

**In Part II – The Tools : Chapters 2 and 3** we show **how ecosystem services can be assessed and valued**, in order to include them more explicitly in decision making.

**Part III – The Practice: Chapters 4-9** covers those areas where local decision making plays an important role in management, in planning, or by setting up or supporting new instruments such as payments for ecosystem services or certification and labelling schemes. These chapters show **how recognizing nature's services** at the local level **can lead to better development opportunities** and aid the long-term conservation of biodiversity and ecosystem services.

**Part IV – Conclusion: Chapter 10** discusses **how to make it happen**; the chapter highlights some common challenges encountered in previous chapters concerning how to include the assessment and valuation of ecosystem services in decision-making processes.

All chapters explain how ecosystem services and biodiversity can be impacted, and they showcase examples of how to explicitly recognize these challenges in decision making. They contain tools or instruments to facilitate these tasks, and provide links to further useful sources of information. The appendix contains an overview of relevant tools for mapping and valuing services as well as databases with further case examples.

### WHO COULD BENEFIT FROM THIS REPORT?

Below we highlight which chapters might be most useful for you to focus on, depending on what role you play in local development.

If you work for a **local authority**, or are a member of a city council, you will find Chapters 4-9 useful, depending on the area you are most concerned with.

If you are directly involved in preparing different decision options then Chapters 2 and 3 on tools and Chapter 10 on “how to make it happen”, which includes practical questions on ecosystem assessment, will also be relevant to you.

The most relevant chapters for **regulating authorities** are Chapter 4 on urban management and municipal service provision, Chapter 5 on natural resource management, and Chapter 6 on spatial planning and environmental impact assessment. If you are also interested in assessment and valuation tools then please refer to Chapters 2, 3 and 10.

If you belong to a **sector agency** which is typically responsible for natural resource management, or are involved in extension programmes for agriculture, forestry or fisheries or are in charge of disaster prevention, then Chapter 5 will be of specific interest. You may also find Chapter 6 to be of interest since it focuses on how to better include ecosystem services in spatial planning and in environmental impact assessment.

If you are a **planner**, then Chapter 6 is directly relevant, but you might also find Chapters 4 and 5 helpful as they relate to municipal service provisioning and natural resource management. Also relevant is Chapter 7 on protected areas, and how to protect the most sensitive parts of ecosystems.

As a **citizen, NGO, resident forum or village council member** you often play a decisive role in communication, advocacy and awareness raising. Depending on the issues in your area you may find interesting examples in all chapters.

## FOR FURTHER INFORMATION

### Ecosystem services guides for decision makers

WRI (2008) *Ecosystem Services: A guide for decision makers*. This easily accessible report provides frames the link between development and ecosystem service, points out risk and opportunities and explores future trends in ecosystem services. [http://pdf.wri.org/ecosystem\\_services\\_guide\\_for\\_decisionmakers.pdf](http://pdf.wri.org/ecosystem_services_guide_for_decisionmakers.pdf)

### National ecosystem assessments

Chevassus-au-Louis, B. et al. (2009) *Approche économique de la biodiversité et des services liés aux écosystèmes*. This comprehensive report on ecosystem services and biodiversity points out policy implications and opportunities. (in French) [www.strategie.gouv.fr/IMG/pdf/Rapport\\_18\\_Biodiversite\\_web.pdf](http://www.strategie.gouv.fr/IMG/pdf/Rapport_18_Biodiversite_web.pdf)

WRI (2007) *Nature's Benefits in Kenya: An Atlas of Ecosystems and Human Well-Being*. This illustrated report summarizes the current state and future trends of Ecosystems in Kenya. [http://pdf.wri.org/kenya\\_atlas\\_fulltext\\_150.pdf](http://pdf.wri.org/kenya_atlas_fulltext_150.pdf)

CONABIO (2009) *Capital Natural de Mexico*. This very comprehensive report (5 volumes) presents the current knowledge on biodiversity, the state of conservation, policy implications, and future scenarios. [http://www.biodiversidad.gob.mx/pais/pdf/CapNatMex/Capital%20Natural%20de%20Mexico\\_Sintesis.pdf](http://www.biodiversidad.gob.mx/pais/pdf/CapNatMex/Capital%20Natural%20de%20Mexico_Sintesis.pdf)

UKNEA/UNEP-WCMC (forthcoming) **United Kingdom** National Ecosystem Assessment. Following the example of the Millennium Ecosystem Assessment the study assesses the natural capital of the United Kingdom <http://uknea.unep-wcmc.org>

Further regional and local ecosystem assessments from around the globe are available on the Millennium Ecosystem Assessment website [www.millenniumassessment.org/en/Multiscale.aspx](http://www.millenniumassessment.org/en/Multiscale.aspx)

### Climate Change

The World Bank (2009); *Convenient Solutions to an Inconvenient Truth: Ecosystem-based Approaches to Climate Change*. The report highlights ecosystem-based measures of adaptation to and mitigation of climate change. [http://siteresources.worldbank.org/ENVIRONMENT/Resources/ESW\\_EcosystemBasedApp.pdf](http://siteresources.worldbank.org/ENVIRONMENT/Resources/ESW_EcosystemBasedApp.pdf)

UNEP (2009) *The Natural Fix: The role of ecosystems in climate mitigation* This brochure with many figures and maps illustrates the contribution of the various ecosystems the climate change mitigation. [http://www.unep.org/pdf/BioseqRRA\\_scr.pdf](http://www.unep.org/pdf/BioseqRRA_scr.pdf)

### Poverty and gender

UNDP-UNEP (2008) *Making The Economic Case: A Primer on the Economic Arguments for Mainstreaming Poverty-Environment Linkages into National Development Planning* [www.unpei.org/PDF/Making-the-economic-case-primer.pdf](http://www.unpei.org/PDF/Making-the-economic-case-primer.pdf)

IUCN (2009) *Training manual on gender and climate change*. This easily accessible report provides information on gender mainstreaming in climate change adaptation; including 18 case studies. <http://www.iucn.org/dbtw-wpd/edocs/2009-012.pdf> Factsheets, reports and handbooks on the link between gender issues, ecosystems and climate change are available on the Global Gender and Climate Alliance website <http://www.gender-climate.org/resources.html>

Alkire S, ME Santos. 2010. *Acute Multidimensional Poverty: A new Index for Developing Countries*. OPHI working paper no. 38. Oxford Poverty & Human Development Initiative (OPHI). This academic report introduces the Multidimensional Poverty Index (MPI); incl. many graphs and figures. [www.ophi.org.uk/wp-content/uploads/ophi-wp38.pdf](http://www.ophi.org.uk/wp-content/uploads/ophi-wp38.pdf)

### Option values of biodiversity

Biomimicry is an emerging discipline that studies nature's best ideas and then imitates these designs and processes to solve human problems. Inspiring examples are available at [www.biomimicry.net](http://www.biomimicry.net)

### Identifying Policy Responses

Millennium Ecosystem Assessment 2005. *Response Assessment*. The Report assessed the effectiveness of various types of response options, both historical and current, examining the strengths and weaknesses of various response options that have been used to manage ecosystem services. It also identifies some promising opportunities for improving human well-being while conserving ecosystems. <http://www.millenniumassessment.org/en/Responses.aspx>

UNDP - United Nations Development Programme (2010) *Biodiversity and Ecosystems: Why these are Important for Sustained Growth and Equity in Latin America and the Caribbean*. This report examines economic trends and policy initiatives focusing on natural capital in South America (launch: September 2010)