The Economics of Ecosystems & Biodiversity

TEEB MANUAL FOR CITIES:
Ecosystem Services in Urban Management

TEEB Manual for Cities: Ecosystem Services in Urban Management

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TEEB - The Economics of Ecosystems and Biodiversity (www.TEEBweb.org) is an international initiative to draw attention to the global economic benefits of ecosystems and biodiversity, to highlight the growing costs of biodiversity loss and ecosystem degradation, and to draw together expertise from the fields of science, economics and policy to enable practical actions moving forward.

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FOREWORD

When we published the TEEB for Local and Regional Policy Makers report in 2010, we hoped we had provided an inspiring starting point for thinking about policy in a new way, one which does not take nature for granted. We are indebted to the contributions of individuals and organisations, providing examples of policy options, case studies and experience from around the world. We could not hope to cover everything within a 200 page report, but we did hope that the report would stimulate others to apply relevant aspects of the content to their particular situation.

ICLEI-Local Governments for Sustainability have done just that by creating this, TEEB Manual for Cities: Ecosystem Services in Urban Management, in partnership with the TEEB for Local and Regional Policy Makers team. This is an excellent publication that builds upon the TEEB reports and tailors the information specifically for an urban context. It highlights how a focus on ecosystem services and their valuation can create direct benefits for urban areas and can be performed even with limited resources.

We congratulate the ICLEI Cities Biodiversity Center team for this initiative and we hope this handbook will take its place alongside the TEEB reports as an essential tool for local and regional policy makers everywhere.

Heidi Wittmer and Haripriya Gundimeda

Coordinators
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City of Cape Town

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SECTION 1:
AN INTRODUCTION TO ECOSYSTEM SERVICES AND CITIES

André Mader

Often ecosystem management in one location influences ecosystem services downstream - water supply is a clear example.

1.1. The Value of Nature for Cities

Cities depend on a healthy natural environment that continuously provides a range of benefits, known as ecosystem services. Some examples of ecosystem services include drinking water, clean air, healthy food, and protection against floods.

Healthy ecosystems are the foundation for sustainable cities, influencing and affecting human well-being and most economic activity.

This manual outlines how cities can incorporate a focus on ecosystem services into city planning and management. By considering ecosystem services, cities have the opportunity to make some very positive changes, saving on municipal costs, boosting local economies, enhancing quality of life and securing livelihoods. The critical role that ecosystem services play in local economies is often taken for granted, and the TEEB approach can reveal the value of natural systems, highlighting opportunities and trade-offs between various policy options, planning proposals or infrastructure choices.

Lack of information, understanding and planning about the effects of decisions on the environment can lead to the loss of essential and beneficial ecosystem services. From an economic point of view, this means the sub-optimal use of this 'natural capital', resulting in unnecessary losses in local welfare, city budgets and business opportunities. It is necessary to maintain a healthy environment because there is a point (known as the 'tipping point') at which a degraded ecosystem will cease to supply the ecosystem services that we rely upon, and it can be extremely expensive, time-consuming, or sometimes even impossible to restore the ecosystems and/or find an alternative solution. For that reason ecosystems need to be factored into city planning, management and budgets to outline the costs and benefits of different policy options, and therefore make better informed decisions.

By identifying the benefits that nature provides, and by understanding the value of these benefits, planners, educators and managers can move towards creating a sustainable city. In the long term, maintaining functioning ecosystems is the most cost-effective solution to meeting human needs, and in some cases it is the only way of meeting

André Mader

Natural elements that were once seen as hurdles to development, should be viewed as natural capital instead. Coastal ecosystems play a role in protecting settlements from natural disasters.

DEFINITIONS

Biodiversity is the variety of life on earth – at the level of ecosystems, but also at the level of the components of ecosystems (for example species and genetic material). Biodiversity of ecosystems and within ecosystems is integral to their functioning and the provision of ecosystem services.

Ecosystem is a way of describing nature's functioning and it consists of components (plants, animals, microorganisms, water, air etc.) as well as the interactions between these components. Functioning ecosystems are the foundation of human well-being and most economic activity, because almost every resource that humankind utilizes on a day-to-day basis relies directly or indirectly on nature. The benefits that humans derive from nature are known as **ecosystem services**. They can be divided into four categories: **Provisioning services, Regulating services**, **Habitat or Supporting services**, and **Cultural services**. (Millennium Ecosystem assessment 2005; TEEB Foundations 2010)

human needs if ecosystem services are irreplaceable.

Consideration of nature's value needs to be integrated throughout local government departments because virtually every line function's work has potential impacts on, and alternative benefits to, the environment.

Decentralisation of government is a growing phenomenon worldwide and local authorities are therefore becoming responsible for an increasing proportion of management at the local level including service delivery for their citizens (World Bank 2011). City administrations in particular are facing increasingly complex challenges as more than 50% of the world's population is now living in urban areas with predictions of a further increase in the next decades (UNFPA 2007; UN-HABITAT 2006). As succinctly put in a study on ecosystem services valuation in rural Africa: although capacity and resource constraints pose very real challenges, local authorities are arguably the best agents of change within the environmental sector. This is because they generally manage substantial budgets, they have strong executive powers with relatively short command structures, and they operate at grassroots level (Golder Associates 2010).

An understanding, consideration and valuation of ecosystem services is necessary for a well-managed environment as an obligation to future generations and out of respect for our surroundings; since ecosystem services often provide the most sustainable, cost-effective solutions. The direct effects of this approach are perhaps most easily observed when used to address the challenges faced by poor communities.

This manual has been compiled in order to provide an easily understandable introduction to the subject of ecosystem services; how to determine their value; and, how to incorporate a consideration of ecosystem services into municipal functioning as a long-term investment to enhance existing municipal management. The focus of the manual is on cities, although the term 'cities' is used to represent all forms of local government. The audience is practitioners and policy-makers at the local level – including those directly responsible for biodiversity management and those whose work is indirectly related to biodiversity management (for example planners).

André Mader

Some ecosystem services are expensive, time consuming or are impossible to replace. Forests may take hundreds of years to regrow, for example.

André Mader

Education can play an important role in preserving ecosystem services. After all, human actions strongly influence the systems that supply them with benefits.

"The value of ecosystem services and natural capital deriving from our biodiversity sites, in underpinning the economy and sustainable development in Cape Town, should be recognized and communicated to all line functions and politicians… so that sufficient investment is allocated to optimally manage these areas in perpetuity."
(City of Cape Town, Dr. Patricia Holmes, Biophysical Specialist)

1.2. Ecosystem services: definitions and examples

Ecosystem services can be divided into four categories: Provisioning services; Regulating services; Habitat or Supporting services; and, Cultural services. Table 1 presents the ecosystem services relevant to cities (illustrated by the TEEB ecosystem services icons) with examples of each.

Table 1: Ecosystem categories and types relevant to cities.

Ecosystem Service	Service Icon	Service description	Example
Provisioning services: Ecosystem services that describe the material or energy outputs from ecosystems.			
Food		Ecosystems provide the conditions for growing food. Food comes principally from managed agro-ecosystems, but marine and freshwater systems, forests and urban horticulture also provide food for human consumption.	In Havana, Cuba (1996), a significant proportion of the urban population's food was produced within urban gardens, including 8,500 tons of agricultural produce, 7.5 million eggs and 3,650 tons of meat (according to a review by Altieri, 1999).
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.	Non-timber forest products such as rubber, latex, rattan and plant oils are very important in trade and subsistence – the annual global trade in such products is estimated to amount to US$11 billion (Roe et al. 2002).
Fresh water		Ecosystems play a vital role in providing cities with drinking water, as they ensure the flow, storage and purification of water. Vegetation and forests influence the quantity of water available locally.	Estimates of the value of the services of a South African mountain fynbos ecosystem with an area of only 4 km^2 indicated that water production was the biggest contributor to the total value of the system. The value was estimated to range from approximately US$4.2 million to 66.6 million in 1997, according to how well the system is managed (Higgens et al. 1997).
Medicinal resources		Biodiverse ecosystems provide many plants used as traditional medicines as well as providing raw materials for the pharmaceutical industry. All ecosystems are a potential source of medicinal resources.	80% of the world`s people are still dependent on traditional herbal medicine (WHO 2002), while the sale of medicines derived from natural materials amounts to US$57 billion per year (Kaimowitz 2005).
Regulating services: The services that ecosystems provide by regulating the quality of air and soil or providing flood and disease control, etc.			
Local climate and air quality regulation		Trees and green space lower the temperature in cities 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.	In Cascine Park in Florence, Italy, the urban park forest was shown to have retained its pollutant removal capability of about 72.4 kg per hectare per year (reducing by only 3.4 kg/ha to 69.0 kg/ha after 19 years, despite some losses due to cutting and extreme climate events) (Paoletti et al. 2011). Harmful pollutants removed included O_3, CO, SO_2. NO_2, and particulate pollutants as well as CO_2.
Carbon sequestration and storage		Ecosystems regulate the global climate by storing greenhouse gases. As trees and plants grow, they remove carbon dioxide from the atmosphere and effectively lock it away in their tissues; thus acting as carbon stores.	Urban trees too, are important in carbon sequestration: in the United States, their annual gross carbon sequestration amounts to 22.8 million tons of carbon per year (as calculated in 2002) (Nowak and Crane 2002). This is equivalent to the entire USA population's emissions in five days. This sequestration service is valued at US$460 million per year, and US$14,300 million in total.
Moderation of extreme events		Ecosystems and living organisms create buffers against natural disasters, thereby preventing or reducing damage from extreme weather events or natural hazards including floods, storms, tsunamis, avalanches and landslides. For example, plants stabilize slopes, while coral reefs and mangroves help protect coastlines from storm damage.	In the case of the Californian Napa City, USA, the Napa river basin was restored to its natural capacity by means of creating mudflats, marshes and wetlands around the city (TEEBcase by Almack 2010). This has effectively controlled flooding to such an extent that a significant amount of money, property, and human lives could be saved.
Waste-water treatment		Ecosystems such as wetlands filter effluents. Through the biological activity of microorganisms in the soil, most waste is broken down. Thereby pathogens (disease causing microbes) are eliminated, and the level of nutrients and pollution is reduced.	In Louisiana, USA, it was found that wetlands could function as alternatives to conventional wastewater treatment, at an estimated cost saving of between US$785 to 34,700 per hectare of wetland (in 1995) (Breaux et al. 1995).

Ecosystem Service	Service Icon	Service description	Example
Regulating services: Continued			
Erosion prevention and maintenance of soil fertility		Soil erosion is a key factor in the process of land degradation, desertification and hydroelectric capacity. 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 soil with nutrients required to support plant growth.	A study estimated that the total required investment to slow erosion to acceptable rates in the USA would amount to US$8.4 billion, yet the damage caused by erosion amounted to US$44 billion per year. This translates into a US$5.24 saving for every US$1 invested (Pimentel et al. 1995).
Pollination		Insects and wind pollinate plants 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).
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.	Water hyacinth was brought under control in southern Benin using three natural enemies of that plant (De Groote et al. 2003). Whereas the biological control project cost only US$2.09 million in present value, its accumulated value is estimated to amount to US$260 million in present value (assuming the benefits stay constant over the following 20 years), representing a very favourable 124:1 benefit cost ratio.
Habitat or Supporting services: These services underpin almost all other services. Ecosystems provide living spaces for plants or animals: they also maintain a diversity of plants and animals.			
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.	In a March 2010 article (IUCN 2010), IUCN reports that habitat loss is the single biggest threat to European butterflies, and may lead to the extinction of several species. Habitat loss was said to occur most often as a result of changes in agricultural practice, climate change, forest fires, and expansion of tourism.
Maintenance of genetic diversity		Genetic diversity (the variety of genes between, and within, species populations) distinguishes different breeds or races from each other, providing the basis for locally well-adapted cultivars and a gene pool for 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'.	In the Philippines, an initiative to conserve local varieties of rice aided in the development of rice strains that are better adapted to local conditions - giving greater yield, a quality seed supply, and decreasing dependence on plant breeders - at a much lower cost than that of formal plant breeding (SEARICE 2007).
Cultural services: These include the non-material benefits people obtain from contact with ecosystems. They include aesthetic, spiritual and psychological benefits.			
Recreation and mental and physical health		Walking and playing sports in green space is a good form of physical exercise and helps people to relax. The role that green space plays in maintaining mental and physical health is increasingly becoming recognized, despite difficulties of measurement.	A review article examined the monetary value of ecosystem services related to urban green space, based on 10 studies, including 9 cities from China and 1 from the USA (Elmqvist 2011). It reported that on average, 'Recreation and Amenity' and 'Health effects' contributed a value of US$5.882 and US$17.548 per hectare per year respectively to the total average of US$29.475 per hectare per year provided by the seven identified ecosystem services in the various studies.
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. Cultural and eco-tourism can also educate people about the importance of biological diversity.	Based on the amounts of money people spent on travel and local expenditure in order to visit Coral reefs in Hawaii, it was estimated that the value associated with these reefs amounted to US$97 million per year (TEEBcase by van Beukering and Cesar 2010). This implies that reef tourism resulted in significant income generation for individuals, companies, and countries.
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.	Prehistoric rock art of southern Africa, Australia, and Europe, and other examples like them throughout the world, present evidence of how nature has inspired art and culture since very early in human history. Contemporary culture, art and design are similarly inspired by nature.
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.	In the example of the Maronite church of Lebanon, the church committed to protecting a hill in their possession, comprising rare remainders of intact Mediterranean forest, independent of scientific and legal arguments, because this was in line with Maronite culture, theology and religion (Palmer and Finlay 2003).

City of Cape Town

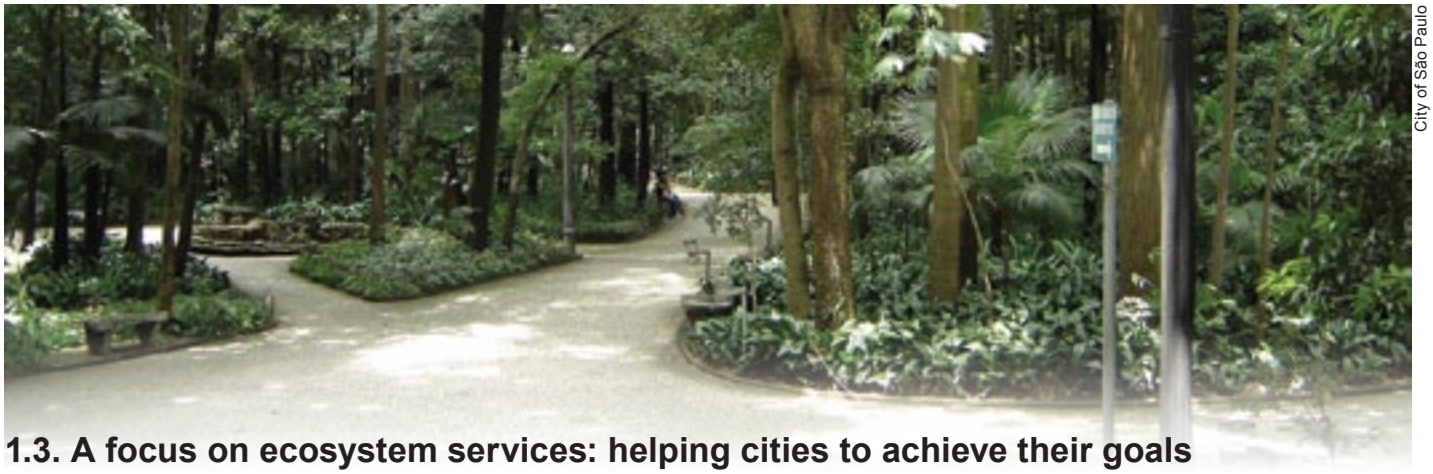
Not all ecosystem services can be measured in monetary terms - some values can be as simple as the beauty of a butterfly in the garden.

City of Cape Town

The medicinal plant, *Sutherlandia frutescens*, from southern Africa - the value of natural traditional medicines should not be underestimated.

Stephen Granger

Environmentally based tourism can be a valuable source of revenue, as in this park in Croatia.


City of São Paulo

1.3. A focus on ecosystem services: helping cities to achieve their goals

This section examines how cities can benefit in various ways from a focus on ecosystem services, especially with regard to urban planning, budget allocations and municipal service delivery. The examples in this section show that such an approach can be economically viable and provide social benefits – arguments which are often vital in order to secure political commitment.

A focus on ecosystem services can support the work of city authorities in at least three ways:

- Firstly, the benefits we derive from a functioning environment become visible at the local level. If we adopt a focus on ecosystem services, their relation to municipal service delivery becomes evident. For example, cities are often responsible for the provision of clean water to their citizens. A focus on the ecosystem services relevant to water provision can help identify the water purification capacity of, for example, nearby forests. The preservation of the forests can therefore become an integral part of the strategy to provide clean water to local residents.

- Secondly, focusing on ecosystem services allows decision makers to better anticipate the consequences of decisions or policies. Ecosystems generate multiple services and by looking at ecosystem services the costs and benefits of the choices can be compared. For example, when a forested area that is valued by both residents and local decision makers for the full range of services it provides, is threatened by a new development, this will have to be considered in terms of the benefits which would be lost.

- Thirdly, a focus on ecosystem services allows effective communication, between all line functions and with the general public, about the environmental consequences and the wider economic and/or social implications of a decision. If a broad range of ecosystem services provided is considered, in terms of the gain or loss of natural resources and benefits, and these are communicated effectively to all stakeholders, it is likely that the most desirable outcomes will be achieved through effective decision making.

By focusing on ecosystem services, the value and multiple benefits of functioning ecosystems will be recognized, and the conservation of natural resources will be implicit as an effective means of creating and maintaining sustainable and healthy cities.

An ecosystem services approach is complementary to other motivations to conserve nature, encouraging policy makers to consider the connections between natural systems and human well-being through various policy and management processes, including planning, budget allocations or infrastructure. Focusing on ecosystem services will help achieve a balance between developmental and environmental objectives. How does this focus on ecosystem services work in practice? There is no 'one-size-fits-all' solution, and it is critical to develop a local approach, unique to each particular situation. The stepwise approach, outlined in Section 2, provides guidance on how to value ecosystem services in a city context. Ecosystem services are a cross-cutting issue and there is often no need to introduce new units or procedures, since local management processes which are in place could simply benefit from adopting an ecosystem services perspective. This can be a comprehensive analysis – as in the case of Cape Town (see case study section 2) – but may be done with limited resources as a preliminary appraisal. Table 2 shows examples of how a focus on ecosystem services has helped cities in various ways.


City of Cape Town

Environmental education will often contribute not only to a public understanding of and appreciation for ecosystem services, but facilitate social upliftment as well.

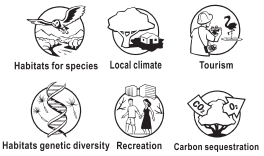
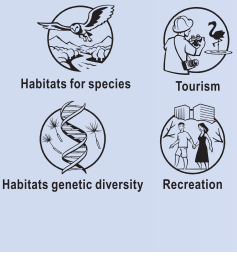

City of Barcelona

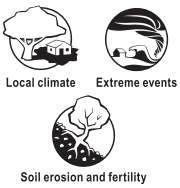
Alien plants threaten biodiversity and underpins many of the benefits of nature.

Wikimedia Commons

The intense terracing in this picture is a reminder of how intimately society, economy and nature interact.

Table 2: How can a focus on ecosystem services help city authorities?

Example	Principal ecosystem services	Municipal tasks and objectives benefitting from a focus on ecosystem services
Canberra, Australia: Local authorities plant and maintain trees resulting in a variety of benefits. The 400,000 trees within the city limits regulate the city climate, reducing air pollution as well as energy costs for air conditioning. Trees also sequester carbon and slow the run-off of precipitation. These benefits are estimated to amount to around US$4 million annually in terms of the value generated or savings incurred to the city (TEEBcase based on Brack 2002).		An assessment of the benefits of trees in urban areas can: ● Inform planning and budget allocations for several city departments, including green spaces, housing and sewage. ● Contribute to the provision of a healthy urban environment (thereby increasing quality of life). ● Identify savings for the city (e.g. cut in energy use).
Ulaanbaatar, Mongolia: Mongolia's capital and economic centre, Ulaanbaatar relies on the watershed of the Upper Tuul valley, which is currently degrading. The future availability of water and other ecosystem services have been estimated under different scenarios. Compared to a sustainable management scenario, 'business as usual' or increasing degradation, will be costly: More important than the direct losses (50-100 million US$ over 25 years), are the impacts of lost ecosystem services on industry and economic growth prospects for the city (300-500 million US$ over 25 years) (TEEBcase by Almack and Chatreaux 2010).		An assessment of the benefits of a watershed can: ● Reveal the city's crucial dependence on one watershed upstream. ● Provide crucial information for land-use planning in the relevant area (to ensure adequate water provision for the current and future generations). ● Inform long term economic strategies.
Melbourne, Australia: A world class network of regional parks, trails, foreshores and waterways support and contribute significantly to Melbourne's liveability and public health.Recognising the health benefits of access to natural areas has recently led protected area authorities to take this up as a central theme. Parks Victoria, and the People and Parks Foundation, have forged a partnership with a major health insurer, investing over $1 million US$ in a program for health care professionals to encourage people to increase physical activity by visiting and engaging in activities in parks (Senior 2010).		Assessing the health benefits of urban parks can: ● Facilitate alliances with the health sector, as a means of fostering preventive public health care. ● Also support the biodiversity conservation agenda of the environmental department and park authorities.
Limburg, Belgium: In this densely populated province, a local NGO convinced policy makers in 2006 with an economic argument (job creation) to create Belgium's first national park: Apart from protecting biodiversity, the 'Hoge Kempen National Park' created some 400 jobs and stimulated private investment in tourism in this historically de-industrialised region. Tourists appreciate the recovering nature in former coal mines for its particular landscape and biodiversity values. (TEEBcase by Schops 2011).		An assessment of the value of protected areas for economic development can: ● Ensure that policy makers of the surrounding municipalities consider the potential of their natural assets for the promotion of sustainable economic development. ● Show how natural assets contribute to job creation. ● Make the case for development strategies which take natural assets into account.
Moyobamba, Peru: What can a city with 42,000 inhabitants and a small budget do to prevent water scarcity and further losses in water quality? The benefits of two small watersheds have been used to raise public awareness. Citizens agreed to pay an additional conservation levy on their water bill. They do so in order to restore the watersheds and secure the livelihoods of its rural residents as watershed stewards (TEEBcase by Renner 2010).		A focus on ecosystem services helped city authorities to: ● Gain broad public support and finance for well-targeted conservation measures to secure good drinking water for the city. ● Design adequate planning processes and allocate budget to watershed conservation.

Example	Principal ecosystem services	Municipal tasks and objectives benefitting from a focus on ecosystem services
Durban, South Africa: Durban examined the role of open spaces, especially in terms of meeting the basic needs (e.g. water, firewood and food) of the poor, who did not have access to adequate infrastructure or municipal services. Thanks to an assessment of ecosystem services, it was possible to demonstrate that the city's open space system significantly improved their quality of life and enhanced their ability to meet their basic needs (TEEBcase by Boon 2010).		An ecosystem service approach to planning was useful to: • Prioritise areas for urban development. • Make decision makers aware of the importance of nature conservation, previously perceived as a luxury. • Motivate municipal leadership and local politicians to take a number of tough decisions to protect the environment.
Miami, USA: The city has used the CITYgreen tool for systematically including 'green infrastructure' such as parks, urban forests and wetlands into urban planning. This is mainly for the purpose of storm water protection, enhancement of air- and water quality and climate regulation. As a result a riverine area was rehabilitated which subsequently generated a range of positive side effects (e.g. recreational and property values) (TEEBcase by Főrster 2010).		A focus on the benefits of green infrastructure can: • Support the effectiveness and efficiency of city efforts to regulate floods. • Help the city to ensure the quality of air and water. • Highlight the positive impact on property values.
Vientiane, Lao People's Democratic Republic: Frequent heavy rainfall results in overflowing drains and urban flooding at least 6 times annually, damaging buildings and infrastructure. Several wetlands, however, absorb a proportion of the floodwater, dramatically reducing damages. The value of the ecosystem services of the wetlands has been measured (using annual value of flood damages avoided), calculating the value of the wetlands to be just under US$5 million per year (TEEBcase by Gerrard 2010).		A focus on the value of wetlands demonstrates: • The potential of natural retention areas for flood control. • The savings which can be achieved by the city (e.g. less damage to infrastructure). • The importance of incorporating an ecosystem service approach in spatial planning.
Kampala, Uganda: At the outskirts of Uganda's capital the Nakivubo Swamps provide an important ecosystem service. The swamps treat and filter the biological waste water from much of the city. Ideas to drain the wetland in order to gain agricultural land were dropped when an assessment of this service showed that running a sewage treatment facility with the same capacity as the swamp would cost the city around 2 million US$ annually (TEEBcase by Almack 2010).		An assessment of the value of the wetland means that: • City planners and the sanitation department may benefit from detailed information. • City council can make informed decisions based on various cost estimates. • Informal land conversion of the wetland for agriculture can be judged in the light of sewage treatment capacity lost. • Direct investment to maintain the wetland can be identified as a cost-effective measure to ensure future purification benefits.

City of Cape Town

Water is perhaps one of the most obvious and sought after ecosystem services, yet ecosystem services are interrelated. It is good practice to consider an entire suite of services rather than focus on only one service at the expense of others.

Stephen Granger

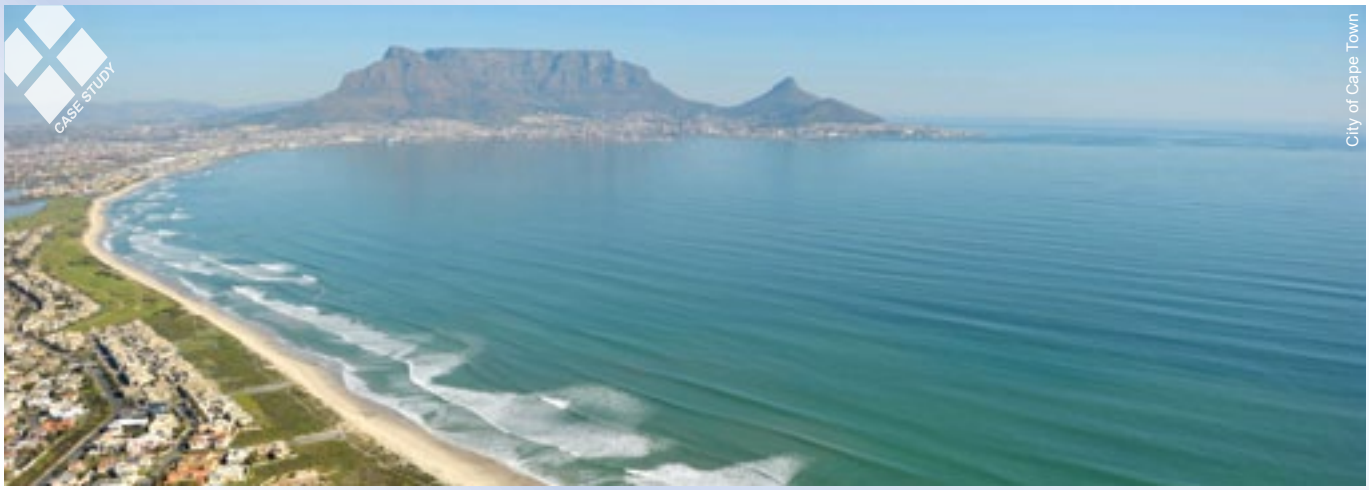
When identifying ecosystem services related to natural features, it is useful to consider the benefits associated with water bodies such as tourism, leisure, water as an agricultural and industrial resource, and transport to name but a few.

SECTION 2:
HOW TO INCLUDE ECOSYSTEM SERVICES IN DECISION MAKING AND POLICY – THE TEEB STEPWISE APPROACH

This section guides the reader through a set of steps that can be considered and adapted in the process of applying a focus on ecosystem services in urban management. Examples illustrate the ways in which each step has been applied in real-life situations. Note that some examples are used to illustrate several steps. By considering each step, and noting how they have been approached in the past, the reader can formulate an idea of how to approach the relevant step in each specific context.

Briefly, the steps are as follows:
Step 1: Specify and agree on the problem or policy issue with stakeholders
Step 2: Identify which ecosystem services are most relevant
Step 3: Determine what information is needed and select assessment methods
Step 4: Assess (future changes in) ecosystem services
Step 5: Identify and assess management/policy options
Step 6: Assess the impact of the policy options on the range of stakeholders

The explanation of the TEEB stepwise approach below draws on case studies to illustrate the practical implementation of a focus on ecosystem services. The following describes the Cape Town context and its key characteristics that have shaped the implementation and successes of applying a focus on ecosystem services.



Cape Town's clear skies are often attributed to the "Cape Doctor", the prevailing summer wind that helps remove air pollution. Doubtless, this is just one of countless examples of nature contributing to human health and quality of life.

Case Study: Assessing the natural assets of Cape Town, South Africa

Cape Town boasts enviable natural assets including world-class mountains, beaches, green open spaces, wetlands and marine life all within the limits of a bustling metro of roughly 3.6 million people. The city has a relatively well-diversified economy and is a world-renowned tourism destination. In addition, it enjoys the status of a 'global biodiversity hotspot' due to its location in the Cape Floral Region. This broader region hosts almost 9,000 indigenous flowering plant species of which 70% are endemic.

Cape Town's latest State of the Environment report indicates that 60% of its original natural areas have been lost and 30% of the remaining vegetation is considered to be either endangered or critically endangered. Its natural assets are under extreme pressure primarily from land transformation, pollution and aggressive alien invasive plant species and are in need of increased investment and management effort.

Municipal budget allocations are heavily contested in Cape Town especially given the existence of often urgent and competing development needs. In this context, the City's Environmental Management Department thought it was important to be able to assess the 'business' case for increased investment in, and protection of, natural assets. This exercise showed the huge value of ecosystem services for the City of Cape Town and highlighted their crucial role in a number of areas, ranging from tourism, where the link is obvious, to waste-water treatment and protection from natural hazards, where the role of ecosystems can more easily go unnoticed. One of the key lessons of this case is that, apart from the impressive results, it was the process of jointly engaging in the analysis with various municipal departments which was most beneficial.

It was valuable to build a shared understanding of Cape Town's ecosystems as natural assets, and thereby prepare the ground for future efforts to better secure their maintenance and protection.

Source: De Wit and van Zyl 2011; De Wit et al. 2009.

STEP 1

Specify and agree on the problem or policy issue with stakeholders

To apply a focus on ecosystem services within city management, a good starting point is to consider a particular management challenge that requires attention. Many of these challenges will have economically viable, effective and sustainable solutions based on ecosystem services. When initiating the process of identifying the challenge, it is essential to plan ahead to determine whether ecosystems will contribute meaningfully to a solution. Some of the more obvious examples might be food security, the need to adapt to the impacts of climate change, or, the provision of clean and safe drinking water. It is important to consider challenges that are critically important to ecosystem health and those that are likely to stimulate broad interest across other sectors.

An ecosystem valuation approach need not necessarily start with the identification of a problem as such, but can also be a way of improving a situation or avoiding a potential problem. Cities such as Montréal and Calgary in Canada are considering the cognitive, social and health benefits of living in close proximity to nature. For example, when planning for the construction of a major residential project for the elderly, Montréal suggests that cities could also consider creating a green area in the vicinity to respond to the specific health and social needs of their citizens (Daniel Hodder, City of Montreal; Chris Manderson, City of Calgary; and, Grant Pearsell, City of Edmonton – Pers. Comm.). Engaging stakeholders at an early stage will assist in identifying appropriate areas and challenges that need to be addressed. For example, consult with personnel from different departments to determine what they consider to be important challenges, and discuss with ecologists or conservationists which of these can be addressed through an increased focus on ecosystem services. Early engagement helps to avoid misunderstandings; makes others aware

City of Cape Town

The Environmental Resource Management Department at the City of Cape Town engaged with other relevant departments around the valuation process of the City's natural assets.

The City of Cape Town's Ecosystem Services Valuation Exercise (continued)

The City of Cape Town's Environmental Resource Management Department set out to determine the economic value of their ecosystem services based on the challenge of rapid biodiversity loss in perhaps the world's most biodiverse and biodiversity-threatened city. In order to involve stakeholders the Department actively engaged with all other Departments within the City's management structure that have responsibility for, or impact on, natural assets within the City, including the Finance Department, involving them in the valuation process. This was done even before consultants were hired to conduct the study and involved a process of relationship-building with the other departments – something important not only for the particular study but for general cooperative management within the City.

Source: De Wit and van Zyl 2011; De Wit et al. 2009.

of the exercise from the start; provides a critical analysis of the challenge from different perspectives; and, helps to foster cooperation and consensus. If necessary, establish a core committee to guide and review the assessment process, to ensure the focus remains on the user and remains credible (O'Farrell and Reyers 2011).Stakeholder engagement is a common thread throughout the six steps. The city administration is probably the most important source of stakeholders with which to engage – both officials and political leadership. Other important stakeholder groups include the general public, often represented through community groups, who are also often willing to assist as volunteers. Research organizations and institutions may be willing and able to contribute expertise, for example by indicating whether a particular challenge identified is indeed relevant to ecosystem services.

The uKhahlamba Drakensberg Park case study illustrates the flexible approach of the TEEB steps, and how they can be adapted for particular situations.

Ensuring that the natural assets benefit local communities in South Africa

The uKhahlamba Drakensberg Park (UDP) was listed as a World Heritage Site by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) in November 2000. The Drakensberg is the longest and highest mountain range in southern Africa, containing unique and endangered biodiversity as well as a large quantity of rock art, one of the richest areas in the world in this regard. The cultural values, aesthetic appreciation and tourism, of this World Heritage Site are great, but the financial impacts on the local municipality and communities are limited, with the main beneficiaries being private tourism operators. There are therefore few incentives from a biodiversity and tourism perspective for the local municipality to protect the environment and promote sustainable land-use options. Planning needed to incorporate priorities other than World Heritage status in order to ensure that local communities benefit from local ecosystem services. An extremely effective policy intervention was therefore to involve local stakeholders and reconcile their needs and aspirations with a range of conservation objectives. The identified priority issues were: food, water and energy security. An economic development strategy was therefore identified, which embraces these issues in order to ensure sustainable delivery of these ecosystem services.

Source: Golder Associates 2010; Blignaut et al. 2011.

Acknowledgement:
The uThukela District Municipality sits on the Buffer Zone Steering Committee and through this position they made the funds available for the study. Ezemvelo KZN Wildlife is driving the Buffer Zone process and established the Steering Committee to bring key stakeholders on board. Through this mechanism, and its Technical Committee, the project received significant support. Notably the Chair of the Steering Committee, Mr Oscar Mthimkhulu, needs to be acknowledged.

Designating natural wealth by means of World Heritage Sites is one way of publicly recognising ecosystem service value.

Guidance on stakeholder engagement

Having initiated the stakeholder engagement process, consider the following points in a facilitated consultation:

For each participatory process, organizers should specify: Who participates? On which terms? For what purpose? Stakeholders need to have a clear idea of what they can expect from the process.

Organizers should analyze (politically and in economic terms), interactions and power relations within the local context as well as between a locality and its wider structural setting. Examining the distribution of ecosystem services provides important insights.

If power relations are neglected, the process may be used by those with the most power to capture additional benefits.

Participation should include everyone directly affected by the decision, as well as those relevant to implementation. Different actors will have different concerns, and bilateral meetings, and an objective facilitator, can assist the process.

The success of a participatory process largely depends on the trust stakeholders place in it. For this reason, the reliability and transparency of the facilitator are key.

Source: Berghőfer and Berghőfer 2006.

FURTHER READING:

- For more general information on stakeholder involvement and support, see: ICLEI-Local Governments for Sustainability. 2010. Local Action for Biodiversity Guidebook: Biodiversity Management for Local Governments. Laros MT and Jones FE (Eds) (pg 33-34).
- TEEB – The Economics of Ecosystems and Biodiversity for Local and Regional Policymakers (2010) (pg 57-60) provides further detail on 'participatory appraisal' – a variety of techniques that incorporate data relating to the interrelationships between people's livelihoods and socioeconomic and ecological factors.
- Richards C, Blackstock K and Carter C. 2004. Practical Approaches to Participation. SERG Policy Brief, Number 1. The Macauley Institute. www.macaulay.ac.uk/socioeconomics/research/SERPpb1.pdf, provides a hands-on overview to organising stakeholder participation.
- For further background on the City of Cape Town valuation study, specifically summarised for decision-makers, see: De Wit M, Van Zyl H, Crookes D, Blignaut J, Jayiya T, Goiset V and Mahumani B. 2009b. 'Why investing in natural assets makes financial sense for the municipality of Cape Town: A summary for decision makers'. Cape Town.

Stephen Granger

Policy often has to mediate between competing stakeholders interests. However, often those stakeholders can be united and brought into discussions by virtue of their shared need for the same resource, such as water.

STEP 2

Identify the most relevant ecosystem services that can help to solve the problem or policy issue

Having identified a challenge that may be solved through a consideration of ecosystem services, it is necessary to identify and prioritize which ecosystem services are most relevant, i.e. those ecosystem services which the policy issues or problem depends upon, or that support it. This includes ecosystem services which are affected, or impacted, by the problem or policy issue, since their future sustainability will depend upon their ability to assist in dealing with the challenges.

To begin with, consider the four overarching questions along with colleagues and other stakeholders (TEEB 2010b):

- Which ecosystem services are central to the local/regional society and economy?
- Which stakeholders are most dependent on these ecosystem services?
- Which ecosystem services are at risk?
- How do the problems and policies affect them?

The list of questions provided in Table 4, pertaining to each of the ecosystem services, will further help to stimulate a basic analysis of what is important in the city and in particular, in relation to the specific problem or policy issue. Consult with the relevant stakeholders, since their involvement at an early stage will be more likely to ensure the maintenance of their support throughout the process. Consider the potential for the provision of each ecosystem service in the city, even if that ecosystem service does not currently play a significant role.

City of Cape Town

Monika Hachtel/ City of Bonn

Many species are sensitive to pollution, and are therefore useful as indicator species. This measure of environmental quality can itself be considered an ecosystem service.

City of Edmonton

Property values are often increased by proximity to natural or semi-natural areas, and ecological restoration may in fact lead to an increase in adjacent property prices.

The various incentive options for the uKhahlamba Drakensberg Park were explored with all stakeholders.

Investigating the value of Ecosystem Services in Rural South Africa (continued)

Sometimes the TEEB stepwise approach may need to be applied in a different way as illustrated in the following example: In South Africa's rural uThukela District Municipality (Blignaut et al. 2011; Golder Associates 2010) a research team followed a slightly different course: They examined the size and ecological condition of the area's (natural and transformed) land cover and habitat types. From this they could draw conclusions about the current (and future) state of ecosystem services (step 4). Combined with the number of users of each service they could prioritize those services in a critical condition (step 2). This in turn served to further specify the problem (step 1).

Source: Golder Associates 2010; Blignaut et al. 2011.

After identifying the ecosystem services, they should then be ranked according to specific relevance. Special consideration should be given to those upon which stakeholders rely, or where stakeholders will be affected by changes in ecosystem service delivery. Often the problem or policy issue (step 1) will determine the priority of the identified ecosystem services. But if this is not the case, look jointly at the levels of demand for each ecosystem service and their supply, using existing data and experience-based knowledge. Table 3 provides an example of how to prioritise ecosystem services, and offers a few aspects to consider when doing so.

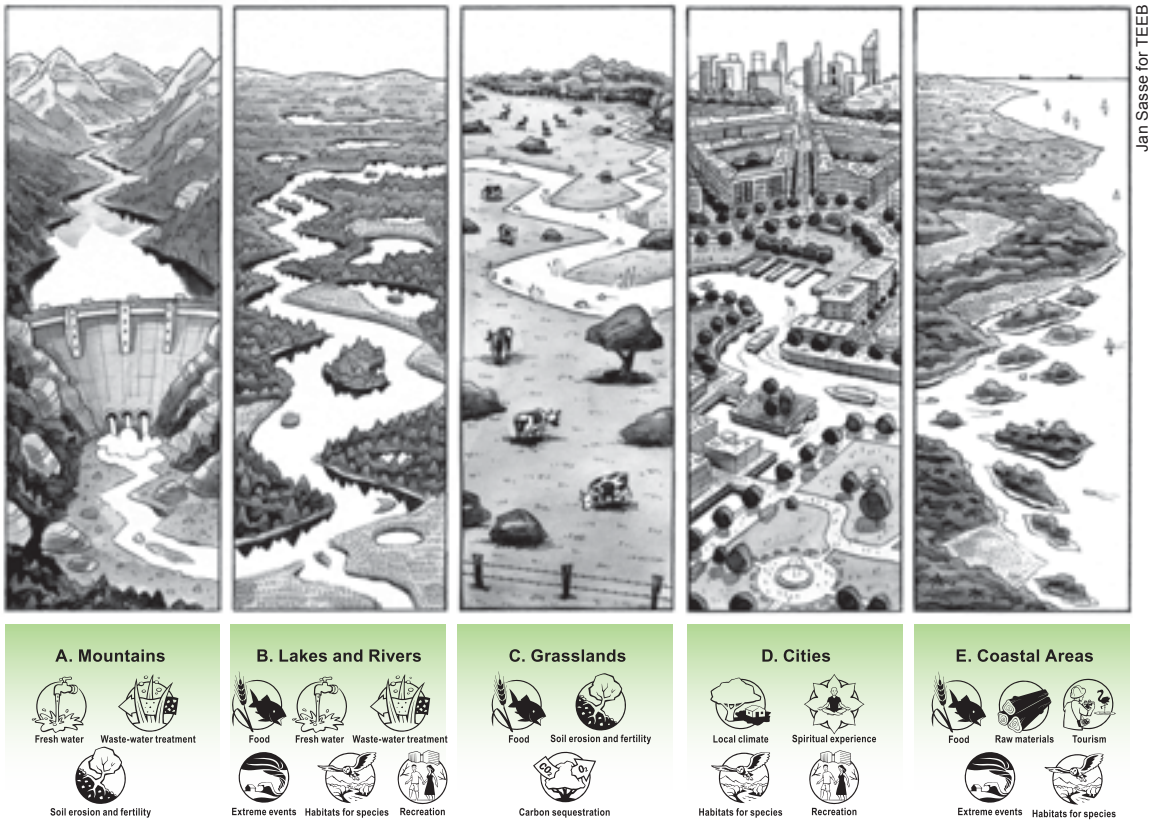
Table 3: An example of how to prioritise ecosystem services

Local ecosystem services in high demand (distinguish between local, national and global)	**Second priority:** Ensure that use levels are kept within the current pressure/risk range. Apply caution. Be attentive to changes in external risks/ pressures.	**First priority:** If pressures are due to high demand, focus on substitutes, or on lowering demand. If pressures are external/unrelated to demand, join forces with service users against external pressures.
Local ecosystem services in low demand (distinguish between local, national and global)	**Fourth priority:** Check for unnecessary losses in natural resources: A currently low demand may lead to inadvertent losses of something that in the future may be highly appreciated (e.g. genetic diversity).	**Third priority:** Severe losses in one service may have an unprecedented effect on others. Consult experts on ecosystem 'tipping points', which once reached may produce a change in ecosystem functioning.
	Local ecosystem services under low pressure/ at low risk	**Local ecosystem services under high pressure/ at high risk**

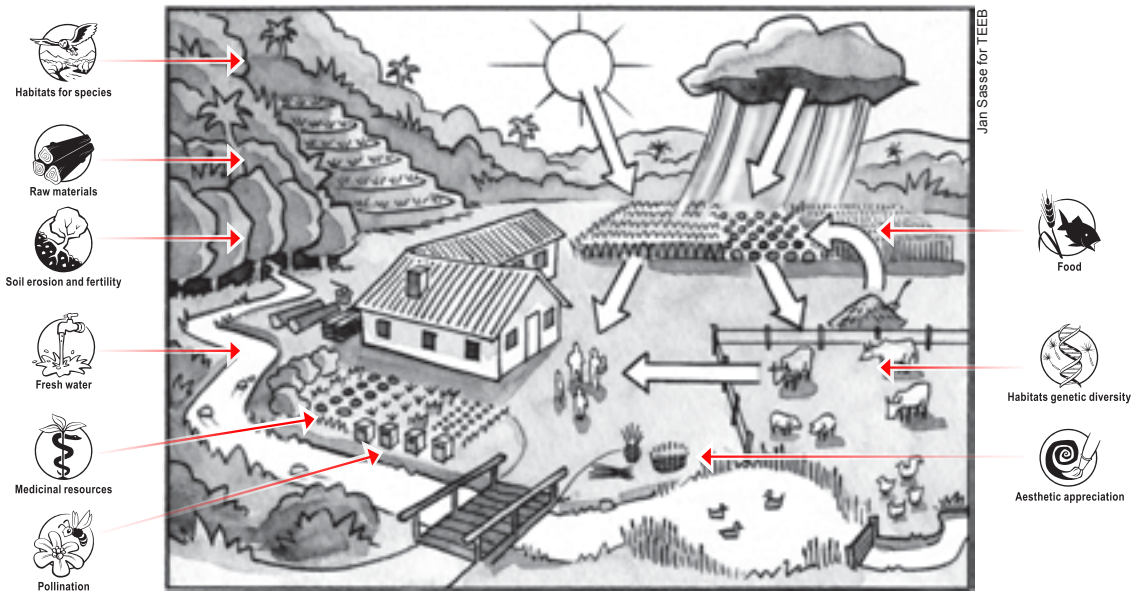
Table 4: Useful questions to identify relevant ecosystem services (Step 2)

Ecosystem Service	Is this ecosystem service relevant to municipal management or the specific problem at hand?
 Food	Is farming (crops, stock or fisheries) one of the economic activities in the city; or are there communities that depend directly on nature for their food?
 Raw materials	Are raw materials such as wood, biofuel or fibre, produced in the city; or are there communities that depend directly on nature for such materials?
 Fresh water	Are there water reservoirs, rivers or other water bodies in the city, that supply drinking or irrigation water? Are the catchment (watershed) areas feeding these water bodies located partly within the city?
 Medicinal resources	Are there populations of wild or domesticated plants or animals in the city, which have medicinal value or are likely to have medicinal potential?
 Local climate	Are trees and other vegetation in the city considered to be important for shade or more broadly for regulating the heat produced in built-up areas?
 Carbon sequestration	Are trees and other vegetation being planted and maintained in the city, especially in built-up areas?
 Extreme events	Does the city contain any wetlands, mangroves, coral reefs; or other ecosystems that can mediate the effect of extreme weather events such as drought, fire, floods and rough seas?
 Waste-water treatment	Is the city reliant on water filtered through wetlands before entering reservoirs, thereby saving on costs of artificial purification?
 Soil erosion and fertility	Does the city contain steep slopes that have good vegetation cover to slow the flow of rainwater and protect the soil?
 Pollination	In the city, is crop farming practiced, which relies on animals (insects in particular) for pollination (for example most fruits and vegetables)?
 Biological control	Are species present in the city, which control pests that endanger human health; or are there any crops for which pest control is delivered by predator species?
 Habitats for species	Does the city contain ecosystems that are healthy enough to support a variety of wild species?
 Habitats genetic diversity	Are there endemic species in your city which depend on ecosystems to maintain their genetic diversity, or are there typical rare cultivars or local varieties of species grown in your city?
 Recreation	Do many citizens regularly use nature (forests, parks, etc.) within the city for recreation; or, is there potential to develop such nature-based recreation?
 Tourism	Does the natural beauty of the city attract visitors to the area?
 Aesthetic appreciation	Do the citizens appreciate the natural beauty of the area? This may be indicated by people enjoying natural areas respectfully; or taking photos or painting scenery.
 Spiritual experience	Are religions, practiced within the city, dependent on natural areas; or do any of these natural areas have particular religious significance?

Examples of ecosystems and a few of the services they provide



Agriculture practices impact on, and are influenced by, the wider ecosystem and its services



City of Cape Town

Key decision-makers were involved in the participatory process of identifying, selecting and prioritising ecosystem services for the City.

Identifying and prioritising ecosystem services in Cape Town (continued)

Based on the Millennium Ecosystem Assessment (2005); different natural assets, which provide ecosystem services, were examined. This included a participatory process with key decision makers focused on the identification, selection and prioritization of ecosystem services. Personal interviews and facilitated sessions were conducted with invited City line function managers and senior staff, representing all functions related to the management of ecosystem services in the City. The following steps were followed:

a) Assessment of the relative importance of different natural assets (e.g. nature reserves, wetlands, near shore environments, etc.) for the generation of ecosystem services. This allowed a basic understanding of the relationships between natural assets and ecosystem services flows in order to appreciate which ones were important and to prioritise underlying assets for investment.

b) Estimation of the importance of ecosystem services for users/ beneficiaries. The number of beneficiaries, as well as estimates on the likely magnitude of value for each of the ecosystem services to these beneficiaries, helped to identify the highest ranked or most important ecosystem service values.

c) Assessment and qualitative information of the broad links between natural assets and economic development. Failure to link investment in natural assets to desired developmental outcomes reduces the probability of increased budget allocations.

d) Assessment of the City's ability to influence the value of ecosystem services through management. The assets and flows, which are completely outside of the City's control, may have high value but will generally be less important when motivating for an increased investment from the City.

e) Ranking of the ecosystem services according to the level of ecological and socio-economic risks they face. This recognises that certain environments are likely to be more vulnerable to habitat loss and degradation and are therefore facing greater ecological risks.

Source: De Wit and van Zyl 2011; De Wit et al. 2009.

FURTHER READING:

- Slightly different terms might be used for ecosystem services, but the list is generally quite consistent between sources. This manual and the TEEB Reports provide a comprehensive list of ecosystem services, which is based on science and is similar to that provided in the Millennium Ecosystem Assessment (MEA). For additional background on ecosystem services and their value, consult the MEA. In particular the MEA Biodiversity Synthesis Report (www.maweb.org/documents/document.354.aspx.pdf) is recommended for its brevity and specific focus (Millennium Ecosystem Assessment 2005).

- WRI. 2008. Ecosystem Services: A guide for decision makers. This easily accessible report frames the link between development and ecosystem service, points out risk and opportunities and provides clear guidance for decision makers (www.wri.org/publication/ecosystem-services-a-guide-for-decision-makers).

- TEEB - The Economics of Ecosystems and Biodiversity for Local and Regional Policy Makers (2010) provides more background information on relevant ecosystem services, especially Chapter 1 (www.teebweb.org/Portals/25/Documents/TEEB_D2_PartI-ForUpload%5B1%5D.pdf).

- For a comprehensive assessment of the fundamental ecological and economic principles of measuring and valuing ecosystem services and biodiversity, and also showing how these can be mainstreamed into public policies, see: The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations (TEEB Foundations 2010).

STEP 3

Determine what information is needed and select assessment methods

Some valuation methods work better for particular ecosystem services, and not all methods are applicable for all ecosystem services. At an early stage it is important to determine whether the method chosen requires statistical analysis (including computer software and skilled people).

Consider what information is required for conducting or commissioning an assessment of the prioritised ecosystem services. The assessment must be tailor-made for each unique situation, and meet the requirements as specified by stakeholder consultation, in order to avoid unnecessary time and expenditure.

The chosen methodology will determine what data and skills are needed in order to obtain useful information. Define the methods to use by looking at the problem or policy issue in four different ways:

(i) What kind of questions need to be answered by the assessment? How do they help tackle the decision or policy issue?

(ii) What is already known about the problem or policy issue? What relevant data, knowledge, experience and expertise is already available to the team or the stakeholders?

(iii) What are the constraints in timing, capacity and financial resources?

(iv) Which are the 'low hanging fruits'? Which are the questions where a little additional input can generate new insights important to the issue?

Discuss the study design with experts in order to ascertain whether to concentrate on a broad range of ecosystem services, or to go into more detail with a few critical ones. Determine the timeframe over which to consider the particular problem or policy issue. When deciding what kind of information is required, select an appropriate type of assessment (see box below).

City of Leicester

The particular nature of each situation will inform what kind of evaluation method for ecosystem services is required.

Types of assessment to consider when deciding on the required information:

a) Qualitative assessment: describing the importance or judging the state of the relevant ecosystem services, as well as showing the connectivity and interrelations between ecosystems and social and economic systems on a spatial scale (this may serve as a communication and awareness-raising exercise, and highlight often-ignored, but important, ecosystem services);

b) Quantitative assessment: for example, indicating the increases/decreases in the flow of ecosystem services expected to result from a certain policy; or estimating the number of jobs affected by a problem that could be solved through preserving ecosystem services;

c) Monetary valuation: calculating the monetary value of selected ecosystem services, or the value of increase in/loss of certain services under different scenarios.

Ecosystem services such as the provisioning of food and raw materials are already valued as part of the economic systems dealt with daily (although they may not be seen as such!). However, most ecosystem goods and services do not have market prices that are easy to calculate. In these cases one can look at the cost of replacing the service, or the costs saved through protection offered by the ecosystem services (e.g. wetlands mediating flooding). These methods can be useful when an ecosystem service has an artificial alternative, the cost of which can be calculated or obtained from existing sources.

For example, in a literature review conducted by the City of Montréal, it was determined that there is a 5-20% increase in the value of property that is within 30 meters of a park. This ensures an increase in income tax for the city for these properties, which are also sold faster when in close proximity to a park (Ville de Montréal 2010). When such approaches are not viable and such information does not exist, one can consider investigating local citizen's preferences which can be indicated through willingness to pay (WTP) for ecosystem services. WTP involves interviewing people about how much they would be willing to pay for a certain amount of a particular ecosystem service, while this method can be useful, it does need to be approached with caution. Results from a WTP study are often inaccurate due to the difficulty of judging hypothetical situations, and it works best where services can be easily judged, such as entrance fees to a protected area, or higher security in water delivery.

City of Cape Town Ecosystem Services Valuation Exercise (continued)

City of Cape Town

In order to make a business case for the City of Cape Town's ecosystem services, the economic values of biodiversity needed to be determined.

Consultants started with a literature review on ecosystem services (ES) and best practices to evaluate ES, and consulted individual valuation studies that had already been done in the city. The purpose and required outcomes were determined at the outset of the study, i.e. that the economic values of Cape Town's ecosystem services were needed to make a business case for biodiversity within the city management and throughout the relevant line functions. the value of ecosystem services from an anthropogenic perspective were studied, and values that were purely ecological or that were independent of humans, which are also clearly important, were not considered in this specific study.

Source: De Wit and van Zyl 2011; De Wit et al. 2009.

Augustin Berghöfer

Urban Managers are faced with reconciling competing needs for land by a growing population - as here in Addis Ababa, Ethiopia.

Table 5: A comparison of monetary valuation methods (TEEB 2010)

Methods		Summary	Statistical analysis	Which services valued?
1. Direct market prices	Market prices	Observe market prices.	Simple	Provisioning services.
2. Market alternative	i. Replacement costs	Finding a man-made solution as an alternative to the ecosystem service.	Simple	Pollination, water purification.
	ii. Damage cost avoided	How much spending was avoided because of the ecosystem service provided?	Simple	Damage mitigation, carbon sequestration.
	iii. Production function	How much is the value-added by the ecosystem service based on its input to production processes?	Complex	Water purification, freshwater availability, provisioning services.
3. Surrogate markets	i. Hedonic Price Method	The extra amount paid for higher environmental quality.	Very complex	Use values only, recreation and leisure, air quality.
	ii. Travel Cost Method	Cost of visiting a site: travel costs (fares, car use, etc.) and also value of leisure time expended.	Complex	Use values only, recreation and leisure.
4. Stated preference	i. Contingent valuation method	How much is the survey respondent willing-to-pay to have more of a particular ecosystem service?	Complex	All services.
	ii. Choice experiments	Given a 'menu' of options with differing levels of ecosystem services and differing costs, which is preferred?	Very complex	All services.
5. Participatory	Participatory environmental valuation	Asking members of a community to determine the importance of a non-marketed ecosystem service relative to goods or services that are marketed.	Simple	All services.
6. Benefits transfer	Benefits transfer (mean value, adjusted mean value, benefit function)	'Borrowing' or transferring a value from an existing study to provide a ballpark estimate for current decision.	Can be simple, can be complex	Whatever services were valued in the original study.

CASE STUDY

Opportunities to quantify the value of supporting ecosystem services

In the City of Abu Dhabi, United Arab Emirates (UAE), the wholesale value of fish landings in 2008 was estimated at 1 million AED (US$272,294) for the Inner Islands Lagoon and 104.8 million AED (US$28.5 million) for the UAE as a whole (Hartmann et al. 2009). Mangroves provide an important supporting service, the value of which is easily determined through the value of the fishing landings, as nursery grounds for several of these commercially important fish species, as well as for other species which contribute to ecosystem functioning. By restoring and protecting mangroves, many other benefits are also afforded to the city, including protection from storms and the control of soil erosion. Through the direct intervention in the late 1970s of the former President of the UAE, Sheikh Zayed, mangrove replanting schemes were implemented adjacent to the city, and currently the adverse effects of recent development around the city have also prompted the EAD and the UPC to mitigate the loss of mangroves by requiring developers to replant lost mangroves. As a result, in the Emirates as a whole, the area of mangroves has actually increased.

Source: Abu Dhabi City Draft Biodiversity Report 2011.

The value of Abu Dhabi's fishing industry has long been known, and mangroves provide essential supporting and regulating ecosystem services for this industry.

Valuing Trees in Edmonton, Canada

City of Edmonton

In 2009, the City of Edmonton analyzed the environmental effects, value and structure of Edmonton's urban forest using the 'Urban Forest Effects Model' (www.nrs.fs.fed.us/tools/ufore/). This modelling software can approximate the effectiveness of the urban forest in at least three ecosystem services: cleansing the air; sequestering carbon; and, reducing storm water in the City. It relies on monetary values for each service which have been taken from other contexts (benefit transfer method) and can be quite uncertain. But the advantage of this method is that it is comparatively easy to apply. If done for similar (e.g. North American) contexts it can quickly deliver useful first approximations.

For the City of Edmonton, which has 12.8 million trees, it was a sufficiently robust approach to understand, and to communicate to their Council and citizens, some of the additional services offered by trees and how the use of trees can save the City money. Financial benefits were tallied and the cost of their boulevard, centre median and buffer trees calculated, focusing on: structure (species composition, extent and diversity); function (environmental and aesthetic benefits); value (annual monetary value of the benefits provided and costs accrued); and, management needs (diversity canopy cover, pruning needed).

It was found that the average benefit per tree in Edmonton's urban forest was US$74.73. The cost for caring for each tree is US$18.38 resulting in a net benefit of US$56.35.

Source: Grant Pearsell, City of Edmonton (pers. comm.).

FURTHER READING:

- TEEB – The Economics of Ecosystems and Biodiversity for Local and Regional Policy Makers. (2010) (page 43-49), for additional details about the selection of methods provided in the Table above.
- Pearce et al. 2002. Handbook of Biodiversity Valuation: A Guide for Policy Makers. This OECD handbook for practitioners provides guidance on biodiversity valuation, points out tradeoffs and contrasts economic and non-economic valuation.
- World Bank; IUCN; TNC (2004) How much is an ecosystem worth? Assessing the economic value of conservation. This brochure introduces the approach of ecosystem services and compares different valuation methods in an easily accessible format. biodiversityeconomics.org/document.rm?id=710
- A easily understandable introduction on ecosystem service valuation, along with essentials, 'the bigger picture' and an overview of existing valuation methods is available at www.ecosystemvaluation.org.
- Bann C. 2003. The Economic Valuation of Mangroves: A Manual for Researchers. This academic 'how-to' guide points out how to conduct a Cost-Benefit-Analysis of mangroves and presents possible management options. http://network.idrc.ca/uploads/user-S/10305674900acf30c.html.
- Department for Environment, Food and Rural Affairs (DEFRA). 2007. An introductory guide to valuing ecosystem services (http://archive.defra.gov.uk/environment/policy/natural-environ/documents/eco-valuing.pdf) provides a good introduction to valuation techniques.
- Kumar P, Verma M, Wood MD and Negandhi D. 2010. Guidance manual for the valuation of regulating services. Ecosystem Services Economics (ESE) Working Paper Series. United Nations Environment Programme, Nairobi.
- Building natural value for sustainable economic development: The green infrastructure valuation toolkit user guide (Green infrastructure Northwest 2011) (www.greeninfrastructurenw.co.uk/resources/Green_Infrastructure_Valuation_Toolkit_UserGuide.pdf) guides stakeholders to make good decisions about the decision options associated with a green infrastructure.
- Turner RK, Georgiou S and Fisher B. 2008. Valuing Ecosystem Services (www.urbanforestrysouth.org/resources/library/valuing-ecosystem-services; www.earthscan.co.uk/?tabid=102770) provides guidance on the valuation of ecosystem services, using multifunctional wetlands as an example.
- The Economics of Ecosystems and Biodiversity in National and International Policy Making (2010), especially Chapter 4, explores a range of instruments to reward those offering ecosystem service benefits, to reduce the incentives of those running down our natural capital, and to offer subsidies that respond to future priorities.

STEP 4

Assess (future changes in) ecosystem services

Having determined the methodology for assessing the value of the relevant ecosystem services in Step 3, the logical next step is to conduct the valuation. This step is, therefore, simply putting the selected methodology into practice and assessing how the problem or policy issues will affect ecosystem services. The examples below illustrate some of the ways in which the methods, introduced above, have been implemented. This is the 'study' component of the process, which can be time consuming and often requires very specific expertise. It is therefore usually worthwhile considering hiring experts to undertake the assessment despite the cost.

Ideally, this step in the process should consider not only the current value of ecosystem services to the city, but also how those values have changed over time and how they will change under different scenarios – i.e. as a result of the problem or under different policy decisions. An integral component of this assessment is understanding the drivers of change. While it is not always possible to include all of these issues into a single assessment or valuation study – it is important to draw on whatever additional information is available for designing the analysis (step 3) and for interpreting its results (steps 4 and 5).

City of Cape Town

The values of Cape Town's ecosystem services were estimated by experts.

City of Cape Town's ecosystem services valuation process (continued)

Expert advice was sought from a group of experienced resource and environmental economists on the consulting team, and validated with experts outside the team. The valuation techniques used and key results were as follows (all values based on 2007 data):

Tourism:
- Total tourism value: US$137 million to US$418 million per annum; based on the amount of revenue generated by visitors who were travelling to, or in, the City in 2007; as a result of the attraction of natural features.

Recreation:
- Local recreational values: US$58 million to US$70 million per annum based on benefits transfer from previous valuation studies in Cape Town for recreation.

Globally important biodiversity:
- Donor funding of US$32 million for conservation has flowed to the region giving a proxy of value - it can easily be argued that Cape Town is one of the most important cities in the world for biodiversity conservation.

Aesthetic and sense of place related values:
- Evidence shows that natural spaces play an important role in improving health and well-being in cities.
- Natural assets help to attract skilled entrepreneurs and others that drive economic development. Cape Town's branding is now strongly linked to its natural assets.
- Natural assets are a key driver of the film and advertising industry and are valued between US$18.8 million and US$56.4 million per annum, based on industry expenditure ascribable to natural asset locations.
- Cape Town boasts some of the most sought-after property, largely because of its natural assets. At a site specific scale, rehabilitation and restoration projects have created significant values.

Natural hazard regulation:
- US$650,000 to US$8.6 million per annum for natural hazard regulation (wildfires, floods and storm surge) based on estimates of the cost of damages avoided from buffering of fires, flooding and storm surge by natural assets.

Water purification and waste treatment, assimilation:
- Case studies show values and risks. For example, the need to dredge Zeekoevlei Wetland for US$8.5 – US$9.9 million represents the minimum clean-up costs needed for the wetland to function normally and avoid ecosystem collapse.

Source: De Wit and van Zyl 2011; De Wit et al. 2009.

Using the 'Benefit Transfer Method' in the City of eThekwini (Durban)

The City of eThekwini (Durban) in South Africa took advantage of a seminal study of ecosystem valuation (Costanza et al. 1997). This study broadly estimated the value of each of the world's biomes according to the ecosystem services they provided, justifying the obvious uncertainties involved by always choosing conservative estimates. The City of eThekwini assigned values based on the Constanza values, to vegetation types within their administration. Each vegetation type corresponded to some extent with one of the biomes used by Costanza, but was adjusted for the local conditions and situation. Like the biomes used in the international study, the vegetation types were therefore used as surrogates for ecosystems, and the values were based on values that had already been determined by a team of international scientists. Note that such values are an estimate, and that caution should be taken when using this method by, for example, underestimating the values when unsure.

Source: EThekwini Municipality Biodiversity Report 2007.

Richard Boon

In order to capture past changes or anticipate future changes, it is imperative to start by asking the right questions. Apply the questions below to each of the ecosystem services prioritised in step 2 (Sources: Ranganathan 2008, TEEB 2010):

- How great is the city's dependence on this ecosystem service? (i.e. High, Medium or Low)
- What are the recent trends in this ecosystem service? (i.e. Stable, Increasing, Decreasing)
- Identify the drivers (which includes threats to each ecosystem service) of these trends, and the level of their recent impact. (High, Medium or Low impact; driven by, for example, land-use change, pollution, etc.)

André Künzelmann/UFZ

Artificial prevention of natural disasters is often more expensive and less effective than natural ecosystem-based buffers.

Stephen Granger

Ecosystem services vary naturally over time, with the changes in seasons for example, but also as a result of intentional or unintentional human influence. In order to get the most out of our natural wealth, we must plan for and adapt to change, or mitigate it where necessary.

STEP 5

Identify and compare management/policy options

Armed with information on the availability, value and/or the changes of the relevant ecosystem services it is possible to identify and compare different options of addressing the problem, arriving at the most effective and useful solution and method of implementation.

From an ecosystems perspective, the management or policy options can be broadly divided into three options:

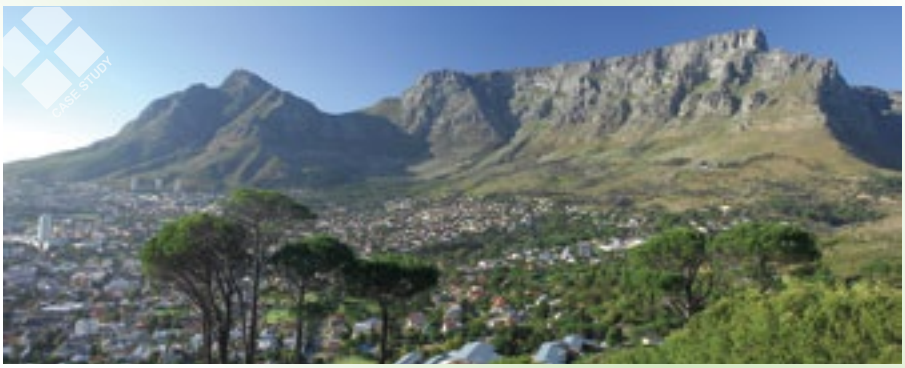
1. Do nothing at all about the problem;
2. Use solutions that do not involve ecosystems; and
3. Use solutions that allow the ecosystem to assist in solving the problem.

The following will assist in how to assess which management option or policy response is the best solution:

- Firstly, incorporate the new insights from the study into discussions in technical planning sessions, council meetings and public consultations, as important information in (re-) shaping positions and arguments. The benefits of the natural resources (i.e. the ecosystem services) are therefore captured in the decision-making process.
- Secondly, incorporate these insights regarding the value of ecosystem services into a cost-benefit analysis of the various policies or planning options, which will assist in identifying the best option. In this process the broad range of ecosystem services should be considered, including those which are not necessarily directly relevant to the problem, but which do have other positive spin-offs. The cost-benefit analysis can be expressed over different time periods, for example, restoring or rehabilitating ecosystems is often likely to pay off more effectively than other options over a longer the period of time.
- Thirdly, management options can be assessed through a transparent multi-criteria analysis, which can be especially useful for contested issues with strong public attention. This allows the various management options to be compared in a systematic and recognizable way. For example, monetised benefits and qualitative stakeholder preferences as well as other data (e.g. ecological indicators) can be considered within a single matrix. These may include weighting and procedures on how to deal with incompatibilities.

It is important to remember that ecosystem service analyses can take on a public life of their own. Media may concentrate on some of the results, while policy makers or business may be interested in other aspects of the study. Monetary estimates can have a powerful effect, but they are often taken at face value and the whole story will not necessarily be understood by the public (including data constraints, assumptions or hypotheses which are needed to draw adequate conclusions from results).

City of Cape Town's ecosystem services valuation process (continued)



City of Cape Town

The evaluation undertaken by the City of Cape Town was integrated into the wider business case and an assessment of additional policy options was undertaken. An estimate of the economic value of ecosystem services does not present a complete case for increased investment in itself.

Investment in ecosystem services can be viewed as investments in the local economy and the ratio between these investments and the gross geographical product (GGP) in the City economy provides a rough measure of a municipalities' leverage on the local economy. This ratio was calculated for the City as a whole, and compared to the ratio between City investments in natural assets specifically and the expected value-added flowing from this investment in the form of an enhanced flow of ecosystem services. It was estimated that the ratio indicating the relationship between the public value generation and public expenditure for the environment sector exceeds that of the general city economy by between 1.2 and 2 times.

Another indicator that was used to communicate the business case was the Unit Reference Value (URV), or the expenditure that is required to generate one Rand's worth of benefits. URV for Cape Town's natural capital assets was calculated at a value of 0.16 South African Rand (ZAR), compared to between ZAR2 and ZAR5 for investments in water supply infrastructure. In summary, it was calculated that the return on investing in Cape Town's natural assets was proportionately high, because this ensured the provision of valuable ecosystem services.

Source: De Wit and van Zyl 2011; De Wit et al. 2009.

Myles Mander

Investigating the value of ecosystem services in rural South Africa (continued)

The team produced a toolbox – a list – of all possible incentive options (global, national and local) that could potentially aid in strengthening the links between the producers and consumers of the identified ecosystem goods and services. The broad objectives for developing the incentive toolbox included: avoiding non-compatible land-use options; conserving biodiversity outside and within the study area; and, balancing the need for economic development and food, water and energy security with biodiversity conservation.

The incentive toolbox was developed considering food, water, energy, tourism and biodiversity as factors. The incentive mechanisms included fiscal mechanisms provided by the public sector; market-based mechanisms; private sector transactions; and, non-financial mechanisms. Criteria used by the team in selecting the preferred incentives were:

- Political expediency to ensure success of implementation;
- Economic viability;
- Contribution to equity and broad economic representation of society;
- Existence of a legal framework within which the incentive structures can be utilized; and,
- Institutional capacity for implementation.

The team presented the stakeholders with a variety of incentive options (see step 6). They were then asked to select the most appropriate incentive options in the context of capacity for implementation and the legal setting. The identified potential incentive options were then grouped according to particular ecosystem services corresponding to the incentives: food security, water availability, energy security, tourism potential and natural resources.

Source: Golder Associates 2010; Blignaut et al. 2011.

Augustin Berghöfer

Often protecting ecosystem services will have dual benefits - addressing the management or policy issue and protecting ecosystem services into the future.

City of Waitakere

A comparison and assessment should be undertaken to establish the most effective solution once the policy options and the possibilities for action have been explored.

FURTHER READING:

- TEEB. 2010. The Economics of Ecosystems and Biodiversity for Local and Regional Policy Makers. (pg 50-55), provides additional information on decision-support frameworks and cost-benefit analysis.
- Bann C. 2003. The Economic Valuation of Mangroves: A Manual for Researchers. This academic how-to guide points out how to conduct a Cost-Benefit-Analysis of mangroves and presents possible management options. http://network.idrc.ca/uploads/user-S/10305674900acf30c.html.
- Mendoza et al. 1999. Guidelines for Applying Multi-Criteria Analysis to the Assessment of Criteria and Indicators. As part of the 'toolbox series' this report gives a first introduction (incl. a case study) of the Multi-Criteria-Analysis, an approach for highly unstructured decision contexts. www.cifor.cgiar.org/acm/download/toolbox9.zip.
- DTLR. 2001. Multi Criteria Analysis: A Manual. This comprehensive and detailed manual presents Multi-Criteria-Analysis techniques and approaches for integration in decision making. http://iatools.jrc.ec.europa.eu/public/IQTool/MCA/DTLR_MCA_manual.pdf.
- Andy Stirling (www.multicriteriamapping.org) introduces an interactive appraisal technique of multi-criteria mapping providing general Information and software tools.
- The Economics of Ecosystems and Biodiversity in National and International Policy Making (2010), especially Chapter 4, demonstrates how the value of ecosystems and biodiversity taken into account in policy decisions, at national and international levels.

STEP 6

Assess the impacts of the policy options on the range of stakeholders

By assessing the social, economic and environmental impacts this step ensures that there are no unforeseen side effects, of a policy, programme or project, which might affect a (sub-) group of stakeholders. The focus is on interviews, group consultations and social indicators.

A complementary way to assess social, economic and environmental impact is to identify changes in the distribution of, or access to, ecosystem services among various stakeholder (sub-)groups, due to the decision considered in step 5.

The stakeholder impact need not be in monetary terms, social, economic and environmental costs and benefits can be made visible in non-monetary terms as well. Consider how different stakeholders are impacted as a result of each policy option, and whether the impact is negative or positive. Changes in availability or distribution of ecosystem services to stakeholders as a result of the policy/decision can be approximated first in a qualitative sense. Based on this, remediation or compensation can be negotiated - and if more data is easily available, monetary estimates of such changes can be helpful.

Michael Sondermann/City of Bonn

Ecosystem services are a great source of wealth and well-being. It is important to consider how this wealth is distributed among stakeholders.

City of Nagoya

To ensure continued delivery of ecosystem services, investment in public goods (such as communally owned ecosystems) is essential - a key role of local govermnents.

Myles Mander

Investigating the value of ecosystem services in rural South Africa (continued)

A series of targeted stakeholder workshops were facilitated in order to present the outcomes of the study to stakeholders, and to facilitate their inputs into the process. The workshops were used to assess the response of the various groupings to incentive options; to include improvements proposed; and, to enhance awareness of the value of the diversity of relevant ecosystem services. The ultimate aim of the workshops was to determine which of the incentive options available would be most useful to the various stakeholder groupings, within which there was varying capacity for implementation. From this the services with the potential to deliver maximum net social benefit, and for which there were potential economic incentives to enhance or maintain service supply, were prioritised.

What is quite remarkable is that while the demand for the study area; from an aesthetic, nature-based tourism point of view; far outstripped the demand for any other ecosystem service, the financial impacts thereof on the local municipality and its people are rather limited. The money flows that do occur are mainly towards private tourism operators and not to society in general. Also, the number of incentive mechanisms from a tourism and biodiversity perspective to protect the land and to promote sustainable land-use options is rather limited. What did, however, emerge as arguably the best policy intervention binding people's aspirations; and reconciling that with a range of conservation objectives, for which a large number of incentive mechanisms are available; was in the promotion of food-, water- and energy security. Food-, water- and energy provision are some of the more important ecosystem services. In most cases they are also available on a local level and are national level priorities. Matching the demand for delivery of these ecosystem services with the sustainable supply thereof (which requires prudent land-use) and with the resources available for delivering such essential services from a national perspective, provided a 'win-win-win' solution.

Source: Golder Associates 2010; Blignaut et al. 2011.

FURTHER READING:

- For additional general information on social impact assessment, see the United Nations Environmental Program: EIA Training Resource Manual (UNEP 2002) - UNEP's Economics and Trade Programme's training manual for Social Impact Assessment (www.unep.ch/etu/publications/EIA_2ed/EIA_E_top13_body.PDF).
- The Social Analysis Sourcebook published by the World Bank (Dani 2003) presents a conceptual framework for social analysis and describes how task teams can incorporate its principles into a project cycle (http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTSOCIALDEV/0,,contentMDK:21177387~pagePK:64168445~piPK:64168309~theSitePK:3177395,00.html).
- For the social impact assessment of carbon projects, the manual for social impact assessment of land-based carbon projects by Forest Trends (Richards and Panfil 2010), provides good guidance (www.forest-trends.org/documents/files/doc_2436.pdf)
- TEEB - The Economics of Ecosystems and Biodiversity for Local and Regional Policy Makers (2010), The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations (TEEB Foundations 2010), and TEEB – The Economics of Ecosystems and Biodiversity Report for Business - Executive Summary (2010) all contain additional information about valuing ecosystem services.

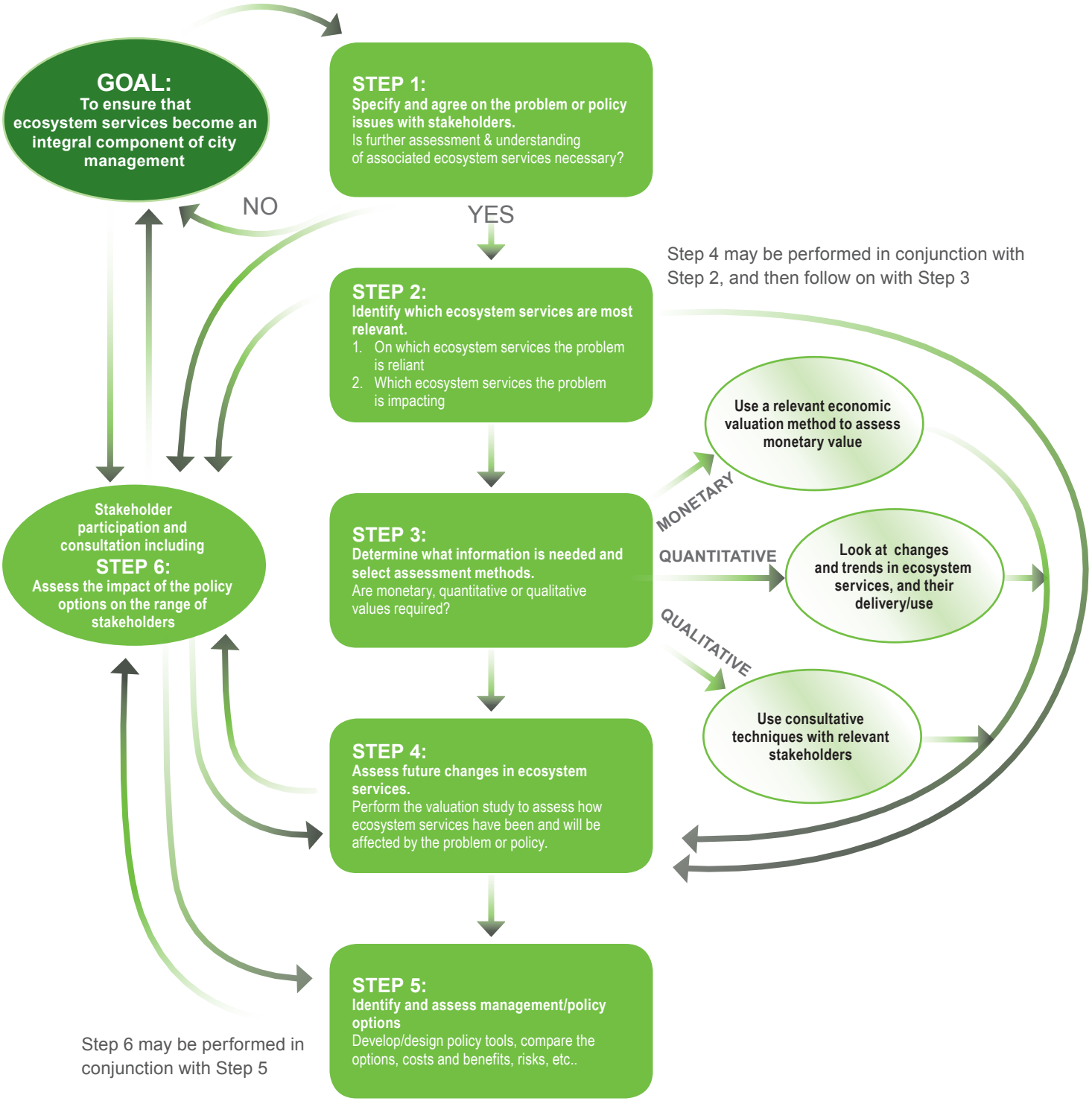


Figure 1: The TEEB stepwise approach is designed to be flexible, and can be adapted for each unique situation. This flow diagram shows how the steps can be linked, and that the order of the steps can be adjusted as necessary.

SECTION 3:
APPLYING THE TEEB STEPWISE APPROACH WITHIN CITY MANAGEMENT

Integrating a focus on ecosystem services is dependent on how a particular administration works. Nevertheless there are certain principles that are more or less universal. Environmental personnel are usually most directly responsible for adopting a focus on ecosystem services, but working alone they can only achieve limited objectives. More importantly, environmental personnel need to be the drivers and champions behind such an approach for it to be adopted widely enough to have an impact. This requires not only dedication but also communication skills and a realization that other views need to be taken consistently into account – hence the focus in this publication on stakeholder involvement. Within local government administrations, these stakeholders can be roughly divided into officials (from other departments or line functions) and elected officials or politicians (who effectively make decisions) based mostly on what officials propose.

Figure 2 illustrates where ecosystem services and biodiversity can be integrated into local policy-making and decisions.

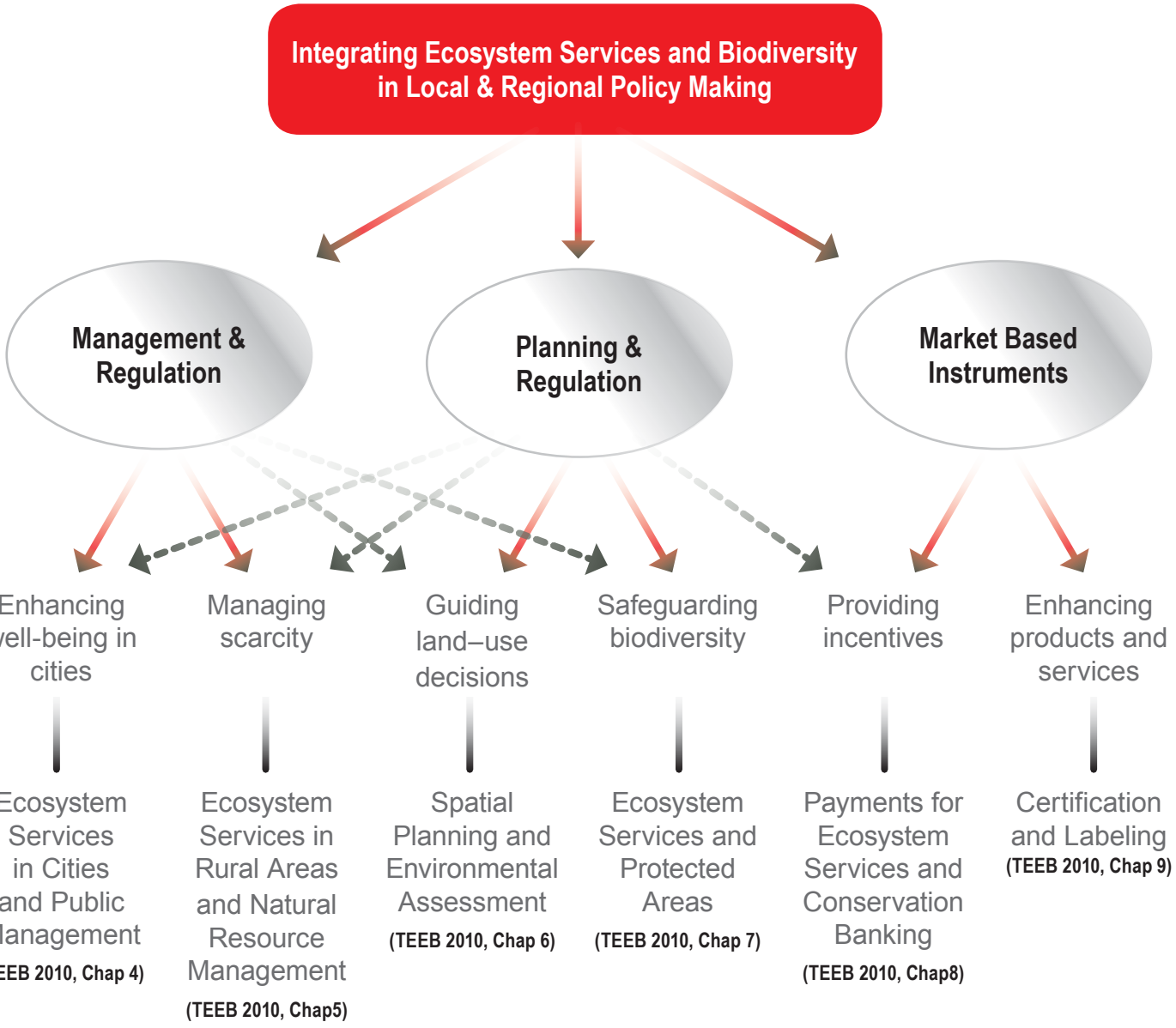


Figure 2: An illustration of the opportunities for integrating ecosystem services and biodiversity into local and regional policy (further reading can be found in TEEB 2010, the specific chapters are shown in brackets). Source: Adapted from TEEB 2010.

3.1 Communicating to decision makers and other line functions

Budget decisions are inherently political and are subject to continuous lobbying by competing interests. A focus on ecosystem valuation can be particularly valuable because it translates natural assets into the same 'currency' as other municipal concerns. When a monetary estimate of ecosystem services is provided, it draws attention to the importance of ecosystems. Caution is necessary here, because for any given ecosystem service, other alternatives (that do not benefit ecosystems) are likely to yield more immediate gain (for example, individual property prices are likely to out-price ecosystem services). However, any given ecosystem provides multiple benefits, though only one or two may have had values assessed. Further because conserving ecosystems means a continual flow of ecosystem services and not a once-off economic benefit, it is hard to compete with ecosystem services when it comes to a longer term return on investment.

Ecosystems typically require very little actual investment to continue provision of benefits; however the replacement costs are high.

Furthermore, it is likely that even when economic benefits cannot be quantified, social benefits are likely to be evident and it may be useful to bring these facts to the attention of decision makers, so that ecosystem services are strongly considered when comparing policy and management options. How this is done will vary according to administration but can be a part of the process from the start, by meeting and presenting to the relevant politician; and, by presenting the calculated values, or estimated worth, of ecosystems in project proposals or budget applications.

City of Cape Town's ecosystem services valuation process (continued)

City of Cape Town

One of the unforeseen benefits of the assessment and valuation of Cape Town's ecosystem services was an increased partnership between the Environmental Resource Department and the Finance Department around the benefits of ecosystem services.

In the case of the Cape Town study the result was not quite what was intended but was nevertheless useful. The study was conducted in the hope that the results – which were impressively in favour of an ecosystem-focus approach – would be able to influence the budget in the following budgeting cycle. However, it was discovered that it is difficult to make direct links between any study and increased budgets given the large number of factors that influence policy decisions. Equally, budget allocations do not change immediately in response to an issue, but tend to be delayed until larger shifts occur as the importance of an issue is internalized and starts building momentum. A better understanding about the value of the City's natural assets was necessary, but not sufficient to bring an immediate shift in financial policy and budget allocations. To make matters more challenging, timing and competing demands were external factors that had an influence on the outcome:

- Timing: results came out in the midst of the global recession. The Cape Town World Cup Soccer Stadium had also just been completed significantly over budget.
- Competing demands: service delivery is urgently required making it difficult to increase environmental spending by drawing from service delivery budgets even though the benefits of environmental investment can be clearly shown.

This study provided, in the words of the Environmental Resource Management Department, 'a fantastic foundation' for the further development of environmental fiscal reform strategies in the City and turned out to be a long-term investment. The Environmental Resource Department learned invaluable lessons from the other departments with whom it engaged, especially the finance department; while officials from the other departments got a sense of the importance and value of ecosystems in the City for the first time. This is certain to prepare the ground for future project proposals, budget allocations, etc. Furthermore the study indicated the need and the viability for attaching payment for ecosystem services to specific user-groups, and options are currently being investigated.

Source: De Wit and van Zyl 2011; De Wit et al. 2009.

***eco*Budget: An ecosystem services budget to set goals and keep track of performance**

ecoBudget was developed by ICLEI-Local Governments for Sustainability to explicitly address the integration of ecosystem services in decision making on a recurrent basis. It provides a method to plan, control, monitor, report on and evaluate the consumption of natural resources (land, water, materials) and ecosystem services (such as climate stability and air quality).

ecoBudget follows the cyclical approach of local financial budgeting, familiar to local decision makers. The traditional budgeting accounting system is complemented by an environmental budget, in which ecosystem services or natural resources are measured in physical units instead of monetary value.

The aim is to keep environmental spending within limits of an environmental 'Master Budget'. After consultations, the Master Budget sets environmental targets which are of general priority and oriented to the sustainable management of the city's natural capital. Once approved by the Council, the targets become politically binding. At year-end a 'Budget Balance' indicates the city's achievement against its targets indicating, for example, how forest cover changed in the peri-urban watersheds or whether total green space was extended as per agreement, etc..

A key feature in the ecoBudget cycle is systematic involvement of political decision makers and urban managers, allowing political steering in the use of environmental resources. ecoBudget can embrace all environmental resources, not only the impact of delivering municipal services, but environmental spending by the entire community including industries, households, education- and health institutions and transport companies. More information is available at www.ecobudget.org.

Source TEEB 2010, chapter 4.

Michael Sondermann/City of Bonn

Local governments must take the lead and set the example in environmental matters in order to preserve ecosystem services for all citizens.

3.2 Budget cycle

It was with good reason that the City of Cape Town focused on the budget cycle in their study – and important that the results of the study could influence the cycle in future because, in cities around the world, the budget allocation process has traditionally focused only on economic and human resources. It has often neglected the natural capital component precisely because the services provided by natural resources have mostly been considered to be free; are taken for granted; or, have simply never been identified.

By identifying the benefits provided by ecosystem services and their value for the local population (both in monetary and non-monetary terms) an assessment can provide solid guidance for budget allocations. Once ecosystem services are incorporated into the budgeting cycle this will ensure their consideration and protection and ultimately the establishment of a sustainable and healthy city. ecoBudget was developed by ICLEI-Local Governments for Sustainability, for and with local authorities, and is a useful tool for integrating ecosystem services and informing policy making.

City Biodiversity Index: an urban biodiversity monitoring and self assessment tool

An alternative approach is the City Biodiversity Index (formerly known as Singapore Index), a monitoring and self-assessment tool which allows local authorities to keep track of their (i) biodiversity; (ii) ecosystem services; and, (iii) environmental policy responses.

Twenty-five indicators have been developed under three sub-headings: Native Biodiversity; Ecosystem Services; and Governance and Management. A description of each indicator is included in the manual, as well as instructions on how to calculate the indicator. The results are scored and calculated to provide a comparative output, which can be the basis of monitoring and evaluating local biodiversity. More information is available at www.cbd.int/authorities/gettinginvolved/cbi.shtml.

King County

Integrating the value of ecosystem services into municipal budget cycles can leverage support for further investment in biodiversity assets which can yield significant benefits in the long-term.

3.3 Spatial planning

A clear planning framework helps to create sustainable communities, and an ecosystem perspective is increasingly recognized as being a key to effective spatial planning. For example, effective planning can be instrumental in reducing a city's ecological footprint by increasing housing density; no longer exporting waste to surrounding areas; decreasing flood risk; or, by providing green space for recreation. The challenge for the planner is to determine how to incorporate an ecosystem perspective into city- and resource management. Ecosystems can be represented spatially (on maps), and, in many parts of the world, data exist that indicate what these ecosystems are – which in turn provides information about the ecosystem services.

One of the challenges is to ensure that communication takes place between the environmental- and planning departments and that information about the ecosystems services is considered as part of the planning process. Perhaps most importantly, ecosystems data should be made accessible to planners, for example, identifying the most sensitive areas, and important areas for the production of ecosystem services. As indicated in the City of Cape Town study, communication is essential and building relationships with the planning department is likely to be as fruitful as ensuring continued political support.

In order to integrate ecosystem services into spatial planning it is important to develop a multi-scale approach to decision making, and ensure that this becomes part of socio-economic decision making as a whole. At the local scale there are key policy issues which would benefit from better integration of ecosystem services into planning and decision making:

- Human health and quality of life (e.g. air pollution regulation by green infrastructure, “green lungs”, access to safe drinking water and sanitation, and access to green spaces);
- Water security, provision and purification (e.g. forest designation, land restoration, land use practices, and potentially payments for ecosystem services);
- Climate adaptation, climate regulation and climate change mitigation (e.g. investment in green roofs , green spaces and green road verges);
- Flood control benefits (e.g. investments in green infrastructures, planning and zoning);
- Energy security (e.g. biomass around cities and green infrastructures in cities);
- Food security (e.g. soil quality and erosion control, genetic diversity);
- Biodiversity (e.g. investment in green infrastructures, protected areas, wetlands and parks);
- Recreation and tourism (e.g. protected areas, quality of landscapes);
- Transport and mobility (e.g. sustainable transport, and greening of grey infrastructure though green road verges); and
- Locational quality, competitiveness and attraction to inward investment (e.g. quality landscapes and amenities to attract business).

Michael Sondermann/City of Bonn

Integrating ecosystem services into spatial planning plays an essential role in creating sustainable communities and cities.

It is advisable to establish a legal framework which provides a statutory basis for local plans to guide development and ensure that adverse effects on ecosystem services can be controlled and remediated (UN-HABITAT 2009). Very often ecosystems such as water catchments (and therefore ecosystem services) span municipal boundaries. It is therefore important to develop a regional and national planning framework to implement plans across entire ecosystems. As has been a theme throughout this manual, stakeholder participation is critical for effective spatial planning. Haines-Young and Potschin (2008) propose three different approaches to ecosystem services, which can be employed within planning systems:

- **Place-based approach** identifies and evaluates the interrelationships between all services in a defined geographical area. As political decision making typically focuses on an area with specific boundaries, this is often the most effective approach, and also encourages consideration of cross-sectoral issues, geographical scales and the values and priorities of different stakeholder groups;
- **Habitat approach** focuses on units of habitat, which is valuable as it has a clear relevance to policy, linking ecosystem services with biodiversity action planning processes.
- **Services approach** focuses on the ecosystem services themselves and is particularly effective in assessing regional and national level services, such as water basin management – for example water supply and flood control services.

FURTHER READING:

- TEEB - The Economics of Ecosystems and Biodiversity for Local and Regional Policy Makers (2010), Chapter 6, provides more information and details about considering ecosystem services in both spatial planning and environmental assessments.
- Global Report on Human Settlements (2009) Planning Sustainable Cities. United Nations Human Settlements Programme (UN-HABITAT). This comprehensive report reviews recent urban planning practices and approaches, discusses constraints and conflicts, and identifies innovative approaches to current challenges of urbanization. URL: www.unhabitat.org/downloads/docs/GRHS2009/GRHS.2009.pdf.

US Geological Survey

Often protecting ecosystem services will have dual benefits - addressing the management or policy issue and protecting ecosystem services into the future.

3.4 Concluding remarks

Ecosystem services are essential to cities. It has been shown through research and through the practical examples provided in this manual, that incorporating ecosystem services into city management is possible and extremely beneficial. Such a focus will reduce efforts and costs over the long-term, boost the local economy, and improve the quality of life for all citizens.

It is easy to begin the process of valuing ecosystem services, for example, by identifying an ecosystem service that has not previously been recognised, or by drawing on studies from similar contexts. It is, however, important to consider the larger context and the full range of ecosystem services across a spatial/geographic area, and not just examine an ecosystem service in isolation. In many cases, once a shift has been made in the way cities think about the local environment, the move to incorporating the ecosystem services concept will follow easily.

As mentioned throughout this manual, involving stakeholders (including the finance and economic development departments) as key role players, at every step of the process, is essential to build a sense of awareness, understanding and ownership.

It is hoped that, above all, this manual will inspire cities to start thinking about how a focus on ecosystem services and their valuation can be useful in the local situation. This approach has been demonstrated to be effective and valuable, and it can be easily performed even with limited resources – the fact of the matter is it is a long-term investment that will save resources into the future.

Stephen Granger

Incorporating ecosystem services into city management is possible and extremely beneficial.

GLOSSARY

Biodiversity: the variability among living organisms, including terrestrial, marine and other aquatic ecosystems. Biodiversity includes diversity within species, between species, and between ecosystems.

Biological diversity: see biodiversity.

Biofuel: A fuel derived from biomass like plant matter instead of fossil fuel resources such as mineral oil.

Biological control: The use of natural enemies (diseases, parasites, predators) to regulate populations of pest species.

Biome: A large geographic region, characterized by life forms that develop in response to relatively uniform climatic conditions. Examples are tropical rain forest, savanna, desert and tundra.

Carbon sequestration: The process by which plants take in carbon dioxide gas and convert it into solid carbon as part of their structural components, as they grow.

Climate change: In the modern day context this usually refers to human-induced change in the earth's climate, caused mostly by the production of greenhouse gases such as carbon dioxide from engines (factories, cars, etc.). This change is happening at a rapid rate and poses a threat to both humankind and biodiversity.

Conservation (also: biodiversity conservation): The preservation of biological units such as genes, species, populations and ecosystems to prevent their extinction.

Degradation, Environmental: The process of loss of quality of the environment, leading to a reduction in ecosystem function and loss of ecosystem services.

Desertification: A form of environmental degradation that is characterised by a change in the natural landscape and environment to look more like a desert, with drier, dustier conditions. It can be caused by overgrazing, removal of natural vegetation, bad agricultural practices and drought.

Diversity: The sum total of variety of biological units at various scales, be it genes, species, populations, or ecosystems.

Ecosystem health or Ecological stability: A description of the dynamic properties of an ecosystem. An ecosystem is considered stable or healthy if it returns to its original state after a disturbance, exhibits low temporal variability with time, or does not change dramatically in the face of disturbance.

Ecosystem: a dynamic complex of plant, animal and microorganism communities and their environment interacting as a functional unit.

Ecosystem services: The direct and indirect contributions of ecosystems to human well-being. The concept 'ecosystem goods and services' is synonymous with ecosystem services.

Ecotourism: Travel undertaken to visit natural sites or regions without harming them.

Endemic / endemism: A species, or taxonomic group, that is restricted to a particular geographic region.

Extinct: A species no longer represented by living individuals.

Microorganisms: Organisms which are so small that they require a microscope to be seen.

Organisms: Any individual life form that can react to stimuli, reproduce, grow, and maintain itself - plants, animals, fungi, viruses, bacteria and other forms of life.

Parasite: The organism that benefits in an interspecific interaction in which individuals of two species live symbiotically with one organism benefitting and the other being harmed. A parasite lives in intimate association with its host.

Payment for Ecosystem Services: A mechanism whereby financial, or other, compensation is used to promote the conservation of an ecosystem, or encourage restoration and rehabilitation of the ecosystem.

Predator: An organism that benefits in an interspecific interaction in which it kills and feeds on prey. A predator lives in loose association with its prey.

Resilience, ecosystem: The capacity of an ecosystem to tolerate disturbance without collapsing.

Restoration: In the biodiversity context, this refers to turning an area back to its natural state by, for example, re-planting native vegetation. It is also relevant when it refers to the repairing of buildings, as this can be done in such a way to benefit biodiversity.

Species: One of the basic units of biological classification, a species is often defined as a group of living things that are capable of interbreeding and producing fertile offspring.

Sustainability: Development and maintenance based on the use of resources that can be replaced or renewed and therefore not depleted. Economic development is sustainable only if it takes into account the limited resources of the biosphere.

Vector: The means by which a pathogen, parasite or invasive alien species travels from one geographic area, or host, to another. For example, the vector of the malaria parasite is the *Anopheles* mosquito.

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The TEEB Report for Local and, Regional Policy Makers (September 2010)

The TEEB for Local and Regional Policy Makers report outlines the value of nature for local well-being and regional development and suggests means of drawing on such insights to support policy making.

The importance of maintaining and enhancing functioning natural systems is often ignored despite its importance, for example to the local economy, food or energy security, and environmental sustainability. When local and regional strategies have included measures to protect functioning natural systems or investments to enhance them, these have frequently been found to deliver robust and cost-effective solutions. The Report explores how considering ecosystem services can help:

- fine-tune by-laws and regulations for the effective management of natural resources, agriculture, fisheries, forestry, tourism, disaster mitigation and adaptation to climate change;
- improve performance in public management, spatial planning and environmental assessments, and save costs in municipal service delivery;
- identify who is affected by environmental change and how they are affected (e.g. bringing local livelihoods to the centre of policy discussions);
- better coordinate conservation efforts with local development aspirations; and,
- design and apply market-based instruments such as payments for ecosystem services (PES), conservation banking, certification and labelling.

ICLEI Local Governments for Sustainability and their Cities Biodiversity Center

ICLEI's mission is to build and serve a worldwide movement of local governments to achieve tangible improvements in global sustainability with special focus on environmental conditions through cumulative local actions. ICLEI is an international association of local governments as well as national and regional local government organizations committed to sustainable development. ICLEI provides technical consulting, training, and information services to build capacity, share knowledge, and support local government in the implementation of sustainable development at the local level.

ICLEI's Cities Biodiversity Center runs the Local Action for Biodiversity (LAB) Programme in partnership with IUCN, which is a global urban biodiversity programme piloted in 2006 with a select group of local and regional authorities from around the world. The LAB Programme has expanded, and a variety of other projects are being developed by ICLEI's Biodiversity Center. The local authorities participating in these programmes and projects are international leaders in managing and conserving biodiversity at the local level.

International Union for Conservation of Nature (IUCN)

IUCN, International Union for Conservation of Nature, helps the world find pragmatic solutions to our most pressing environment and development challenges. It supports scientific research, manages field projects all over the world and brings governments, non-government organizations, United Nations agencies, companies and local communities together to develop and implement policy, laws and best practice.

IUCN is the world's oldest and largest global environmental network - a democratic membership union with more than 1,000 government and NGO member organizations, and almost 11,000 volunteer scientists in more than 160 countries.

IUCN recognises the crucial importance of sound management of biodiversity and ecosystems at the level of local and regional authorities and is committed to mobilise its network to support local efforts.

The Secretariat of the Convention on Biological Diversity (CBD)

The Secretariat of the Convention on Biological Diversity (CBD) was established to support the Convention on Biological Diversity, the reference global treaty on all issues related to the variety of forms of life and their use. The Convention was opened for signature on 5 June 1992 at the Rio "Earth Summit". 193 Parties have ratified the agreement until 2011.

The Secretariat organizes meetings, supports Parties, prepares documents and position papers and facilitates the flow of authoritative information on the implementation of the Convention. It also plays a significant role in coordinating the Convention's work with that of other relevant institutions and Conventions, and represents the Convention at meetings of relevant bodies.

The Convention's comprehensive and integrated approach to biodiversity conservation and management acts as a framework within which Parties can define national policies, strategies and action plans subsequently implemented at the national, regional, sub-national and local levels. Since 2008, it also works with partners like ICLEI to provide a platform for sub-national and local authorities to contribute to the Convention by defining local policies and regulations. Guidance for these activities lies in decisions of the Conference of the Parties (COP), notably decisions IX/28 and X/22, on the engagement of cities and local authorities.

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The TEEB Manual for Cities: Ecosystem Services in Urban Management

Why and how can a focus on ecosystem services help cities achieve their goals? This manual guides practitioners and decision makers in a stepwise approach towards counting on a city's natural capital - and making it work for you. The concept of 'ecosystem services' is key to this.

This manual builds upon the report TEEB – The Economics of Ecosystems and biodiversity for Local and Regional Policy Makers (2010) and draws on the combined expertise in sustainability management of participating local governments in ICLEI-Local Governments for Sustainability's Local Action for Biodiversity Programme, run in partnership with the International Union for Conservation of Nature (IUCN).

Provisioning Food

Provisioning Raw Materials

Provisioning Fresh Water

Provisioning Medicinal Resources

Regulating Local Climate

Regulating Carbon Sequestration

Regulating Extreme Events

Regulating Waste Water Treatment

Regulating Soil Erosion and Fertility

Regulating Pollination

Regulating Biological Control

Habitats for Species

Habitats for Genetic Diversity

Cultural Service: Recreation

Cultural Service: Tourism

Cultural Service: Aesthetic appreciation

Cultural Service: Spiritual Experience

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