Nature Report 2014

Flanders Regional Ecosystem Assessment - State & Trends Synthesis Report

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NATURE AND FOREST

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Nature Report 2014

Ecosystems and ecosystem services in Flanders - State and trends

PREFACE

It is an established fact that the loss of biodiversity has serious social and economic consequences. Our well-being and welfare are strongly dependent on healthy ecosystems. However, the contribution that nature makes remains largely invisible in public debate, in which nature is still often regarded purely as a cost. Ecosystem services make this invisible contribution more visible. The carefully considered and sustainable use of our natural capital both saves money and increases human well-being, and nature itself benefits from it too.

This message is increasingly finding its way into national and international policy strategies. In addition to the Natura 2000 network, ecosystem services form an important second pillar of the European Biodiversity Strategy. Moreover, as well as supporting nature policy, ecosystem services are also being used to make Europe a sustainable and competitive region by 2020.

INBO wishes to contribute actively to the achievement of these goals. This Nature Report, Flanders REA-S&T 2014, is the first part of an ecosystem assessment for Flanders. With this assessment, we seek to establish the knowledge basis for a policy that takes due account of the need to maintain and restore natural capital and ecosystem services. In this first part, we have performed a detailed analysis of the state of and trends in ecosystem services in Flanders. In doing so, we have adopted an interdisciplinary, cross-sectoral approach. This has not been an analysis of and by a single agency, but one supported by and performed in partnership with a broad group of partners from different policy and knowledge domains. In the next stages of the assessment we again plan to make maximum use of cooperation across policy fields. In this way, we seek to emphasise that nature policy is not a free-standing entity, but also offers socio-economic added value to society as a whole.

I therefore wish to invite you to write the next chapters of the assessment with us and to further integrate the concept of ecosystem services in Flemish policy frameworks.

I hope you enjoy reading the report.

Dr Jurgen Tack
Managing Director, INBO

This Synthesis Report summarises the main findings of a more extensive and thorough Technical Report. The Technical Report consists of 26 chapters and represents the knowledge base for the Flanders Regional Ecosystem Assessment. Each chapter is developed as a separate publication and is available in Dutch at www.nara.be/technisch-rapport.
When reading this Synthesis Report, it may be useful at times to refer to the Technical Report. At various places in this Synthesis Report you will therefore see the symbol on the left, with the number of the relevant chapter in the Technical Report.

During the winter storm of 2013, the Bergenmeersen controlled flooding area in Wichelen came into use for the first time, protecting vulnerable residential areas and industrial zones against flooding. Valleys are able to store large volumes of river water in extreme weather conditions. Moreover, an extremely valuable river habitat develops there in which a wide variety of plants and animals thrive.

01

WHY ASSESS ECOSYSTEM SERVICES IN FLANDERS?

01. Why assess ecosystem services in Flanders?

Nature provides people and society with numerous benefits – the production of food and drinking water, crop pollination and green spaces for recreation to name but a few. Even in our highly urbanised and industrialised society, we are still dependent on such 'ecosystem services'. In order to protect these valuable services, we need to give them an appropriate weitgh in the public debate, policy and ecosystem management. An ecosystem assessment provides the scientific knowledge base for doing this.

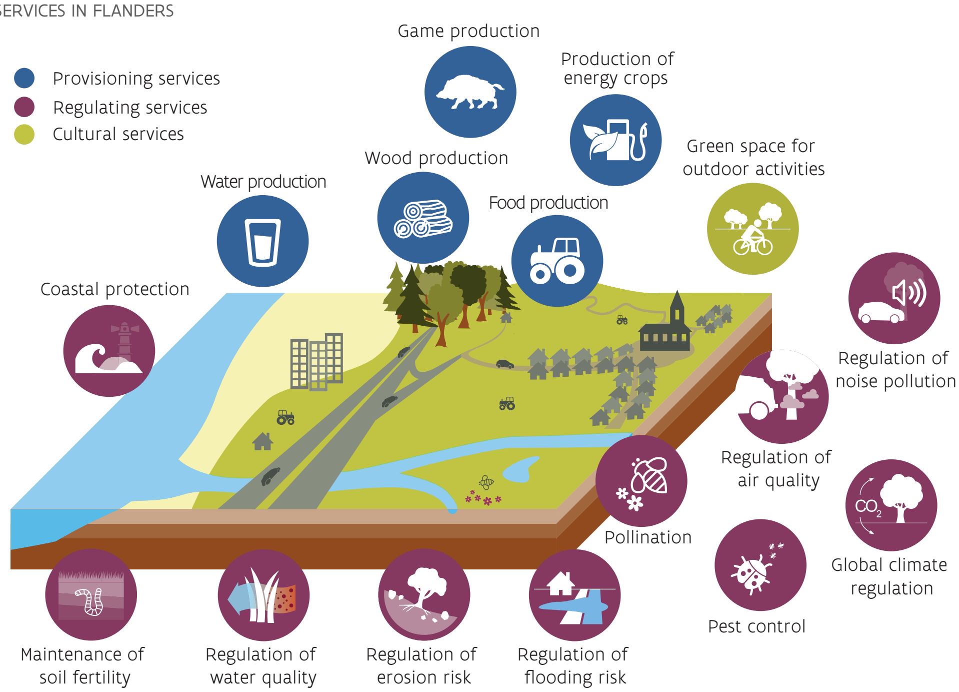
1.1. What are ecosystem services?

Nature removes fine particulate matter from the air, purifies our water, produces food and energy crops and provides us with healthy recreation options. All sorts of processes that occur in nature provide us as individuals and as a society with priceless, but not always tangible benefits. The natural environments in which these processes occur are ecosystems, and we call the benefits they provide to humans ecosystem services (ESSs).

Ecosystem services are classified as follows:

- **Provisioning** ecosystem services provide tangible products such as food, water or wood.
- **Regulating** ecosystem services refer to processes such as water purification, climate regulation or pollination.
- **Cultural** ecosystem services comprise the possibilities that ecosystems offer us in terms of recreation, relaxation, cognitive development, inspiration and spirituality.

FIGURE 1. THE SIXTEEN ASSESSED ECOSYSTEM SERVICES IN FLANDERS



Detailed information about ecosystem services can be found in Chapters 11 to 26 of the Technical Report.

Supporting ecosystem services, like soil formation or photosynthesis, make the services of the three other groups possible. We do not assess supporting ecosystem services separately in Flanders REA, because they are implicit in the delivery process of the other services. However, we discuss sixteen ecosystem services for Flanders: ten regulating, five provisioning and one cultural (see Figure 1).

1.2. Undervaluation of ecosystem services

The importance of natural ecosystems as a source of food, drinking water or wood is clear. Other ecosystem services that are not mediated directly through the market, are often much less visible. Water and air purification, for example, or the pollination of crops and maintenance of soil fertility. Less tangible ecosystem services of this kind, and the ecosystems that generate them, play a role in our well-being and welfare, but are not always properly valued. Ecosystems and the services they deliver are being increasingly affected by this undervaluation. In this way, we are losing services on which we depend, and society has to pay a high price for additional health care, nature restoration and technical solutions.

1.3. The ecosystem approach

The ecosystem approach can help give ecosystems a proper place in public debate and in decision-making. It is a comprehensive strategy proposed by the UN Biodiversity Convention for the conservation and sustainable use of ecosystems and their services.

At its basis lies the idea that not only our environment, but we ourselves – with all of our activities, our welfare and well-being – are part of ecosystems. Interaction between humans and ecosystems leads directly or indirectly to changes in these ecosystems. Such changes may in turn have a positive or negative impact on our well-being and welfare. If we want to give ecosystems more weight in decision-making, we must pay more attention to the interactions and interdependencies between ecosystems and society.

The ecosystem approach looks at both the impact of humans on ecosystems and the effects of ecosystems on society. It combines ecological, economic and social aspects in a single methodological framework. When that framework then becomes the new basis for policy and management, ecosystems and their services can be given a proper place in decision-making.

The ecosystem approach is a key element of the current biodiversity policy. By emphasising the value of ecosystems to humans and society, this approach addresses additional arguments for nature conservation. As such, it bridges the gap between the nature sector and other social actors.

1.4. Ecosystem assessment as a policy foundation

To be able to base policy on an ecosystem approach, policy-makers need to be accurately informed about the situation with regard to biodiversity, ecosystems and the services they provide to society. The scientific knowledge for this is provided by the ecosystem assessment. This is conducted in three stages: an analysis of state and trends, a scenario analysis and a discussion of possible responses. Such an assessment must in the first place inform policy-makers about complex problems through synthesis and communication. Moreover, the policy-makers themselves become involved in the research at an early stage, with explicit encouragement being given to cross-sectoral communication and cooperation. In this way, a receptive context is created for the research findings and for ensuring that they are taken into account in policy-making.

The United Nations Millennium Ecosystem Assessment (2005) is the best-known example of an ecosystem assessment. The study describes at a global scale the consequences of ecosystem change for human well-being.

1.5 The Flanders Regional Ecosystem Assessment

In order to apply the ecosystem approach in Flemish policy, Flanders needs its own regional ecosystem assessment. The Nature Report represents a first assessment of ecosystems and their services for Flanders. Like the Millennium Ecosystem Assessment, Flanders REA consists of three phases:

- In the first phase (Flanders REA-S&T 2014), we produce a synthesis of the state of the ecosystems in Flanders and the services they provide.
- In the second phase (Flanders REA-P 2016), we present and apply methods and tools for taking ecosystem services into account when making policy decisions.
- In the third phase (Flanders REA-S 2018), we explore the impact of possible future scenarios on ecosystems and their services.

The Research Institute for Nature and Forest (INBO) is conducting the assessment in close cooperation with other scientific institutions, governments and civil society.

Numerous disciplines from both the natural sciences and the social sciences were involved in the creation of the Nature Report 2014. In addition to scientific research, the report also draws on extensive practical knowledge from different sectors.

1.6 Flanders REA-S&T as the first step

Flanders REA-S&T compiles knowledge and insights from existing research, but also includes new analyses. It offers an overview of the benefits that we as a society receive from ecosystems. Which ecosystem services are important for Flanders? How do we value them? How do we ourselves affect their delivery? What is the role of people in all this? The ecosystem approach is central. All components that play a role in the supply, use and management of ecosystem services are covered.

Flanders REA-S&T also responds to a European reporting obligation: under the Biodiversity Strategy 2020, the European Commission asked its member states to assess and report the state of ecosystems and their services by 2014.

Synthesis Report as summary

The Flanders REA-S&T Synthesis Report summarises the main findings of a wider-ranging and more thorough Technical Report. The 26 chapters of the latter were written by researchers from INBO (the Research Institute for Nature and Forest) and external partners.
The Technical Report is the knowledge base for the regional ecosystem assessment. After two introductory chapters, Chapters 3 to 10 seek to answer the research questions of Flanders REA-S&T (see below). The last sixteen chapters discuss the best-known and most relevant ecosystem services in Flanders. Each chapter of the Technical Report has been prepared as a separate publication and is available at www.natuurrapport.be. The full report has undergone an extensive review process.

Whereas the Technical Report is intended primarily as a background document that provides scientific underpinning, the Synthesis Report is written for a wide audience of policymakers and other stakeholders.

1.7 Research questions

Flanders REA-S&T is structured around eight key research questions:

- How do humans influence ecosystem services?
- What are the state and trend in ecosystems and biodiversity?
- What are the state and trend in ecosystem services?
- What is the role of biodiversity for ecosystem services?
- How do ecosystem services contribute to well-being?
- How can we value ecosystem services?
- What interactions exist between ecosystem services?
- What are the characteristics of an ecosystem service-oriented policy?

These questions are addressed in the chapters that follow.

Like to learn more about this subject? You can read all about it in Chapters 1 and 2 of the Technical Report.

Flood protection as an ecosystem service

Due to population growth and the associated phenomena of extensive urbanisation and climate change, the number of floods continues to rise. And because flood-prone areas are being used ever more intensively, these floods generate ever greater compensation claims. Valley areas for water storage and wide dune belts as a sea defence are essential to guarantee our safety. Moreover, these areas offer a series of ecosystem services.

What is it?

The ability of ecosystems to protect us against floods and sea surges. For instance, our coastline is largely protected by dune belts, sandbanks and beaches. Mudflats and marshes moderate storm surges and flooding. In extreme weather conditions, valley areas can store large volumes of river water. In this way, the vulnerable residential centres and industrial areas behind them stay dry.

What are the benefits?

Floods often cause severe damage, both tangible and intangible. Restoring the ecosystems that naturally protect us against floods means that we need to invest a lot less in expensive infrastructure such as dams. Often such floodplains or natural seawalls are also pleasant, green environments where people can engage in leisure activities. Moreover, these wetlands – both along the coast and alongside rivers – also have highly beneficial effects on biodiversity and contribute to regulating ecosystem services such as water purification and carbon sequestration.

How important is it in Flanders?

Around 30 percent of Flanders is currently regarded as liable to flooding. Moreover, our region is becoming increasingly urbanised, and climate change is both raising sea levels and making extreme weather conditions more frequent. Large parts of our coastal plain are particularly vulnerable, lying more than two metres below sea level during an average annual storm. Storm surges – a combination of a spring tide and strong winds – pose a particular hazard. Wide stretches of sand or dune belts used to offer protection against these, but have disappeared in many places as a result of human intervention. The direct economic loss of a thousand-year storm – in which the water rose 7 metres above Ostend mean low tide – would be as high as 2 billion euros in Flanders.

Inland, many areas are enclosed by dikes. Under the current water management system, about four percent of Flanders is flooded once every hundred years. The areas concerned are home to around one percent of the population. In addition, many valley areas are used intensively for industrial activities or professional agriculture. The business owners and farmers in question are keen to minimise the problems caused by

flooding, and as a society we need to reduce the environmental risks of flooding. Public acceptance of such measures can be increased by combining flood protection with recreation, with a risk prevention policy for industrial activities and with the reorganisation of local agriculture. Incurring operating costs instead of compensation claims could enhance solidarity between the owners and users of upstream and downstream areas.

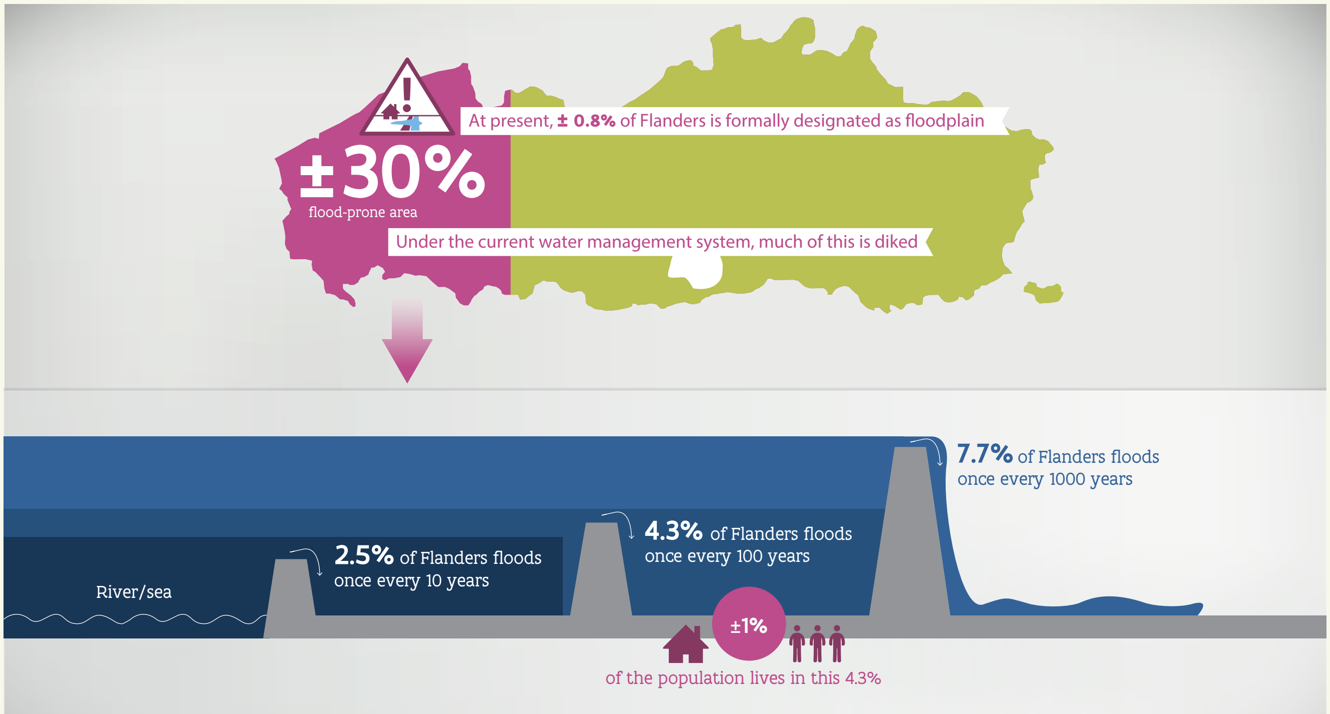
How does this relate to biodiversity?

In order to retain and store water, the main requirement is of course more space. The vegetation in well-managed floodplains slows down the water, retaining it for longer so that the hinterland is better protected. As a natural transition between water and land, such areas are also an excellent habitat for all kinds of flora and fauna.

Interaction with other ecosystem services

Such transitional areas are important ecosystem service providers. They regulate floods and at the same time contribute to water purification. They are often also popular with hikers and cyclists. The more natural the flooding process and floodplain, the better the ecosystem service can be combined with other ecosystem services, both cultural and regulating. Along the coast, this attractiveness can also have disadvantages, for example if too many visitors walk in coastal areas. The interaction with food production has both advantages and disadvantages. For instance, floodplains may reduce the agricultural yield locally, whereas crops elsewhere will be better protected. In many of the flood-prone areas, land use and management can be adjusted so that they are easier to combine with the existing flood regime.

Some figures from the Technical Report



Like to learn more about this subject? You can read all about it in Chapters 22 and 23 of the Technical Report.

Timber production is fully compatible with other ecosystem services, such as air purification, climate regulation, water production and green space for outdoor activities. This versatility, however, is reduced if forest managers seek to maximise the timber yield. This will have an adverse impact not just on other ecosystem services, but on the biodiversity of the area too.

02

THE ECOSYSTEM SERVICE CYCLE AS A FRAMEWORK FOR THE STUDY

02. The ecosystem service cycle as a conceptual framework for the study

People are an inseparable part of the ecosystems in which they live. Our well-being and welfare are only possible thanks to all the benefits with which nature provides us, including clean air, water, food and building materials. Conversely, we also affect the ecosystems in which we live. And that in turn has an impact on the services provided by nature, and thus on society. This complex ecosystem service cycle constitutes the framework for this study.

2.1 Ecosystems: structures, processes and functions

An ecosystem is a coherent, dynamic complex of animals, plants and micro-organisms and their entire non-living (abiotic) habitat. Humans are also part of ecosystems. Ecosystems exist in all shapes and sizes: we can see a pond in a garden as an ecosystem, but that same garden, the village where it is located and even the whole world are also ecosystems. The term does not just refer to the (semi-)natural landscapes such as forest and heathland that we find in nature reserves. The more intensively used parts of the landscape, such as farmland and the urban areas in which we live, work and move around, are ecosystems too.

In each ecosystem, all biotic and abiotic factors influence one another to a varying degree through natural processes. For example, moist soil is more suitable for some tree species than for others. Beavers can radically change their habitat by building dams. In this way, countless complex processes occur in ecosystems, on both a large and a small scale. Some of those processes perform functions that may be beneficial to humans. An important example of such a useful function is photosynthesis. With the aid of light energy, plants convert water and carbon dioxide into glucose and oxygen. By doing so, they not only grow themselves, but also make other life possible. Humans can use the mature plant as food, for building materials or as an energy source. Plants also perform other useful functions, such as water and air purification and temperature regulation. In this way, they generate tangible and intangible benefits for humans, and enhance our welfare and well-being. Ecosystems are thus more than just a beautiful landscape, a background against which human life takes place. They are a valuable stock of renewable natural capital. We owe much of our welfare and well-being to ecosystem structures and processes. Ecosystems remove fine particulate matter from the air, purify our drinking water, prevent flooding and give us healthy recreation opportunities. All sorts of processes that occur in nature provide benefits to us as individuals and as a society that are priceless, but not always tangible. These benefits are generated by ecosystem services.

2.2 Ecosystem services: supply, demand and use

In Flanders, we have converted much of our natural capital into social, technical and financial capital. The current supply of ecosystem services is therefore partly the result of human expertise and technical and financial resources. For instance, there are few rivers or lakes suitable for swimming, but we have swimming pools to cater to this need (to some extent). Even in the most natural environments that remain to us, we create facilities for outdoor activities: cycling routes, visitor centres, information boards and so on. Many people therefore also go in search of 'unspoilt' countryside outside Flanders. We are also highly dependent on ecosystem services from outside the region for other needs. For instance, we import a large amount of timber, because there is not enough commercial forest available in Flanders itself to meet our needs.

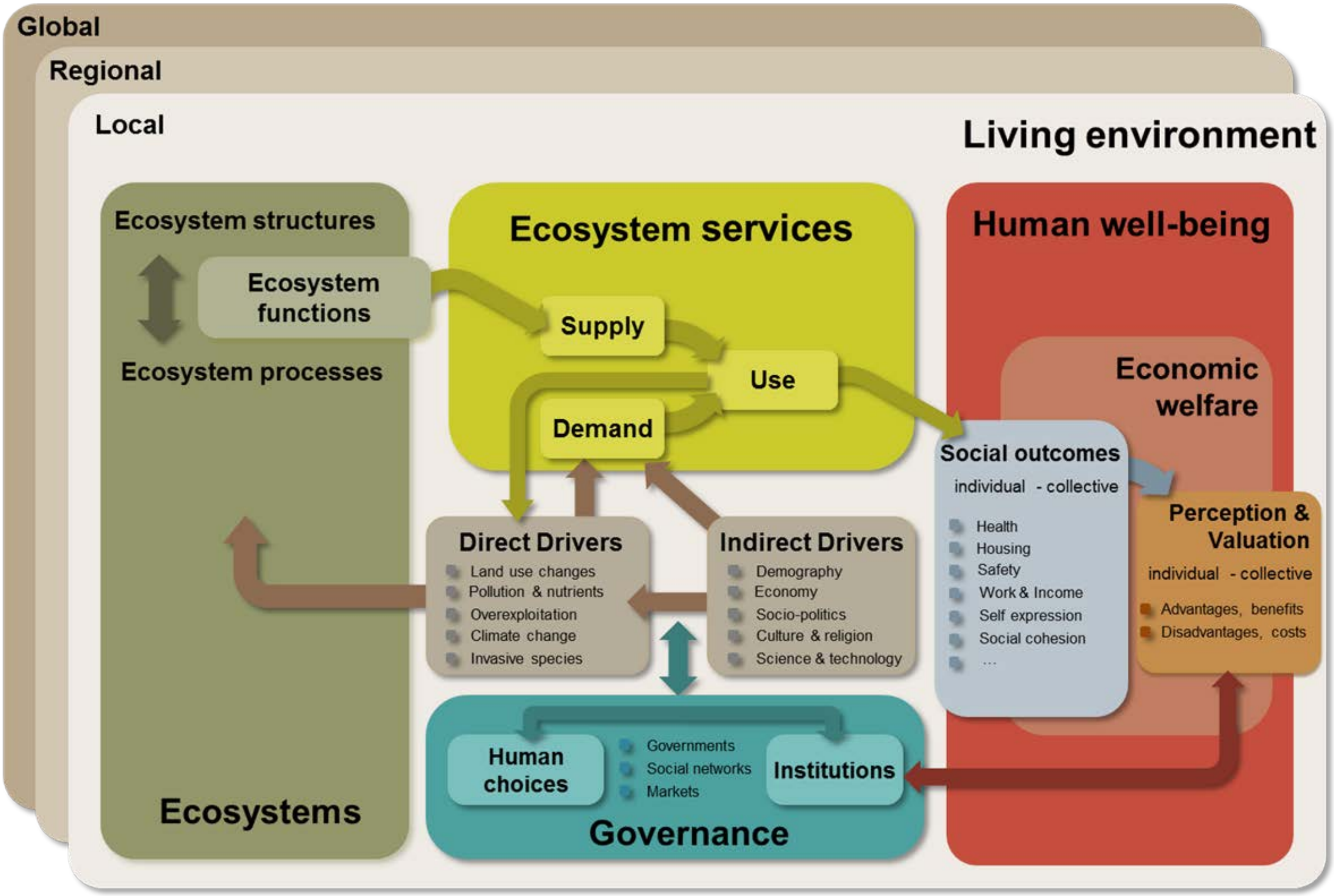


FIGURE 2. THE ECOSYSTEM SERVICE CYCLE WITH THE MAIN RELATIONSHIPS BETWEEN ECOSYSTEMS, ECOSYSTEM SERVICES AND THEIR IMPACT ON HUMAN WELL-BEING AND ECONOMIC WELFARE

The demand for ecosystem services depends partly on population size, but there are numerous other factors too. Culturally or religiously motivated dietary habits determine which animals are raised for human consumption and which are not – pork or horse meat, for example. Climate change increases the need for sustainable flood protection. And growing population density and urbanisation intensify demand for green space for recreation.

The more we use ecosystems and the services they provide, the greater their impact on our welfare and well-being. A forest that many people visit is more valuable to society than a comparable forest in a remote location that attracts few recreational users. But physical interaction is not strictly necessary for the assignment of social value. The mere knowledge that the last forests in a region are disappearing can affect personal well-being, even in people who rarely or never visit those forests. 'Non-use values' are therefore also taken into account when assessing value. Furthermore, the extent to which or the way in which we use certain ecosystem services determines whether these and other such services can be sustainably provided in the long term. For instance the current use of the ecosystem service of food production has a negative impact on its future provision, because it reduces soil fertility. It also has negative effects on the ecosystem service of water quality regulation through the leaching of fertilisers and pesticides. For the implementation of an ecosystem service-oriented policy, a distinction between supply, demand and use is crucial. The three must be weighed up against one another in order to estimate correctly the importance of an ecosystem – not just ecologically, but in socio-economic terms too.

2.3 Direct and indirect drivers

The presence of humans has changed ecosystems profoundly all over the world. For example, forests have been cleared to create farmland or residential areas. Since the industrial revolution, the human impact on ecosystems has only increased. We consume fossil fuels, our numbers have grown and we build on more land than ever. We call such activities or trends **drivers**. They may proceed from either humans or nature. We distinguish between drivers with a direct impact and those with an indirect impact on ecosystems.

Direct drivers are factors and processes that directly cause changes in ecosystems on a local, regional and global scale. Through their impact on ecosystems, they also affect their functions and services, of course. A well-known example in Flanders is the black cherry. This exotic species was widely planted in the twentieth century for its soil-improving properties, but turned out to spread much faster than native species, threatening to supplant them and alter the entire ecosystem. Measures are now being taken to control this species in Europe. Drivers can thus also have unintended and even negative side-effects.

Flanders REA-S&T analyses the role of five direct drivers:
- land use change
- pollutants and nutrients
- overexploitation
- climate change
- invasive species

Behind the direct *drivers* lies a complex combination of **indirect drivers** that interact both with one another and with the direct drivers. An example of an indirect driver is population growth. Population growth leads to increased demand for food, but also for more space for living, working and travelling. As a result, ecosystems become increasingly built over, and little room remains for some services. As a result of the increasing urbanisation of Flanders, more and more land is being covered with hard surfacing, making it impervious to rainwater. Ecosystems in Flanders today are therefore less able to protect us against flooding.

Flanders REA-S&T distinguishes five indirect drivers affecting ecosystems in Flanders:
- demography
- economy
- socio-politics
- culture and religion
- science and technology

2.4 Social outcome, human well-being and welfare

Ecosystem services make a valuable contribution to our society. That value can, as we have seen, be derived from their effects on our welfare and well-being. Welfare is the extent to which people can satisfy their material needs and requirements. However, those needs are in principle infinite: people can always strive for even more wealth. Well-being is a much broader concept and is determined by both individual and social elements: the ability to make provision for basic needs, physical and mental health, safety, social cohesion, self-development and so on. There is a direct link between ecosystem services and well-being. Access to basic commodities such as food and water, for example, or the assurance that these do not contain added, potentially harmful substances, is essential to our well-being. Again, wood can be converted into a comfortable living space, or into paper for a book which we can read for pleasure or to acquire knowledge.

To make the links visible between ecosystems and ecosystem services on the one hand and well-being and welfare on the other, we need to resolve the question of how to value ecosystem services. On a global scale, life on earth, and hence human well-being and economic welfare, would be impossible without natural ecosystems and their services. In this sense, ecosystems and the services they provide are literally invaluable. Attempts to express their total value in economic terms are therefore of little use, as it extends far beyond economic value. The values of different services cannot simply be added up, but must be weighed against each other carefully in social and political debate. What constitutes an economic gain for some may be seen by others as an ecological or social loss. For entrepreneurs and politicians, a new business site may mean growth, financial profit and employment; for local residents it also means more traffic, possible health problems and loss of green space.

Such disparate perceptions and valuations shape the choices we make as individuals or as a group: our social behaviour, consumption habits and production standards. Human choices crystallise over time into behavioural patterns and thus shape institutions. These are recognisable organisational forms in a society such as the family, schools, the markets in which we consume and government. They in turn also affect our choices and behaviours, but at the same time are either reproduced or altered by them. Institutions therefore have a big impact on how we value ecosystems and ecosystem services and how we use them.

2.5 Governance

This constant interaction between personal and collective choices and the institutions to which we belong is what we call governance. The functioning of the market and governments' different policy instruments (legislation, awareness raising, subsidies and taxes) are also elements of governance.

'Governance' is distinct from 'government'. In a government model, the authorities take a more central role and are positioned hierarchically above the market and other social actors. This dominant position of the authorities has gradually weakened since the seventies. In a governance model, the authorities, the private sector and civil society all work together. The idea is that in this way, society can respond more effectively to new, more complex challenges such as globalisation, individualisation, multiculturalism, population aging and environmental pressure.

2.6 Spatial and temporal scales

All elements of the ecosystem service cycle can be found in everyone's immediate local environment, but also at regional and global levels. Flanders REA-S&T focuses mainly on trends in the Flemish Region, i.e. at regional level. However, these cannot be separated from local and global mechanisms. Furthermore, the ecosystem service cycle transcends not only geographical borders but also temporal borders. The choices we make now will also determine how viable the ecosystems are that we leave for future generations.
For a policy that seeks to focus on ecosystem services, incorporating and integrating multiple scale levels is therefore a major challenge.

Like to learn more about this subject? You can read all about it in Chapter 2 of the Technical Report.

FOCUS: WOOD PRODUCTION

Wood production as an ecosystem service

We derive numerous benefits from wood. We use it to make furniture, construction materials, paper, cardboard and handy everyday objects. Wood is not just an industrial raw material: it can also serve as an energy source. In colder periods, many families light their fireplace or wood stove with firewood from the garden or the Flemish forests – whether as a luxury or to save on fuel oil and natural gas.

What is it?

The capacity of vegetation or landscape elements to deliver usable wood in a renewable way. This wood production is expressed in m^3 per hectare per year. 'Usable wood' means wood that has a direct useful function, either as a raw material for industrial processing, or as firewood for energy generation. The wood harvest comes from forests, rows of trees, hedges and trees and shrubs in residential and recreational areas.

What are the benefits?

Besides its direct utility value – for personal use or as a commodity to sell – wood has other benefits. Thus the use of timber in housing creates a pleasant and healthy living environment and is good for our well-being. By using wood as an energy source, we can avoid using fossil fuels. Moreover, wood-producing vegetation (in forests and elsewhere) delivers numerous other benefits: better air quality, climate regulation, green spaces for leisure and playing, and an attractive and pleasant environment that is good for our mental health. Such aspects are highly valued, including financially. Houses in green, 'natural' settings are significantly more expensive.

How important is it in Flanders?

Only a limited area of Flanders consists of woodland or green areas that can provide wood. Even if we would use the entire available stock, the demand for wood in Flanders would still outstrip the supply many times over. The timber market is highly globalised. In Flanders, a great deal of wood is imported, but also exported. The local supply is particularly important for niche markets. Poplar wood, for example, is often used for packaging. Nevertheless, the importance of wood production as an ecosystem service for Flanders is greater than the formal market figures suggest, as there is a large informal market for private firewood, which is probably far larger than the formal market.

How does this relate to biodiversity?

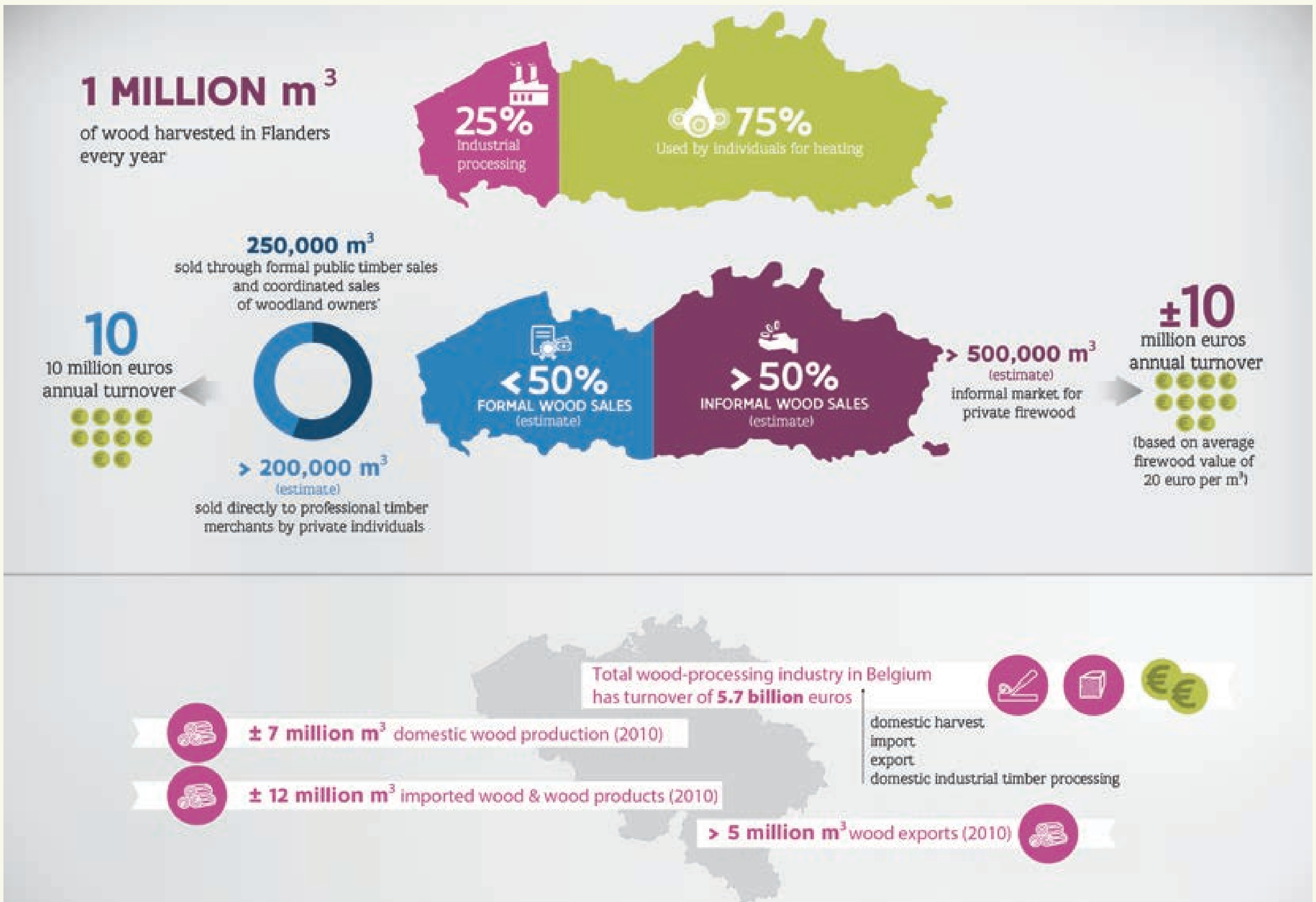
Forests with higher biodiversity are generally more robust. Because there are more tree species and vegetation structures in the forest, the trees are more resistant to disturbances and hence more resilient. However, the direct impact of higher diversity on productivity is unclear. Among other factors, it depends on differences in growth rates between species.

Wood production as an ecosystem service can coexist well with biodiversity goals, provided the forest is managed with an eye to its natural value. Maximising wood production usually leads to a sharp decline in biodiversity, and vice versa.

Interaction with other ecosystem services

Wood production is highly compatible with other ecosystem services, such as air quality and climate regulation, water production, game production, erosion risk regulation, water management and green space for outdoor activities. However, this synergy is often less pronounced when the goal is to maximise the wood yield.

Some figures from the Technical Report



Like to learn more about this subject? You can read all about it in Chapter 13 of the Technical Report.

Many Flemish people seek out nature for recreation purposes. Yet 21 percent of Flemish people have no green space within walking distance. Having more nature nearby would encourage people to take more exercise outdoors, to the benefit of both their physical and mental health. Our society therefore has a strong interest in increasing the number and accessibility of green spaces.

03

THE STATE OF BIODIVERSITY AND ECOSYSTEM SERVICES IN FLANDERS

03. The state of biodiversity and ecosystem services in Flanders

If we want to carry on using nature's services, we have to protect biodiversity. Part of our research focused on the state of biodiversity and ecosystem services in Flanders. What condition are these ecosystems and species in? What is the state of our ecosystem services? And what influence do we ourselves have on the state of nature and the services it provides us?

3.1 What is biodiversity?

Biodiversity is the variety of 1) living organisms, both terrestrial and marine and other aquatic ecosystems and 2) the ecological complexes of which they are part. This includes diversity within and between species and ecosystems.

The above definition of biodiversity was first formulated at the Earth Summit in Rio de Janeiro in 1992, where 168 countries signed the Biodiversity Convention. It is still applicable today.

The definition is linked to a broad objective, namely to halt the decline of biodiversity. However, it is not easy to observe the complex processes of this decline. The concept of biodiversity is therefore often divided into four levels of organisation:

- genetic diversity encompasses the wealth of genes that underlies the formation, stability and adaptability of species.
- species diversity includes species richness. It is determined not only by the presence of species, but also by their proportions in terms of population sizes. Diversity increases as the numbers are better distributed among the various species.
- ecosystem diversity includes the variety of ecosystems, with each ecosystem constituting a coherent, dynamic complex of microorganisms, plants, animals and their habitats. As species diversity increases, ecosystems become more robust and can maintain themselves for longer in a changing environment.
- landscape diversity includes the complex spatial relationships between ecosystems and geomorphological, hydrological and cultural relationships with the environment. The larger the scale on which landscape processes and structures occur, the greater the stability of the ecosystem network that is created and the longer ecosystems persist within it.

The four organisational levels are closely intertwined. The best-studied levels are the second, species diversity, and the third, ecosystem diversity. Below, we describe the state of these two levels.

3.2 What is the distribution of ecosystems and what condition are they in?

Biological communities of animals, plants and microorganisms often form a dynamic complex with the abiotic environment, with which they function as a single entity. We call these entities ecosystems. Humans too are an integral part of them.

European ecosystems in Flanders. For reporting on ecosystems and ecosystem services in Europe, an international working group has defined twelve ecosystems. Nine of these are found in Flanders, as can be seen in Figure 3.

More than three-quarters of Flanders consists of croplands (37.8 percent), urban areas (30.4 percent) or grasslands (17 percent). The ecosystems that we normally associate with nature cover – with the exception of woodland and forest (11.4 percent) – a relatively small part of the land area in Flanders. Heathland and inland dunes, water and water-dependent ecosystems such as wetlands, estuaries, mudflats and salt marshes, coastal dunes and beach together cover less than 2 percent of Flanders.

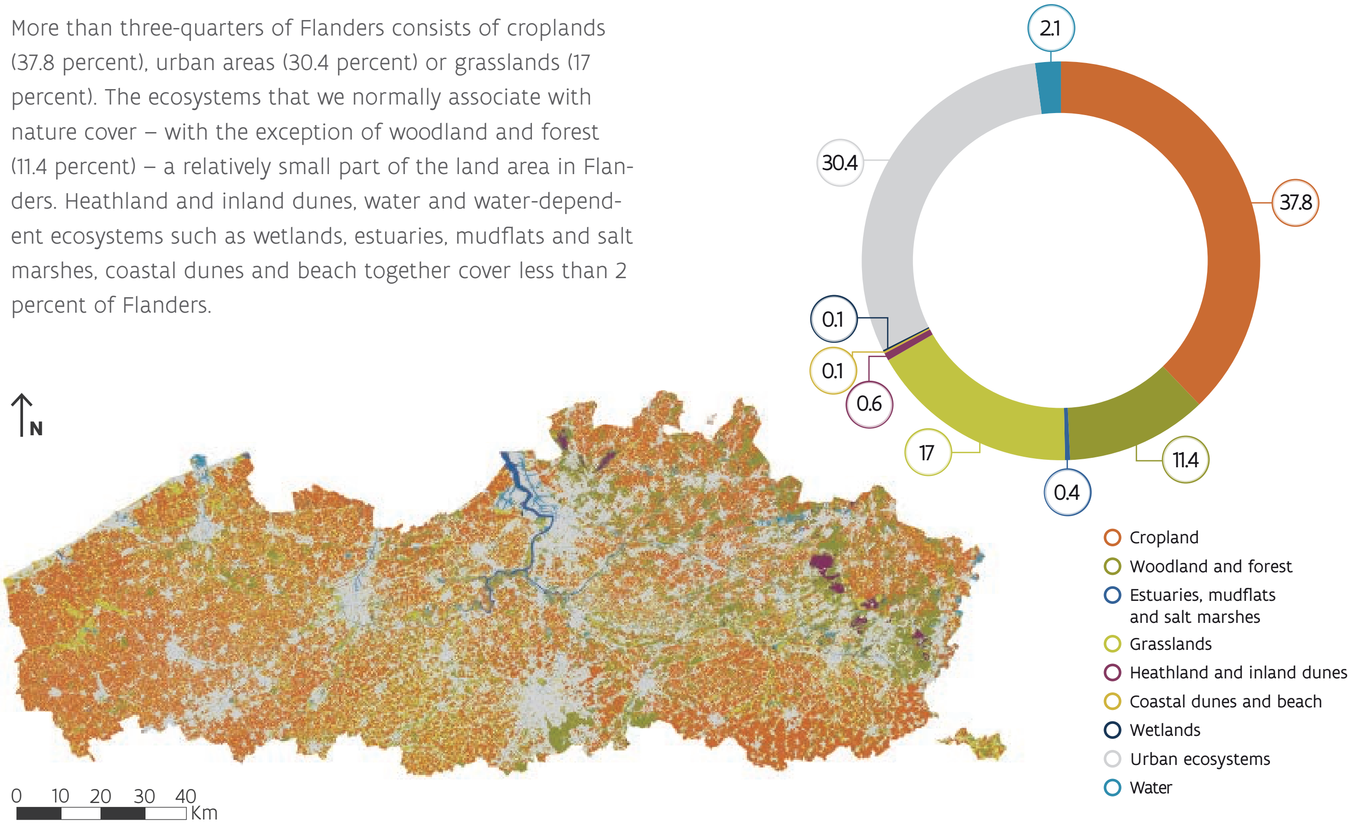


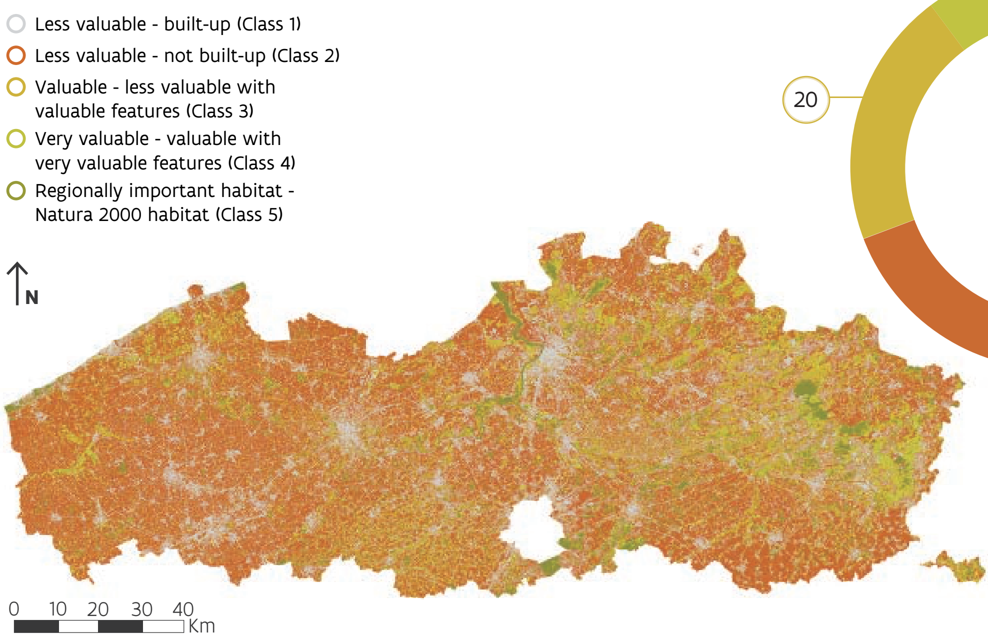
FIGURE 3. GEOGRAPHICAL DISTRIBUTION AND PROPORTIONAL AREA (%) OF THE NINE ECOSYSTEMS IN FLANDERS AND THE BRUSSELS-CAPITAL REGION

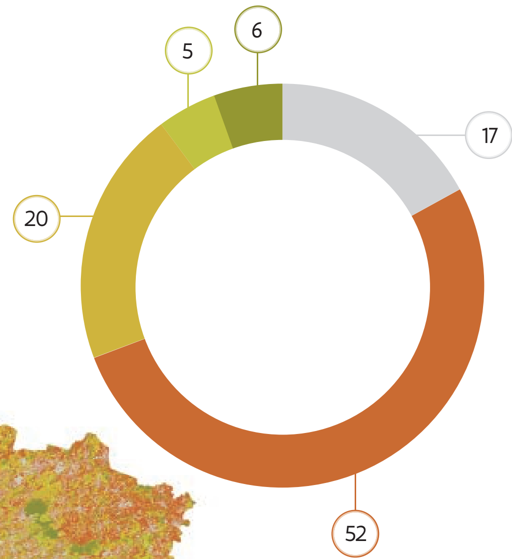
Biological valuation of ecosystems in Flanders. Based on rarity, biological quality, vulnerability and replaceability, we distinguish five classes of ecosystem valuation. Figure 4 shows the geographical distribution of these five classes across Flanders. Half of Flanders consists of Class 2 (less valuable – not built-up): the land in this class is mainly cropland, grasslands and gardens. About 17 percent is Class 1 (less valuable – built-up). Class 3 (valuable – less valuable with valuable features) includes, for example, areas with small landscape features, but also complexes with valuable and less valuable grasslands. This class accounts for 20 percent of Flanders. Classes 4 and 5 (very valuable – valuable with very valuable features and regionally important habitats or Natura 2000 areas) account for 5 and 6 percent respectively of Flanders.

Status of the Natura 2000 habitats. Of all European Natura 2000 habitat types (3.6 percent of the surface area in Flanders), 47 occur in Flanders. More than three-quarters (38 out of 47) are in an unfavourable conservation status according to European criteria (extent, area, quality and future prospects). However, seven of them have increased slightly in area since 2007. At present only five Natura 2000 habitat types in Flanders are in a favourable conservation status.

Biological water quality. Not a single river, stream, polder watercourse, lake or estuary in Flanders has a very good status according to the criteria of the European Water Framework Directive. Only 8 percent of the measurement sites in Flanders score well on biological water quality. Especially in the estuaries and rivers, the biological condition is poor.

FIGURE 4. GEOGRAPHICAL DISTRIBUTION AND PROPORTIONAL AREA OF THE BIOLOGICAL ECOSYSTEM ASSESSMENT CLASSES IN FLANDERS





3.3 What is the distribution of species and what condition are they in?

Of the 3 to 100 million species that exist worldwide, an estimated 44,000 are found in Flanders. The vertebrates are the smallest group among these. Mammals, birds, fish, amphibians and reptiles together account for only 1 percent of the species present in Flanders. Vascular plants represent about 5 percent of the number of species, and algae around 12 percent. Fungi and mushrooms comprise about 19 percent of the species. By far the largest but also the least-known group is the invertebrates, such as insects, worms, snails, spiders and centipedes. Together they comprise over 60 percent of all species in Flanders.

For a small proportion of these species, the distribution across Flanders can be mapped and we can calculate a trend. The species concerned are mainly vascular plants and vertebrates. For invertebrates, we mainly know the trends for a few noticeable groups of insects such as butterflies and dragonflies. Very little information is available about microorganisms and soil invertebrates.

Distribution of species richness (Figure 5). Especially in the sandy loam region in West Flanders, the species richness is remarkably low. In the polders and the loamy and sandy loam region in the southern part of Flanders, the species richness is moderate to good, although few Red List species are found there. These are species that according to the criteria of the IUCN (International Union for Conservation of Nature) are critically endangered, endangered or vulnerable. The most species-rich areas are located in the Kempen 'ecoregion', with an outlier extending towards the Demer Valley. The most species and the greatest concentration of Red List species are found there.

Status of the species (Figure 6). The status of 2,400 species was examined. Of these, 6 percent were found to be regionally extinct. A number of these species could still recover, however. Thanks to the recent improvement of the water quality in the Scheldt Estuary, for example, regionally extinct species such as the twait shad and sea lamprey are present again. Of the other species, around one in four is on the Red List.

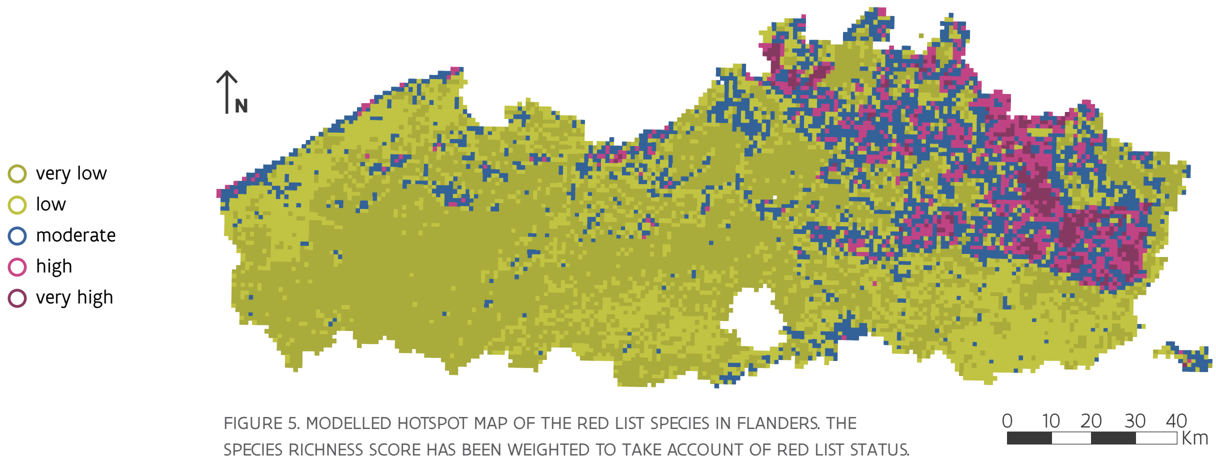
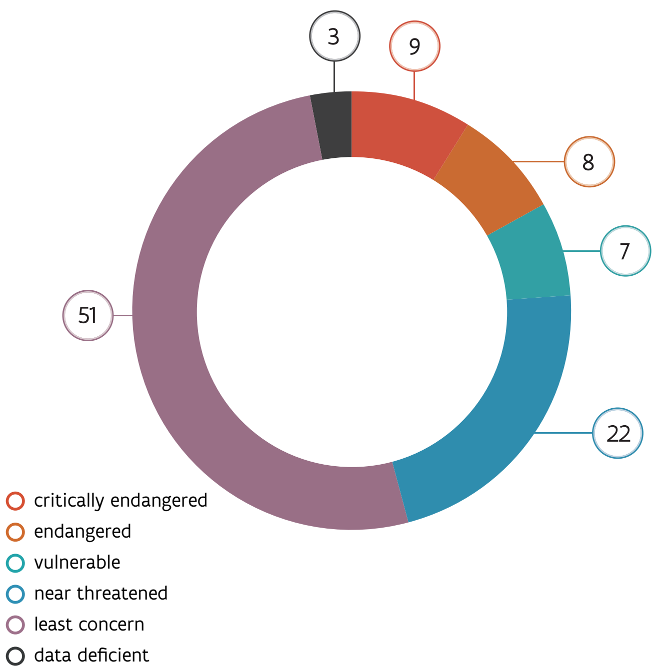


FIGURE 5. MODELLED HOTSPOT MAP OF THE RED LIST SPECIES IN FLANDERS. THE SPECIES RICHNESS SCORE HAS BEEN WEIGHTED TO TAKE ACCOUNT OF RED LIST STATUS.

Flanders also has 59 species listed in the European Habitats Directive and 60 species listed in the Birds Directive. Of the Habitats Directive species, only 15 percent have a favourable conservation status, including five bats, three amphibians and one fish. More than half have an unfavourable conservation status, and another 17 percent have an unfavourable-inadequate status.

FIGURE 6. PERCENTAGE DISTRIBUTION OF RED LIST CATEGORIES IN FLANDERS.



Protective measures. To combat the further decline of endangered species, Flanders is taking a wide range of measures. At an earlier stage, eighteen specific species protection plans were drawn up. Since 2009, species protection plans have been replaced by species protection programmes, eleven of which are under preparation and/or have been launched. Various LIFE projects, nature development projects, municipal species adoption plans and nature management plans also help protect species in Flanders.

3.4 What condition are ecosystem services in?

The state of an ecosystem service is determined by the relationship between supply and demand, the trend in that relationship and the impact of the use of ecosystem services on the supply of other ecosystem services. Because demand exceeds supply (by a large margin in some cases), most ecosystem services in Flanders are intensively used or exploited, including the regulating services. The demand for various services is also increasing, and is no longer in equilibrium with the natural supply. Unbalanced, intensive use often has negative effects on other services. This jeopardises the current and future provision of both provisioning and regulating ecosystem services. Figure 7 shows the state and trend of the sixteen ecosystem services for Flanders. We discuss below the state of three important services: food production, pollination and maintenance of soil fertility.

Food production. The demand for food in Flanders is increasing as the population rises. The supply is also growing, but in the current agricultural model is unable to keep pace with the growing demand. Flanders therefore imports large quantities of food. Modern agriculture, which is highly dependent on chemicals and fossil fuels, is associated with numerous adverse effects on the supply of other ecosystem services, both in Flanders and beyond. This can in turn have a negative impact on food production, for example, when natural pollination, pest control or maintenance of soil fertility comes under threat.

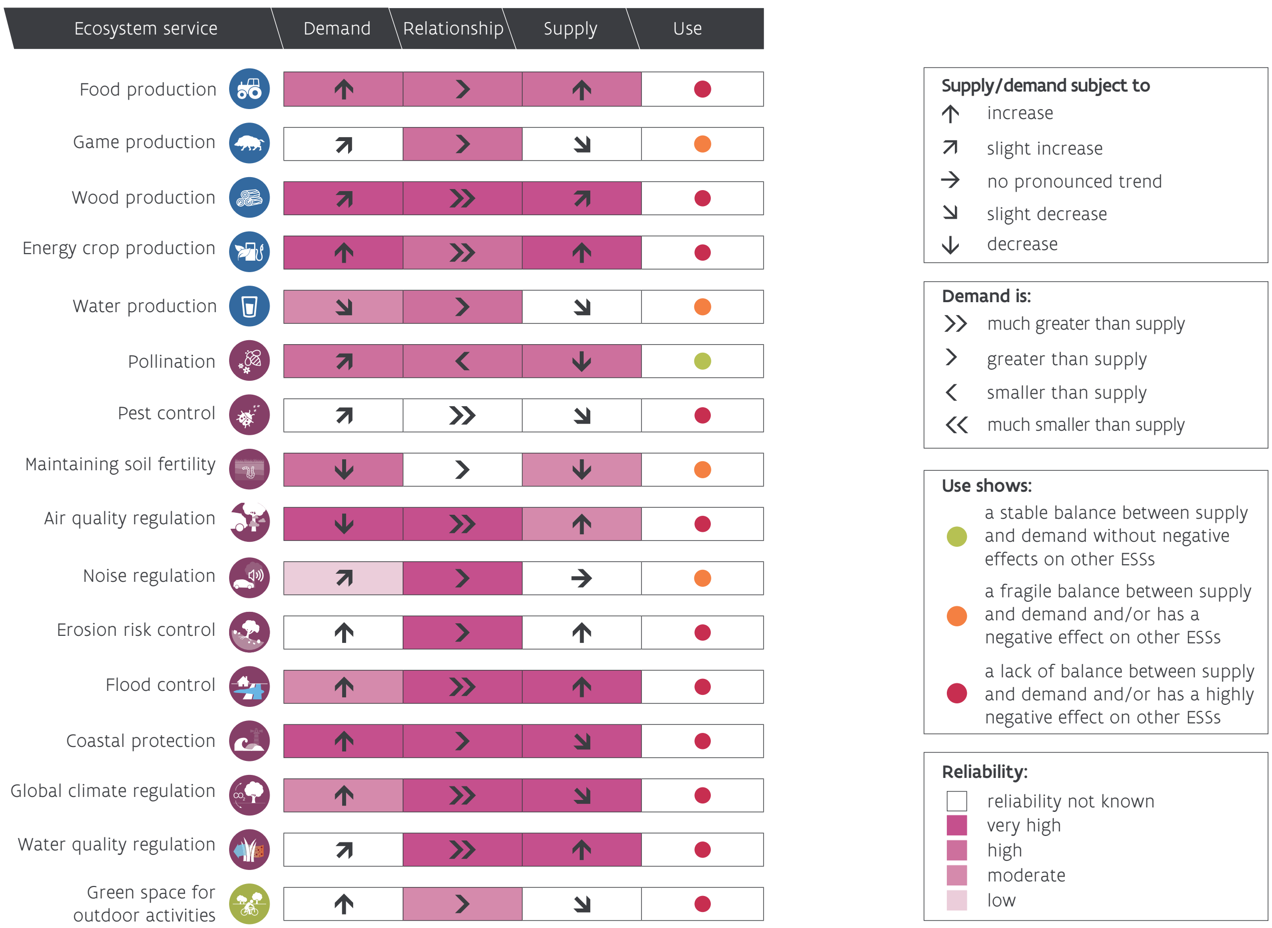
On the demand side, cutting down on food waste and changes in eating habits (including less meat consumption) are an important but difficult solution. On the supply side, agriculture can combine food production better with other ecosystem services, especially services that support food production. By sowing flower-rich field margins, for example, farmers can attract insects that ensure pollination and pest control.

Pollination. For nature to be able to provide the ecosystem service of pollination, pollinating insects such as bees must have sufficient habitats near crops that require pollination. Although detailed ecological knowledge is scarce and the local context can vary greatly, our analysis indicates that there are enough potential habitats around pollination-dependent crops. Supply and demand for the ecosystem service of pollination are therefore in balance. Furthermore, this ecosystem service has no negative effects on the supply of others.

However, if the populations of pollinating insects were to shrink or even die out, the economic and social costs would be high.

FIGURE 7. STATE AND TREND OF SIXTEEN ECOSYSTEM SERVICES IN FLANDERS

For more information about the state and trend of all ecosystem services in Flanders, see Chapter 5 of the Technical Report.



Maintaining soil fertility. Soils that are used to produce our food are becoming less and less fertile, yet the maintenance of soil fertility is essential for food production. This trend is further exacerbated by the surface area of farmland in Flanders, which has fallen in recent decades. Farming techniques that introduce more carbon into the soil can improve the fertility of our soils. Examples of these techniques which have been more frequently used recently include green manures and non-inversion tillage.

Read more about the ecosystem services of food production, pollination and soil fertility on pp. 42-43 of this report, and in Chapters 11, 16 and 18 of the Technical Report.

3.5 Our influence on ecosystems and ecosystem services

Many human influences directly or indirectly affect ecosystems. As a result, ecosystems are no longer able to provide the services that we need as a society. The main human influences on ecosystems and their services are changes in land use such as urbanisation, changing agricultural practices and environmental pollution. Other causes of the loss of ecosystem services are overexploitation of groundwater resources and the soil, climate change and the presence of non-native plant and animal species. These direct influences are driven by indirect factors. Often, these are social processes such as population growth, economic growth and cultural shifts that shape human choices and activities. Figure 8 shows the impact of all the influences on the ecosystem services examined.

FIGURE 8. EXTENT AND TREND OF THE IMPACT OF DIRECT DRIVERS ON THE SUPPLY OF ECOSYSTEM SERVICES IN FLANDERS

	changing land use			overexploitation			
Ecosystem service	urbanisation	agriculture: crop choice & management	pollutants & eutrophication	groundwater	soil	climate change	invasive species
Food production	↗ (high)	↗ (high)	↘ (low)	↗ (moderate)	→ (moderate)	↗ (moderate)	↗ (moderate)
Game production	↗ (moderate)	↘ (moderate)	↘ (low)	↗ (low)	→ (low)	↗ (moderate)	↗ (low)
Wood production	↗ (moderate)	↘ (moderate)	↘ (moderate)	↗ (low)	→ (low)	↗ (low)	↗ (moderate)
Energy crop production	↗ (high)	↗* (high)	↘ (low)	↗ (moderate)	→ (moderate)	↗ (moderate)	↗ (low)
Water production	↗ (high)	↘ (moderate)	↘ (high)	↗ (high)	→ (moderate)	↗ (high)	↗ (low)
Pollination	↗ (low)	↘ (high)	↘ (high)	↗ (low)	→ (low)	↗ (moderate)	↗ (high)
Pest control	↗ (low)	↘ (high)	↘ (high)	↗ (low)	→ (low)	↗ (moderate)	↗ (high)
Maintaining soil fertility	↗ (moderate)	↘ (high)	↘ (low)	↗ (moderate)	→ (low)	↗ (low)	↗ (low)
Air quality regulation	↗ (moderate)	↘ (moderate)	↘ (low)	↗ (low)	→ (low)	↗ (low)	↗ (low)
Noise regulation	↗ (moderate)	↘ (moderate)	↘ (low)	↗ (low)	→ (low)	↗ (low)	↗ (low)
Erosion risk control	↗ (low)	↘ (high)	↘ (low)	↗ (low)	→ (moderate)	↗ (low)	↗ (low)
Flood control	↗ (high)	↘ (moderate)	↘ (low)	↗ (low)	→ (low)	↗ (low)	↗ (low)
Coastal protection	→ (high)	↘ (low)	↘ (low)	↗ (low)	→ (low)	↗ (moderate)	↗ (low)
Global climate regulation	↗ (moderate)	↘ (moderate)	↘ (low)	↗ (moderate)	→ (low)	↗ (moderate)	↗ (low)
Water quality regulation	↗ (moderate)	↘ (high)	↘ (moderate)	↗ (moderate)	→ (low)	↗ (moderate)	↗ (low)
Green space for outdoor activities	↗ (high)	↘ (high)	↘ (moderate)	↗ (low)	→ (low)	↗ (low)	↗ (low)

Impact of the direct driver on the supply of ESSs

- ↗ increasing
- → stable
- ↘ decreasing
- high
- moderate
- low

* depending on origin (cultivated energy crops or grass clippings/ prunings)

or more information on this subject, refer to Chapter 3 of the Technical Report. You can read the discussion of the state of all ecosystems in Flanders in Chapter 5.

3.5.1 Changing land use

Across Europe, urbanisation has been in progress for decades. Large and small cities are sprawling outwards and the countryside is becoming ever more densely developed. Flanders is one of the most urbanised areas in Europe and has one of the continent's densest road networks. Typically, the spread of buildings takes the form of ribbon development and suburbanisation. The urbanisation of Flanders means that there is less land available for farming and for forest, grassland, heathland and dunes. And even the remaining open spaces are undergoing changes. Farms are operating on an ever larger scale and with increasing intensity. As a result, landscape features without a direct productive function are disappearing and the landscape is becoming more homogeneous. Yet at the same time, investment is taking place in urban forests and recreational green areas around the cities. The total area of forest and nature reserves is also increasing slightly. Even so, experts expect the trend of urbanisation and fragmentation to continue unless policies change.

Influence on species and ecosystems

A change in land use usually has a drastic impact on the ecosystem. Due to new cultivation choices, permanent grasslands are increasingly being turned into cropland, especially for growing maize. Rows of trees, hedges and woodrows are also disappearing from the landscape, so that plants and animals have fewer suitable habitats and are coming under pressure. For instance, many field birds have been unable to cope with the intensification of agriculture. Among others, the partridge, skylark, corn bunting and tree sparrow have gone into decline in recent decades.

Urbanisation has also led to deforestation and fragmentation of forests. Water ecosystems have in turn suffered seriously from the straightening and deepening of rivers and strengthening of their banks. In addition, the waterway network in Flanders has become highly fragmented, so that a sustainable recovery of fish species is no easy matter. Over the last century, significant areas of heathland, estuary, mudflats and salt marshes have also disappeared. Many wetlands have been drained or raised. Projects such as the Flemish Sigma Plan and the achievement of the conservation objectives under the Habitats Directive may increase the area of mudflats, salt marshes and wetlands again.

Influence on ecosystem services

Changing land use has major consequences for the supply of ecosystem services, especially if the soil cover or physical system changes. As farmland gives way to housing development or private gardens, there is less space for food production. Soil sealing increases the risk of flooding. Along with minor landscape features, habitats for pollinating and pest control insects are disappearing. In a monotonous landscape, the risk of erosion also increases. But the demand for nature's services can also change. For example, urbanisation is increasing the demand for urban green spaces and urban forests.

3.5.2 Pollution and overfertilisation

Farmers in particular, but also households, governments and industry, use pesticides to control diseases, pests and weeds. Farmers also fertilise their fields with nutrients (especially nitrogen and phosphorus): if they did not do so, current yields could not be achieved. Through runoff and leaching, all these substances can end up in the groundwater and surface water. Since 1990, however, the use of pesticides and emissions of nitrogen and phosphorus have dropped significantly in Flanders. Heavy metals and persistent organic pollutants (POPs) mainly derive from industry, households and the energy and transport sectors. Through measures in industry, emissions of heavy metals among other substances have fallen sharply in the last decade. Concerning air quality, Flanders remains one of the most polluted regions in Europe, despite measures in virtually all sectors to reduce emissions.

Influence on species and ecosystems

Many plant protection products can also be toxic to organisms that do not harm crops. They thus reduce the species richness and biodiversity in an ecosystem. Excess nitrogen and phosphorus is another major threat to biodiversity. Despite the decrease in nitrogen deposition in Flanders, the 'critical load' for biodiversity is still exceeded for all Natura 2000 habitats. The critical load is the threshold above which there is an increased risk of the species composition in the habitat type being adversely affected. Especially in deciduous forests, the critical load is often substantially exceeded.

Nutrient leaching into watercourses leads among other things to excessive algae growth and affects the habitats of fish and other aquatic organisms. Water and bank plants are also affected. After a flood with contaminated water, it often takes a long time for nature to recover in the land that was flooded.

Another consequence of excessive nitrogen and phosphorus is that heathlands and dune vegetation are being grassed over. In heathlands, heather (Erica and Calluna vulgaris) is being displaced by grasses such as purple moor grass. Also, in biologically valuable grasslands and wetlands, overfertilisation causes a shift in vegetation, with fast-growing species becoming dominant.

Influence on ecosystem services
Plant protection products directly or indirectly affect the supply of ecosystem services. Pesticides can kill organisms that pollinate crops, prevent pests or ensure soil fertility. Pesticides are capable of destroying the habitat of these beneficial organisms. If high concentrations of pollutants enter the food chain, they can be harmful to our health. The accumulation of chemicals in the food chain can make certain products obtained from nature, such as mushrooms or game, unfit for human consumption. Conversely, ecosystems can also remove pollutants. For example, forests purify the air. Conifers are good at removing fine particulate matter, and deciduous forests absorb gaseous substances more easily. However, excessive concentrations of pollutants can be disadvantageous for trees and plants.

Nutrients make crops and plants grow faster, thus reinforcing certain ecosystem services, such as food or wood production or the storage of carbon in biomass. However, excess nutrients can make crops more susceptible to pests and diseases, and so increase the risk of a lower yield. Nutrients that enter the soil by nitrogen deposition, for example, bring about acidification, so that plants grow less well and forests become less robust. The provision of ecosystem services that depend on healthy forests can be compromised as a result of this. In water, nutrients stimulate the growth of algae and vascular plants, which may increase the risk of flooding and make an area less attractive for recreational users. Certain algae also produce toxins and hence put the production of drinking water at risk.

3.5.3 Climate change

Climate change is a global problem that exerts an influence around the world on ecosystems and their services, but also on society and social processes. The response to it is therefore increasingly being managed internationally. The main effects of climate change in Flanders will be rising temperatures, an increase in the frequency of extreme weather events and a rising sea level.

Influence on species and ecosystems
Low-water levels in rivers and wetlands during the summer are falling: there is both more evaporation and less precipitation. As a result, the risk of drought increases. Moreover, climate change is affecting the leaching of nutrients into surface waters. Desiccation accelerates the mineralisation of organic matter, causing extra nutrients to be released from the soil. This in turn has implications for the nutrient balance and the structure of species communities in surface waters.

The effects of climate change are also already apparent in the tree and herb layers of forests in Flanders. These effects are expected to increase. Floods can affect the herb layer of valuable alder-ash forests or moderately nutrient-rich alder brook woodlands. Climate change can also cause heathland to dry out, affecting both fauna and flora.

These factors may then improve the conditions for exotic species, because they are better adapted to reproduce quickly in the changed circumstances. Ecosystems that come under pressure from climate change are more susceptible to biological invasions.

Influence on ecosystem services
Climate change has major implications for ecosystem services in Flanders. Rising temperatures are extending the growing season of plants, and the increase in the concentration of CO_2 has a fertilising effect.

Ecosystem services that rely on primary production, such as food, wood or energy production and climate regulation, could therefore create additional biomass. However, the fertilising effect of CO_2 is highly species-dependent, and the potentially positive effect may be offset by increasing drought. Desiccation in the summer also increases the risk of water shortages. A combination of falling groundwater levels and a reduced supply of surface water can have a major impact on the water supply. Moreover, due to the rise in sea level, the groundwater in the coastal zone may become subject to silting, with adverse consequences for farming and drinking water production.

Temperatures that are too high may also slow plant growth. High temperatures in the spring increase the chances of early flowering and hence the risk of frost damage. An early blossom may also make pollination more problematic, as honeybees only become active from about 12 degrees Celsius. As pest species react differently to temperature changes than their natural enemies, pests become more likely. Moreover, pathogens and insect pests are more likely to survive warmer winters. Finally, the increased frequency of extreme weather events, such as hail or heavy rains, is associated with a risk of damage to crops.

3.5.4 Invasive alien species

Invasive alien species are species that establish themselves outside their natural range and reproduce explosively there. They can cause severe damage to the local economy, public health and biodiversity. Invasive alien species are regarded as one of the main causes of the decline of biodiversity worldwide. Their economic cost – in terms of both the damage they cause and the cost of managing them – amounts to more than 12 billion euros per year for the European Union alone.

Alien species are not always a threat: in only one out of a thousand cases will such species survive, become established, reproduce and cause harm. Yet the number of invasive plant and animal species continues to grow rapidly. In Flanders, there are at least 89 species that are on the international warning lists of problematic alien species. At least 41 of these are displaying invasive behaviour in nature. Given the seriousness of the threat, the European Commission has issued a regulation to prevent the spread and impact of invasive alien species in Europe.

Influence on species and ecosystems
Invasive alien species are sometimes deliberately introduced for their economic value, in ignorance of the potential damage. When they enter the wild, they can spread rapidly and displace other species. Through competition, hybridisation, predation and disease transmission, they pose a direct threat to native species. Alien species also end up in our region unintentionally. The increasing globalisation of trade and transport increases the chances of alien species being brought along. For instance, via ships' ballast water, millions of litres of seawater are transported every day from port to port. That water contains large numbers of organisms which, if they survive the journey, end up in our waters. Invasive alien species can also be introduced by species which are not themselves invasive. For example, a garden centre may import plants which have invasive seeds or animals on them.

Influence on ecosystem services
Through competition and predation, alien species pose a direct threat to native species. Asian ladybirds were originally introduced to combat aphids organically, but as a result of their voracity they developed into direct competitors for native ladybirds. Moreover, they feed on the larvae of ladybirds and other insects. In this way, they actually pose a threat to natural pest control species. Other alien species bring parasites and pathogens with them, or by cross-breeding bring about a genetic impoverishment of native species. One of the reasons for the severe decline of the honeybee in Western Europe is probably the introduction of the Varroa mite. This parasite was originally only found on bees in Southeast Asia, but was spread virtually all over the world by international bee transportation.

In some cases, alien species hinder the recreational use of open spaces. For instance, contact with giant hogweed in combination with sunlight can cause severe burns to the skin. Water pennywort can cover entire waterways and ponds in a short time. Oxygen-depleted conditions then develop, causing fish to die and making the water unsuitable for fishing. This massive plant growth also causes difficulties for both recreational boating and the discharge of streams, thus entailing a higher risk of flooding.

3.5.5 Overexploitation

Overexploitation occurs when natural resources are so heavily used that they become depleted over time, as for instance when overfishing occurs or forests are harvested faster than they grow. Examples of overexploitation in Flanders include soil degradation through intensive agriculture and forestry, and falling groundwater levels due to water extraction. Overexploitation of forests through timber harvesting is theoretically impossible in Flanders. Whenever timber is extracted, the forest owner must hold a felling permit, or the extraction must be included in an approved forest management plan. The government also has tools to prevent overhunting. For instance, it must give its approval to a shooting plan before big game species (roe deer, red deer, wild boar) may be hunted.

Influence on ecosystems and species
Overexploitation in the form of groundwater extraction can cause desiccation in many ecosystems, with negative consequences for biodiversity. In ecosystems that depend on groundwater, such as purple moor grasslands, wet Nardus grasslands and wet heathland, desiccation changes the vegetation composition and causes the disappearance of characteristic flora. Desiccation also causes organic matter to mineralise faster, releasing extra nutrients and disrupting the ecological balance in nutrient-poor ecosystems such as ponds and pools.

Water extraction for agriculture or industry may affect the dynamics of natural water levels in rivers. Rivers are also draining ever larger volumes of water. This is because the basin storage capacity of upstream areas has fallen and large areas of land have been paved over. River diversity is also adversely affected by this.

When soil is overexploited, the consumption of nutrients and carbon from the soil exceeds their natural replenishment. Historically, the soil in Flanders has been characterised by excess nitrogen and phosphorus. Through years of overfertilisation, a phosphate accumulation has even arisen in agricultural soils. Soil degradation in Flanders is therefore mainly caused by a decreasing carbon stock. Yet the carbon content in forest and agricultural land rose between 1960 and 1990. In forests, this was probably the result of an aging forest stock and soil acidification, meaning that carbon was broken down more slowly. The increase in carbon levels in cropland and pasture was accompanied by the growth of livestock numbers, leading to increased manuring.

Between 1990 and 2000, the carbon level continued to increase in forest soils, whereas in cropland and grassland it fell until 2007. This decrease may have been due to a reduction in the use of manure (manure legislation), the decrease in the area under cereals in favour of maize (leading to less crop residue being ploughed back into the soil), and the conversion of permanent into temporary grassland. Between 2008 and 2011, a slight increase in the carbon content in arable land was again observed, possibly due to an increase in the area of farmland used for grain maize (with crop residues being ploughed back into the soil) and the generalised use of green manures.

Influence on ecosystem services
Decreasing carbon content makes the soil less fertile and affects its structural quality. This has adverse consequences for ecosystem services that are dependent on healthy soils, such as the production of food or energy crops. Soils with a lower carbon content are also more susceptible to erosion and less permeable to rainwater. This eventually leads to a decline in groundwater levels. Overexploitation of the deeper aquifers reduces the availability of water, for example for drinking water production. A falling water table also has implications for water-dependent ecosystems and poses a threat to the delivery of ecosystem services such as water purification. Desiccation is not just a problem for forests and nature reserves and the provision of services that depend on these ecosystems: it also affects agricultural production. The less water there is available in the root zone, the more the growth of plants is inhibited. The mineralisation of organic matter will increase as a result, which in turn leads to higher nitrogen and phosphorus levels and to eutrophication.

Like to know more about this subject? You can read all about it in Chapters 3, 4 and 5 of the Technical Report.

FOCUS: GREEN SPACE

Green space for outdoor activities as an ecosystem service

Many people in Flanders lead a hectic life and spend much of their time indoors in sedentary activities. For recreation purposes, they seek out nature. Walking, cycling, landscape-painting: outdoor leisure activities do us good. Society therefore benefits from increasing the number and accessibility of green spaces.

What is it?

The suitability of green space as a place for recreation and socialising. Taking exercise in a natural setting is good for people's physical and mental well-being. The mere presence of greenery in or near a residential area may make it a more pleasant place.

What are the benefits?

Having green areas nearby encourages people to take exercise. This benefits both their physical and their mental health. Outdoor recreation improves mood, counters stress and reduces the risk of illness and depression. In cities, people living in a neighbourhood with plenty of green areas have even been found to feel happier than those living in districts with few natural features. We often derive part of our identity from the environment in which we live, and this reinforces a society's cohesion.

While outdoor activities are possible in all ecosystems and landscapes, there are a number of characteristics that make them more attractive to people. The availability of recreational green space in cities or municipalities is determined by diversity of land use, degree of naturalness, the presence of protected areas, water, river banks and lake shores, forests (preferably deciduous or mixed), unsurfaced footpaths, views and beautiful scenery, natural resources, tourist facilities and ease of access.

How important is it in Flanders?

In highly urbanised Flanders, attractive green spaces are unevenly distributed. Some areas are still very natural – Haspengouw, the Kempen region or the Voerstreek – while others are almost completely built up. 21 percent of the people in Flanders do not have a green area within walking distance. There is therefore high demand in Flanders for more attractive and accessible green areas. Everyone should have a green area close to home, if only for its health benefits.

How does this relate to biodiversity?

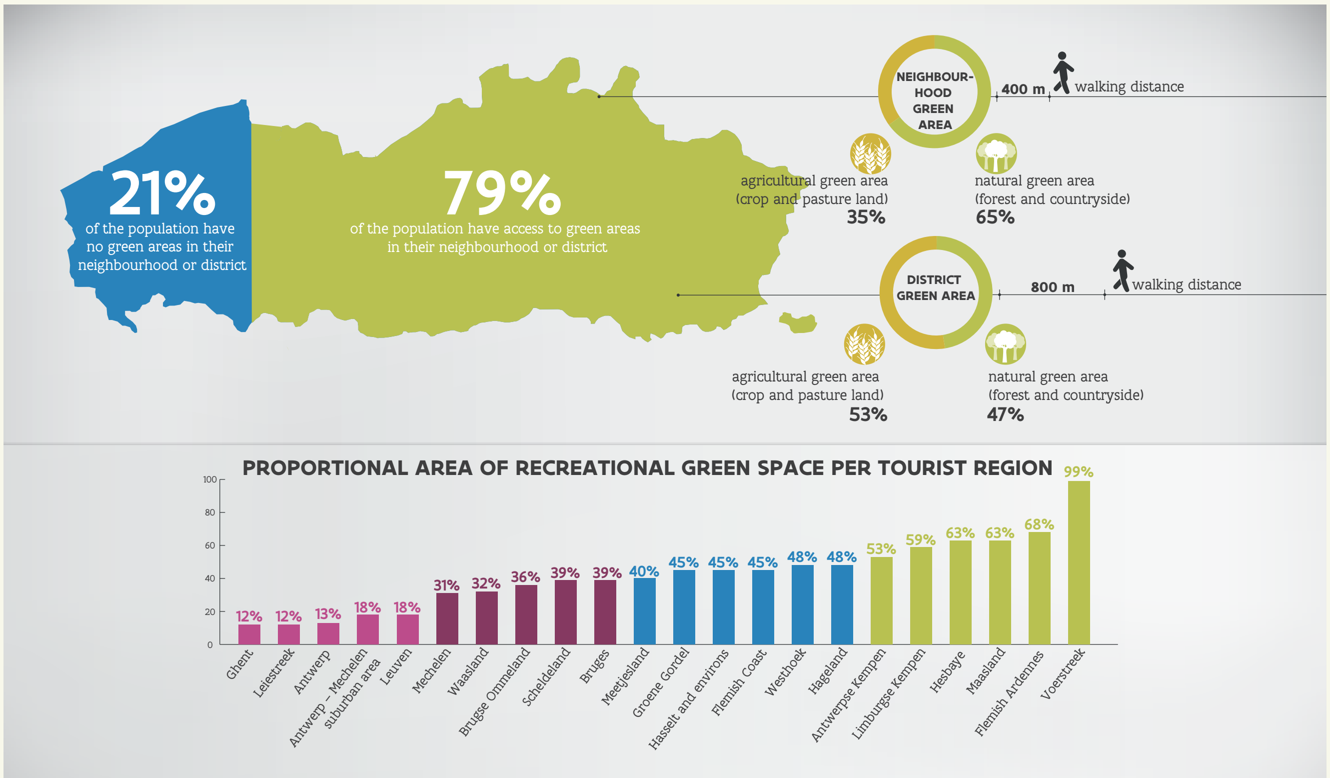
In areas of high biodiversity, there is a wider range of ecosystem services to enjoy. Some people take up bird-watching and look out for rare species. Others enjoy the variation in colour and structure in a conservation area, or take advantage of the opportunity to pick berries or mushrooms. Hunters appreciate the presence of wild boar, hare and deer.

Intensive use of green spaces can reduce biodiversity, however. Activities such as motocross can cause problems for plants and animals. Even quiet recreational users and walkers can disturb rare and often timid birds during the breeding season. Recreation is only one of many ecosystem services, and intensity of use must therefore be kept in balance with the required provision of other ecosystem services and the specific biodiversity targets for that area.

Interaction with other ecosystem services

Coastal protection in Flanders is mainly affected by extensive residential development, but recreation too can have a negative effect. In some places, the large number of recreational users prevents the development of dunes and dune vegetation, which could otherwise fulfil a sea-defence role. Again, wooded areas are appreciated by the population mainly for their aesthetic and recreational value, and less for their timber-producing capacity. That public appreciation translates into policies that give better protection to forests and small landscape features such as rows of trees and hedges and aim to raise the ecological quality of woodlands; but often, this is done at the expense of a forest's timber output.

Some figures from the Technical Report



Like to learn more about this subject? You can read all about it in Chapter 26 of the Technical Report.

Modern agricultural techniques produce high yields in the short term, but have a negative effect on numerous ecosystem services in the long term. A complete transition to agro-ecological farming is unlikely in the near future, but many Flemish farmers are giving nature a more important place. They are establishing green buffer zones between their lands and adjacent forests, turning fields into an ideal habitat for field birds or sowing wildflower margins around the edges of their fields that attract bees.

04

THE ROLE OF BIODIVERSITY IN THE DELIVERY OF ECOSYSTEM SERVICES

04. The role of biodiversity in the delivery of ecosystem services

Urbanisation, pollution, overexploitation of groundwater... Our society is putting biodiversity under severe pressure. On the other hand, biodiversity itself has a considerable influence. It controls the processes in natural ecosystems and thus serves as a vital safeguard for many ecosystem services, such as the annual harvest, the regulation of soil processes or flood protection. Which organisms and ecosystems are decisive for the delivery of ecosystem services? And what is the role of biodiversity in the different links of the ecosystem service cycle?

4.1 The interaction between biodiversity and ecosystem services

In the previous chapter, we saw that biodiversity is under pressure from numerous human influences. At the same time, it too exerts an influence. Biodiversity regulates and optimises many processes in nature, so that they function better and with more stability and produce a wider range of ecosystem services. The role of biodiversity can vary greatly. It can contribute directly to a type of yield (such as the timber harvest or the game yield) or to a recreational value (such as butterfly-spotting, or outdoor sporting activity). It can also have a regulating role, such as the self-purifying capacity of a river, or a stabilising one, for example by acting as a climate buffer.

The richer an ecosystem's biodiversity, the more stable it will be and the more services it can provide us. For instance, a wide range of organisms is responsible for soil formation, water purification, air purification, pollination and pest control. Greater biodiversity leads to greater welfare and well-being for humans; the loss of biodiversity is detrimental to humans.

Thus biodiversity can be very important in the delivery of ecosystem services. Yet we fail to recognise this role. On the contrary, instead of relying on biodiversity we often resort to technical interventions, such as noise barriers and dikes, fertilisers and chemical pesticides. This is why it is important to study the role of biodiversity in all stages of the ecosystem service cycle.

4.2 Levels and components of biodiversity

From genes to landscapes. In order to describe its complex role in the delivery of ecosystem services, we have divided biodiversity into four organisational levels, examined from four different approaches (Figure 9). The four organisational levels have been described earlier: genes, species, ecosystems and landscapes. Ecosystem services can be provided at all these levels: genetic crop diversity that stabilises yields; bumblebees that pollinate; boars or pheasants as game species; a valley for water storage or a forest to walk in.

Different approaches, varying valuations. Different approaches can be taken to each level of biodiversity. Each of these approaches emphasises a different aspect of biodiversity and its use or value to people:

(1) **composition** or an emphasis on the constituent components of biodiversity. The focus here is on the current conservation of nature: listing and monitoring rare species and ecosystems, and seeking to preserve them.

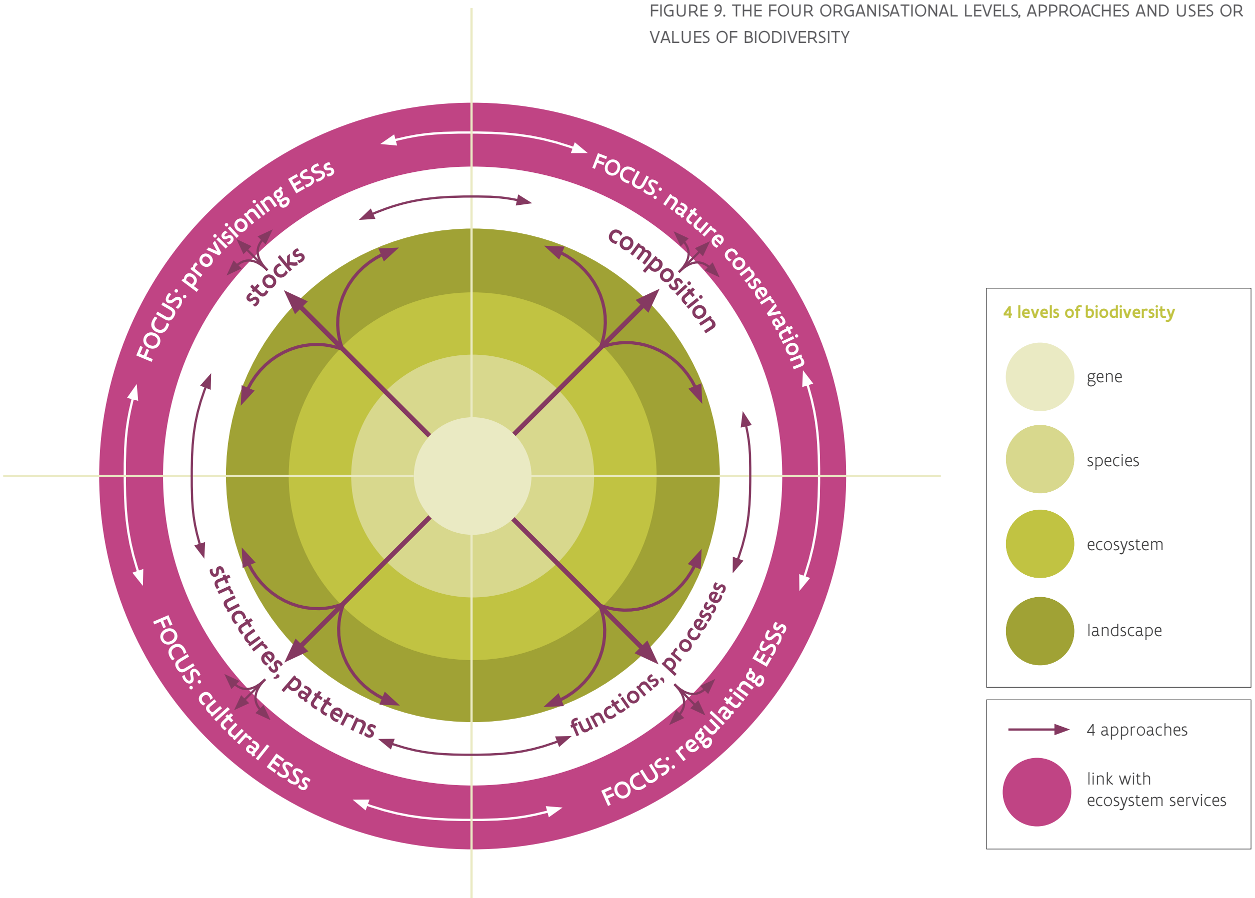
(2) **functions and processes** or an emphasis on the functioning of ecosystems and the relationships between species. This approach is mainly relevant to the regulating ecosystem services, such as the production and decomposition of organic matter, water quality regulation, and so on.

(3) **stocks** or an emphasis on the amount of biological resources, such as the genetic stock of a tree species, the volume of wood in a forest or the biomass production of a maize field. This is essentially the provisioning services approach, but stocks are also relevant to regulating services. For example, a bee population must be large enough to pollinate an entire orchard, and there must be enough organisms present in the soil to break down organic material.

(4) **structures** (4) or an emphasis on landscape patterns: the stratification of vegetation for example, or the extent to which a landscape is fragmented or contiguous. This approach is relevant to cultural ecosystem services. People like to spend leisure time in varied landscapes such as open meadows, heathland, or forests with a rich undergrowth of wild plants. Structural characteristics are also relevant to regulating services. For example, leaf structure determines how well a tree captures fine particulate matter, and forest density determines how well a forest buffers noise.

Analysing the role of biodiversity. The four levels and four approaches are closely interrelated and interact with one another. To optimise ecosystem services or make them more sustainable, we need to analyse the different components of biodiversity. For air quality, the structural variation of the forest and the trees in it play an important role as well as the volume of wood. The trees' density and height, and the specific leaf structure of each individual tree, determine how much fine particulate matter can be captured. For pest control, it is important to understand the habitat and life cycle of specific species and their enemies properly, but also the ecological interactions between the two, and the importance of population sizes at different times.

FIGURE 9. THE FOUR ORGANISATIONAL LEVELS, APPROACHES AND USES OR VALUES OF BIODIVERSITY



Four forms of biodiversity in the Sonian Forest (Brussels)

- **The role of the Sonian Forest in conservation**
  The Sonian Forest or Forêt de Soignes to the southeast of Brussels contains many target species and habitat types protected at European level. Oak-beech forest is found in some places, a forest type that Europe has designated as a protected habitat type for Natura 2000. There are also specific species such as the stag beetle, the bitterling and many bat species. The composition and structure of the forest are key components for the achievement of conservation objectives.

- **The Sonian Forest as a regulating ecosystem service**
  Because the trees remove fine particulate matter from the air, the Sonian Forest helps improve the air quality. This service is especially important because the forest lies near a number of major motorways. The forest also provides many other regulating services such as carbon storage and temporary water storage.

- **The Sonian Forest as a cultural ecosystem service**
  As a green lung in an urban environment, the Sonian Forest is an important leisure facility for walkers, cyclists and joggers. With its rich history, the ancient cathedral-like forest is a major attraction for recreational users: a cultural ecosystem service.

- **The Sonian Forest as a provisioning ecosystem service**
  The Sonian Forest also provides wood: a provisioning ecosystem service that is mainly due to its large, thick beech trees of good quality.

4.3 The importance of species and ecosystems for the delivery of ecosystem services

Research into the role of biodiversity in the delivery of ecosystem services generally focuses on two elements: species and ecosystems.

4.3.1 Species

An ecosystem or landscape can only provide a range of services if the necessary species are present. The multifunctional and optimal use of an ecosystem thus requires a certain biodiversity. For instance, food production is mainly a consequence of primary production. Plants perform photosynthesis, obtain water and nutrients from the soil and produce biomass. Once they are fully grown, they are (partly) suitable as food for humans or animals. Nitrogen-fixing bacteria or fungi can make this primary production even more efficient by entering into a symbiotic relationship with the plants.

Soil organisms, bees, parasitic wasps and ladybirds have a regulating role: they contribute to soil formation, pollination and pest control. But species or groups of organisms can also work against each other. For example, certain bacteria and fungi cause damage to crops or make them inedible. Antagonistic species can also be used to control one another and create a healthy balance. Only if the net outcome is positive for humans can we speak of a service or benefit having been provided.

4.3.2 Ecosystems

Which ecosystems provide which services, and how extensive is the supply? Based on the nine ecosystems which according to the MAES classification are present in Flanders, we have developed an ecosystem map (see Chapter 3). In addition, for fourteen ecosystem services we have developed an integrated ecosystem service map. This summarises the potential provision of any service on a scale from 0 (no provision) to 5 (maximum provision). Figure 10 (p. 47) is a combined map for all ecosystem services. Using these maps, we have been able to consider, for each ecosystem, the potential provision of pollination, timber production, water purification and so on.

The maps show that some services are clearly linked to a specific ecosystem. Forests, or even rows of trees on streets and in gardens, are excellent noise absorbers and air purifiers, for example. Coastal dunes with marram grass offer the best protection against the pounding of the sea's waves. Croplands and grasslands provide food for humans and animals. Most ecosystem services, however, are spread across different ecosystems, just as most ecosystems provide a variety of services. Honeybees and bumblebees can settle in gardens, forests or grasslands. Because they pollinate crops within a radius of one kilometre around their nesting site, they do not necessarily have to find a suitable habitat on farmland.

When we consider the total area of each ecosystem type in Flanders, the picture is very different, though. Per hectare, forests stock the most carbon, but in Flanders there is a much larger area of cropland. In total, our croplands therefore store more carbon than our forests. A slight change in cropland management to promote carbon storage could thus generate a very substantial benefit. The reverse is equally true. A slight fall in the carbon content of cropland soils could lead to a large net loss in carbon storage. Wetlands provide another example. Per hectare, they make the largest contribution to water storage, but in Flanders the total wetland area is so limited that these areas only make a small contribution to flood protection. Grasslands, croplands and forests currently store larger water volumes. Complex networks of private gardens can also play a major role in the delivery of ecosystem services in urban areas.

4.4 The role of biodiversity in the ecosystem service cycle

Biodiversity plays an important role in each stage of the ecosystem service cycle:

- Biodiversity is the **natural storehouse** from which humans can draw for genetic crop varieties, new medicines or technologies.
- Biodiversity **regulates** a large number of ecosystem processes so that they work better and in a more stable manner.

- Biodiversity contributes directly to the **harvest** of food, timber and game, among other products. In this sense it is also an end product.
- Part of biodiversity is directly **valued** for its aesthetic, ethical and cultural properties.

4.4.1 Biodiversity and ecosystem functions

More diversity ensures better ecosystem functions. Most ecosystem functions contribute to various services. For instance, the decomposition of organic materials by various macro- and micro-organisms is crucial for maintaining soil fertility and water purification, but at the same time also supports food production. Ecosystem functions such as primary production, soil formation and pollination together determine an ecosystem's capacity to deliver services.

Biodiversity can improve, support and stabilise ecosystem processes and functions. Many scientific studies have shown that greater variety of genes or species improves and stabilises functions. Species are partly complementary. This means they have different ecological ranges. For example, different plants may root at different depths, as a result of which they absorb a different set of nutrients. Insects may fly and act as pollinators during different times of year.

Because they are partly complementary, they fulfil the function better when they are together than when they occur separately. As the number of species increases, so the additional contribution of any new species to an ecosystem function reduces. The so-called saturation point is approached. As the number of functions increases, so the saturation point shifts, and ever greater diversity is needed in order to guarantee the various functions.

Variety ensures stability and resilience. The pressure on our ecosystems is increasing all the time, and the risk of sudden, drastic changes is growing. For instance, climate change increases the risk of storms, floods, droughts and the presence of invasive alien species. One ecosystem may be much more resistant to such changes in the environment than another. Biodiversity plays an important role here. As the variety of genes, species and functional groups increases, so an ecosystem becomes more stable. Moreover, stability and resilience are dependent on scale. The larger the area of an ecosystem, the better protected it is against external influences.

4.4.2 Biodiversity and the use of ecosystem functions

Biodiversity is thus decisive for the quality and quantity of ecosystem services. Despite this, its role is not properly valued. Often, energy or technical alternatives take over the function of biodiversity.

Useful or 'marketable' production is especially highly valued, which means that the emphasis is on homogeneity and quantity. For example, a forest with high biodiversity will be more resistant to pests and deliver multiple ecosystem services, but the harvesting of timber in such unevenly aged forests requires more technical skill and effort on the part of the forest manager for the same return. Many timber producers therefore tend to opt for evenly-aged monocultures.

From nature-based to technical use of ecosystem services. For each ecosystem service, there is a continuum from a more nature-based form of use, in which biodiversity and natural processes play a fundamental role, to a more technical form of use in which that role is secondary. As a single service of an ecosystem becomes maximised – such as timber production in the case of a forest – so there tends to be a shift towards a technical form of use.

The difference between nature-based and technical use is one of degree rather than kind. The most natural use of the ecosystem service of food production, for example, is gathering wild berries and mushrooms which we know from tradition to be edible. The least natural use, producing meat in a laboratory from stem cells, is an (almost) entirely technical process. Between these two extremes lie such approaches as, for instance, growing crops on farmland with a natural soil, the addition of artificial or natural fertilisers and pesticides, cultivation in greenhouses and hydroponics, in which the climatic conditions and soil processes are also controlled technically. Water purification varies from natural wetlands and self-purifying rivers via wet berms and buffer zones through to technical treatment plants. In this continuum from nature-based to technical use, the role of biodiversity decreases. Technological solutions are often accompanied by more intensive use, diminishing biodiversity and a decrease in the capacity to provide combined services. For instance, the broad-spectrum chemical pesticides used in modern agriculture destroy natural pest control agents.

Restoring ecosystem services. Targeted management makes it possible to use less energy or technology and deliver more stable ecosystem services over longer periods. As a result, the pressure on other areas and services is further reduced, which in turn has a positive effect on biodiversity. For instance, a farmer who establishes a wildflower margin increases the habitat of pest controllers and pollinators and restores their natural regulating function. Natural pest control then ensures that fewer chemical pesticides are needed, and this in turn is good for biodiversity.

4.4.3 Valuing biodiversity

Only when we recognise the role of biodiversity, value it properly and focus our management approach on it can we make ecosystems and their services more durable and stable. The first step is knowledge, so that people know what biodiversity means and realise its importance. Appreciation and attribution of value will follow. We can only value what we know. This appreciation is always subjective and has a strong cultural and personal element. What we value will in turn have an impact on what we study and what measures we take. For example, many people enjoy observing butterflies, birds and mammals. Because we know and appreciate these species, they are more likely to be incorporated in a normative framework, and conservation measures will be developed more rapidly for them. Many soil organisms may play at least as important a role, but because we do not take that role into account, these species are not included in conservation programmes.

4.4.4 Biodiversity in policy

Biodiversity is both a valuable asset that is under pressure and in need of protection, and a vital safeguard that supports the delivery of ecosystem services. Both views are central to the objectives of the European Union's biodiversity policy (EU-2020). The first EU-2020 target mainly focuses on the continuation of the conservation policy for rare species and ecosystems. The second target is green infrastructure, in combination with the restoration of ecosystems and the services they provide. The two goals are complementary. Although the implementation of the conservation objectives also delivers many benefits for ecosystem services and biodiversity, the implementation of the two EU targets partly involves different approaches.

Like to learn more about this subject? You can read all about it in Chapter 6 of the Technical Report.

FOCUS: FOOD PRODUCTION

Food production as an ecosystem service

Food is a basic human need. Numerous ecosystem services are involved in its production: soil fertility, pollination and pest control. Moreover, food production requires a large amount of space. Modern agriculture has increased the yield per hectare with technical interventions that can adversely affect other ecosystem services. Society would therefore benefit from more agro-ecological farming. Although the food yield per hectare is usually lower with such an approach, agro-ecologically managed fields offer many other ecosystem services.

What is it?

The ability of ecosystems to deliver our food. That food production is driven by regulating ecosystem services. For instance, the soil must remain fertile enough for food crops. Furthermore, food production benefits greatly from the ecosystem services of pollination and pest control. The ecosystem processes of water regulation and photosynthesis also play an important role.

What are the benefits?

Humans need food to survive, but food also provides a host of other benefits. Sharing a meal together is a very important cultural activity. It creates a bond between families, neighbours or even entire societies (traditional dishes for example).

The actual production process can also have positive effects on both producers and consumers. Doing physical work outdoors is good for both the physical and mental health. Growing vegetables together on an allotment strengthens social cohesion. In addition, fields, fruit orchards and meadows have a high recreational value.

How important is it in Flanders?

There is enough (safe) food available In Flanders, although a large proportion is imported from abroad. In total, food is produced on 45 percent of the land area in Flanders. Without imported food, we would have to cultivate 60 percent of the land area to continue to meet our current food consumption. Moreover, we mainly use 'modern' agricultural techniques. Agro-ecological farming offers great benefits for ecosystem services, yet it is only used on 1 percent of the food production area in Flanders.

How does it relate to biodiversity?

Modern food production in Flanders is often accompanied by a decline in biodiversity. Specialist species in particular – those that depend on specific circumstances – are becoming less common, while generalists – those that thrive in many circumstances, but are often less valuable – are growing in numbers. This is true of both plants and animals. Farmers are trying to reduce their impact on biodiversity, however. Between 1990 and 2010, the impact of pesticides on aquatic life fell by 60 percent.

But biodiversity plays an important role in virtually all food-related ecosystem processes. For example, soil fertility is also dependent on it to a large degree. High doses of fertilisers lead to lower soil biodiversity. Organic fertilisers preserve it much more effectively.

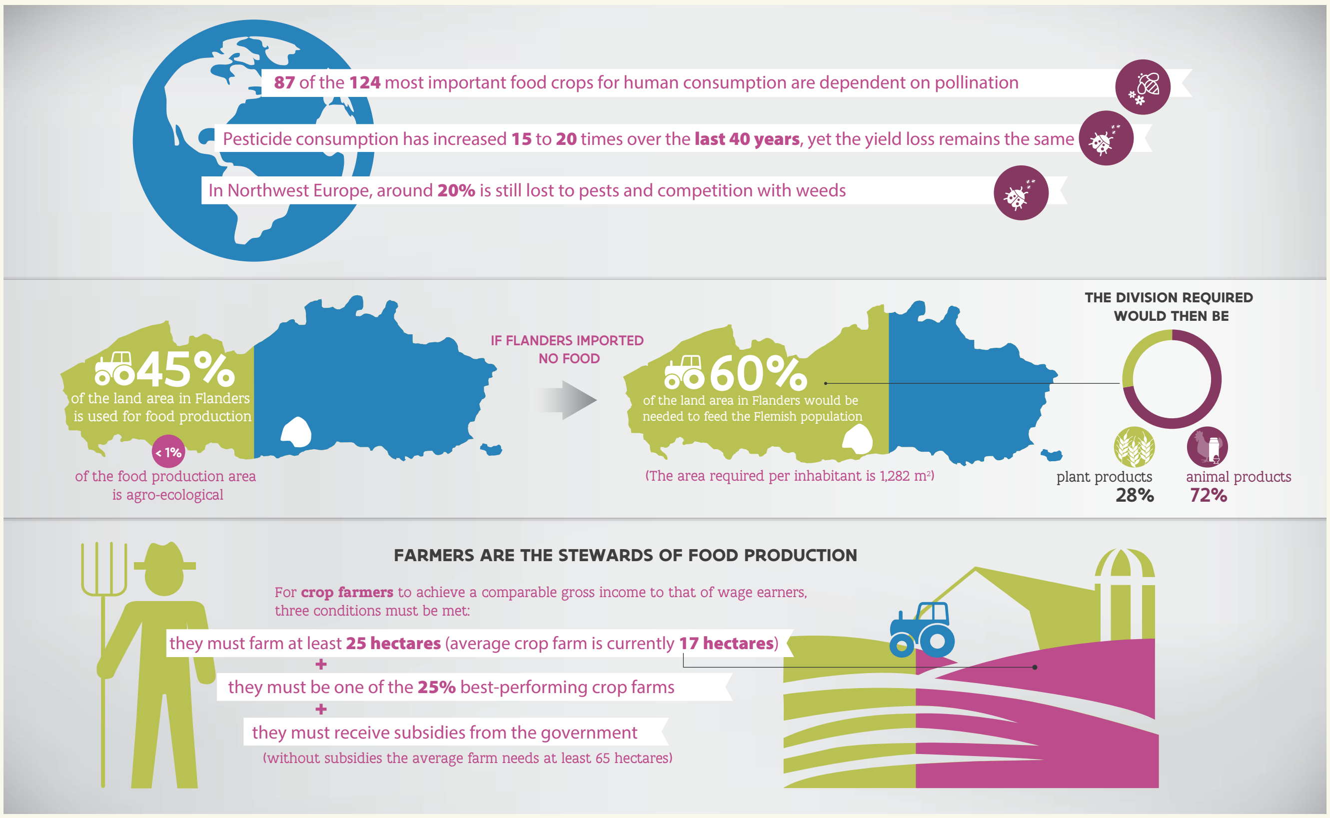
Interaction with other ecosystem services

Modern food production has negative effects on the supply of various other ecosystem services. Climate regulation is hampered by excessive greenhouse gases, ground that has been drained jeopardises water production, water quality is affected by the leaching of nutrients and pesticides, and so on.

Moreover, over-intensive land use often actually leads to reductions in food production in the long term, for example due to reduced soil fertility.

However, farmland in Flanders supplies the majority of ecosystem services because it occupies so much space. For example food crops trap fine particulate matter and CO_2, and agricultural landscapes also offer numerous recreational opportunities. To maximise the benefits of farming and minimise the disadvantages, agro-ecology or further ecological modernisation (such as precision farming techniques) may offer a solution.

Some figures from the Technical Report



Like to learn more about this subject? You can read all about it in Chapters 11, 16, 17 and 18 of the Technical Report.

The quality of the surface water in Flanders still leaves much to be desired. In many cases, there are too many nutrients present, which can disrupt the natural balance in rivers or ponds. Moreover, numerous watercourses have lost their self-purifying capacity as a result of human actions. For example, much of the water-purifying vegetation along river banks has disappeared.

05

INTERACTION BETWEEN ECOSYSTEM SERVICES

05. Interaction between ecosystem services

A forest is simultaneously an air filter, wood supplier and play area. The different services within a single ecosystem cannot be separated from one other. A change to one ecosystem service often has an impact on the other services. Some ecosystem services can coexist or reinforce one other, while others compete or even exclude one another. With a view to using ecosystem services sustainably, we have examined the relationships and interactions between supply, use and demand.

5.1 Interaction between supply, demand and use

Changing one ecosystem service always causes changes in others. Some ecosystem services are provided at the expense of others (trade-off), while others reinforce one another (synergy). In a carefully devised policy, it is therefore inadvisable to approach ecosystem services separately. Only when we view ecosystem services as cohesive and closely intertwined will we have sight of the overall result. Interactions between ecosystem services occur in terms of supply, use and demand. In each case, specific challenges arise for both researchers and policy-makers.

5.1.1 Supply

To make optimal use of the services of ecosystems in Flanders, their total supply must be optimised. To work out how to do this, we look at supply interactions between ecosystem services. Each ecosystem is more or less suited to providing certain services. A forest produces more wood than a field, but food crops grow better in a field. This has to do with the specific characteristics of the ecosystem: structure, composition, area, etc. The interaction between all these characteristics determines which services the ecosystem offers, or which ones are the best for it to offer. Researchers and policy-makers should strive to optimise land use, so that ecosystems can provide the services for which they are best suited.

5.1.2 Use

To convert ecosystem services into benefits, we need to provide some input of our own. The extent and nature of that input (for example work, energy or intellectual effort) can vary greatly. For instance, major inputs of non-renewable capital (fuel, fertiliser, etc.) are needed to cultivate a field intensively and produce food from it. For a relaxing walk in nature, however, only a small physical effort (or input) is required. Current inputs often place ecosystems and their services under pressure. This leads to high costs and inefficient use. The challenge is not only to maximise the supply and use of ecosystem services, but at the same time to ensure that ecosystems can continue to deliver their services in the long term. A nature-based ecosystem service reduces negative interactions and can thus provide a solution. Such nature-based use implies a minimal input of non-renewable capital and the most efficient possible use of natural processes and ecosystems (renewable natural capital). For each ecosystem service, we therefore define types of use along a continuum from nature-based to technical.

5.1.3 Demand

The importance to society of an ecosystem service is defined by the people who want to use it. That demand is driven by complex socio-economic factors. Property rights, political participation and unequal distribution of power, information and resources have a big influence.

Furthermore, it matters how sustainably an ecosystem service is used and how important the service is for future generations. An understanding of the interactions between the needs and desires of the various stakeholders is therefore essential. Local and global interests and present and future stakeholders all play a role.

5.2 Optimising supply

5.2.1 The potential supply of ecosystem services

Not every location delivers the same ecosystem services, or the same number of them. Some locations can take up water better than others, and hence contribute more to the available supply of drinking water. Whether a place is suited to delivering one or more ecosystem services is determined by characteristics such as soil fertility, levels of air humidity, position, distance from housing and so on. We also speak of 'physical potential'. It is important to note here that the optimal conditions for the delivery of one ecosystem service do not always coincide with the best conditions for the delivery of another such service. The interaction between ecosystem services thus affects the supply. Yet the supply of ecosystem services is not determined exclusively by physical characteristics: people adapt ecosystems, both deliberately and unwittingly. Thus ecosystems may be able to deliver multiple services at the same time, but are often managed by people in order to maximise just one service. A large part of the ecological potential is thus not exploited.

5.2.2 The geographical distribution of supply in Flanders

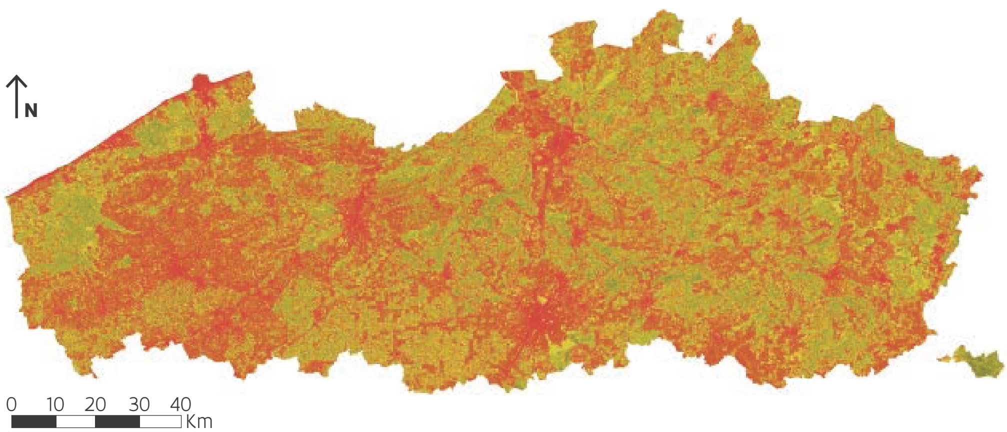
To give an idea of the total supply of ecosystem services in Flanders, we have drawn up a 'bundle map' (see Figure 10). An analysis of the spatial and thematic patterns on this map makes it clear which regions, landscapes or forms of land use provide which ecosystem services. Provisioning ecosystem services are mainly concentrated in agricultural areas. Regulating services are distributed fairly homogeneously throughout Flanders, but on a smaller scale it is noticeable that they are clustered in wet areas. A clear picture emerges for cultural services: their pattern reflects the landscape of the countryside. Mapping ecosystem services in this way has several limitations. For instance, the spatial variation of the supply can only be taken partially into account. Thus horse pastures count as grasslands, and so fall into the same class as agricultural grassland. However, they provide very different ecosystem services. Moreover, it is not always possible to ascertain precisely from the maps why certain ecosystem services occur together. There may be no interaction at all: their presence in the same ecosystem may be explained by physical patterns or even unknown factors. Finally, a limited supply of services may still be important if it is spread over a large area. For instance farming, despite its low provision of ecosystem services per hectare, supplies the lion's share of ecosystem services in Flanders.

5.2.3 Limiting trade-offs and maximising synergies

How can we increase the supply of ecosystem services? By limiting trade-offs and creating as many synergies as possible in the use of space. Where trade-offs occur, a negative interaction arises between the services that an ecosystem offers.

FIGURE 10. BUNDLE MAP OF THE TOTAL SUPPLY OF ECOSYSTEM SERVICES IN FLANDERS AND THE BRUSSELS-CAPITAL REGION, BASED ON THOSE SERVICES WITH AN ABOVE-AVERAGE SUPPLY

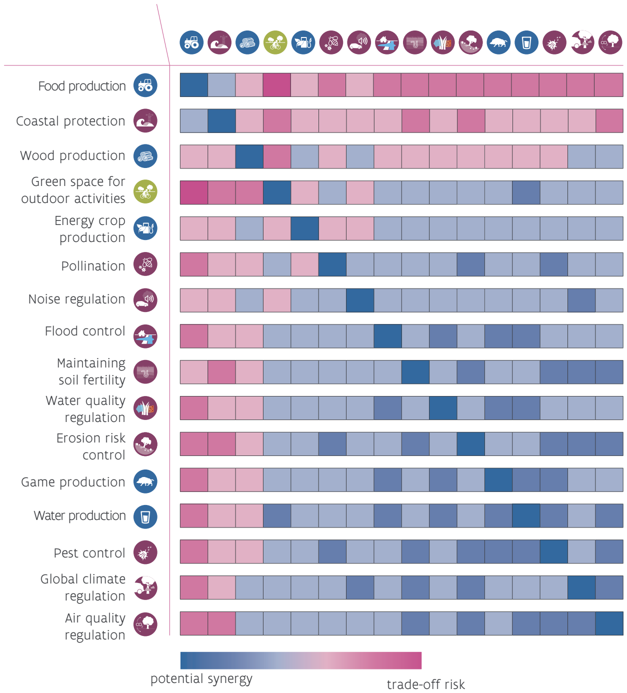
- 0 - 10%
- 10 - 20%
- 20 - 30%
- 30 - 40%
- 40 - 50%
- > 50%



Thus, a wetland area is ideal for reducing flood risks for the environment, but far too damp for crop production. These two ecosystem services thus exclude one another in a trade-off: we lose the benefit of one service for the benefit of another. Where synergies exist, by contrast, services can be combined perfectly by a single ecosystem. For example, a forest is ideal as a noise buffer, offers space for recreation and improves air quality. Figure 11 gives an overview of possible trade-offs and synergies in Flanders. Dark red is used to indicate that it is difficult to deliver two ecosystem services together (trade-off). Blue indicates that the combination of two services is possible (synergy). The darker the blue, the greater the synergy.

Figure 11 shows that potential synergies in Flanders mainly lie in combinations of regulating services. Pest control and pollination, for instance, can take place within the same ecosystem, as can noise reduction and air quality. The greatest risk of trade-offs exists with the provisioning services, as these usually require a specific land use. When this overview is combined with the data on the potential supply of ecosystem services per land use type, it can be seen that services provided by monofunctional land use involve a high likelihood of trade-offs. By contrast, multi-functional land use presents many potential synergies.

FIGURE 11. POTENTIAL SYNERGIES AND TRADE-OFF RISKS BETWEEN ECOSYSTEM SERVICES



More information on the calculation of the interactions can be found in Chapter 9 of the Technical Report.

To maximise ecosystem services, we need to develop models that can predict trade-offs and synergies. In Flanders, however, land use is strongly entrenched. Major land use changes rarely occur in the countryside. To analyse trade-offs and synergies, we therefore need to look at what takes place within land use. For example, the trade-offs between food production and water quality regulation on farmland closely depend on exactly how a field is used.

5.3 Multifunctional land use: one plus one equals three

For a multifunctional and hence more extensive use of ecosystem services, the potential supply of an ecosystem is not the only thing that counts. It also matters how those services are used by people. We can find this out by studying how the use of one ecosystem service affects the supply of another.

5.3.1 Interactions in the current pattern of use versus a more nature-based use

Interactions of use relate to the way people use ecosystem services and the effects this has on the ecosystem. Water purification by wetlands, for instance, affects the supply of water recreation, another ecosystem service.

As discussed in Chapter 4, for each ecosystem service there is a continuum from a more nature-based use, in which natural processes play an important role, to a more technical use, in which the role of natural processes is secondary. In nature-based use, as little non-renewable natural capital as possible (such as fossil fuels and minerals) is invested, and as much renewable natural capital as possible. This enables ecosystems to be exploited more widely, and to deliver multiple services at the same time.

5.3.2 Towards a more nature-based use of ecosystem services in Flanders?

At present we use ecosystem services in Flanders mainly in a technical manner, which produces more negative interactions than nature-based land use. Positive interactions increase with more nature-based use, while negative interactions are reduced. By promoting or developing existing and new forms of nature-based use, we can create positive effects for both the existing supply of ecosystem services and the stability and resilience of supply in the future.

impact of current use on supply of ESS	production of food and water	production of material and energy	regulation of pollution and nuisance	regulation of material flows	regulation of physical, biological, chemical state	cultural services
production of food and water	-1	-1.5	-1	-1	-2	0
production of material and energy	-0.5	-2	-2	0	0	0.5
regulation of pollution and nuisance	0	1	1	0	1	1.5
regulation of material flows	2	0	0	1	1	2
regulation of physical, biological, chemical state	2	0.5	-2	2	1	1
cultural services	-0.5	2	2	-2	/	1

impact of more nature-based use on supply of ESS	production of food and water	production of material and energy	regulation of pollution and nuisance	regulation of material flows	regulation of physical, biological, chemical state	cultural services
production of food and water	-0.5	-2	-0.5	0.5	0	-0.5
production of material and energy	0	-1	0	0.5	0	0.5
regulation of pollution and nuisance	0	1	1	0	1	1
regulation of material flows	2	0	/	0	0.5	2
regulation of physical, biological, chemical state	2	2	0.5	2	1.5	2
cultural services	0	/	/	/	/	/

-2 2 0 1 2

Interaction: negative, slightly negative, neutral, slightly positive, positive

FIGURE 12 (TOP). INTERACTION BETWEEN ECOSYSTEM SERVICES WITH CURRENT USE, BASED ON DOCUMENTED USE INTERACTIONS (MINIMUM AVERAGE RELIABILITY).

FIGURE 13 (BOTTOM). INTERACTION BETWEEN ECOSYSTEM SERVICES WITH MORE NATURE-BASED USE, BASED ON DOCUMENTED USE INTERACTIONS (MINIMUM AVERAGE RELIABILITY).

For the method of calculating the impact and for supporting data, see Chapter 9 of the Technical Report.

Provisioning services offer the greatest potential for improvement, as the way they are currently used is responsible for the vast majority of trade-offs (Figure 12). More extensive application of the nature-based forms of use of these services (Figure 13) can cut down on these trade-offs. Because of the area it covers, arable and agricultural land in Flanders delivers the greatest amount of ecosystem services. This means that a small change in land use by agriculture, e.g. by means of organic farming or ecological intensification, can produce a large gain in ecosystem services. The gains from such measures for society may be far greater than if we were to invest in ecosystems with the potential to provide a large amount of services per hectare, but with only a small area in Flanders.

5.4 Interactions on a local and global scale

landers uses many ecosystem services which are wholly or partly produced elsewhere. We are therefore highly dependent on foreign ecosystem services, as well as having an influence on them ourselves. It follows that an ecosystem services policy cannot be confined to demand, supply and use in Flanders.

Moreover, both the demand and supply of ecosystem services can exhibit considerable local variations. For example, the demand for services in a city differs from district to district. For one city dweller, an accessible park is a nice extra, whereas for another it is a crucial means of reducing air pollution.

Whether the scale of supply and demand is local or global depends on the service. Scale is also important for policy-makers. It determines the opportunities to develop effective policy instruments focusing on the sustainable use of ecosystem services.

Like to learn more about this subject? You can read all about it in Chapter 9 of the Technical Report.

Production of clean water as an ecosystem service

The quality of river water and groundwater leaves something to be desired almost everywhere in Flanders. Firstly, there are too many nutrients present (especially nitrogen and phosphorus), and secondly, many watercourses have lost their self-purifying capacity as a result of human actions. At the same time, Flanders suffers from water scarcity, potentially making food production, power generation and navigation all more difficult. Natural water purification can help us out, however.

What is it?

Nature's ability to clean water and to store it. For example, rainwater slowly percolates into the ground, and we can then pump it out again. It is made suitable for human use by numerous environmental and technological processes. After consumption, much of our water first has to be treated in a water treatment plant, because we dispose of more waste and nutrients than the ecosystem can naturally purify.

What are the benefits?

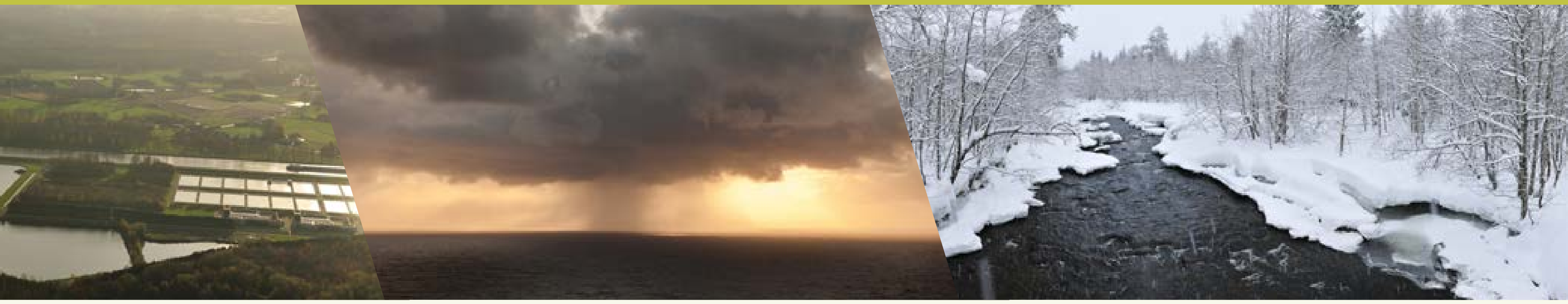
The largest consumers of fresh surface water are the shipping, energy and industrial sectors. Together they account for 90 percent of total consumption. Our economy and welfare are therefore particularly dependent on the amount of water that the ecosystem can produce.

But it is not just the quantity of water that matters: its quality must be good enough too. Every human being needs to be able to drink clean water every day. In addition, the entire ecosystem benefits from cleaner water: it increases biodiversity and enables all kinds of plants and animals to thrive. The contribution of natural purification here is huge.

How important is it in Flanders?

Although Flanders has relatively high precipitation totals, our region still suffers from water scarcity. Mainly due to our high population density, we have far less drinking water available per person than other countries of the Organisation for Economic Cooperation and Development (OECD). Sustainable water production is therefore doubly important for us: we must not exceed the supply of this ecosystem service.

This is why we need keep our water as clean as possible. In 2007, however, not one of the 202 water bodies in Flanders was found to be in 'good ecological condition'. This is mainly due to the excess nitrogen and phosphorus in the water, coming from Flemish households, factories and agricultural areas. Such nutrients are required for life in water, but can disrupt ecosystems at excessive concentrations. Moreover, the natural self-purifying action of rivers in Flanders has been diminished by numerous human interventions.



How does it relate to biodiversity?

A wide range of micro-organisms play a role in the purification of water. These organisms have specific requirements of their environment. Often, natural water purification takes place best in wetlands, in the transition between oxygen-rich and oxygen-poor conditions in the river bottom or sediment. However, many rivers have been straightened or lined with dikes, and as a result have lost their self-purifying capacity. By giving rivers more space again, we can restore biodiversity, and hence the ecosystem service of water purification.

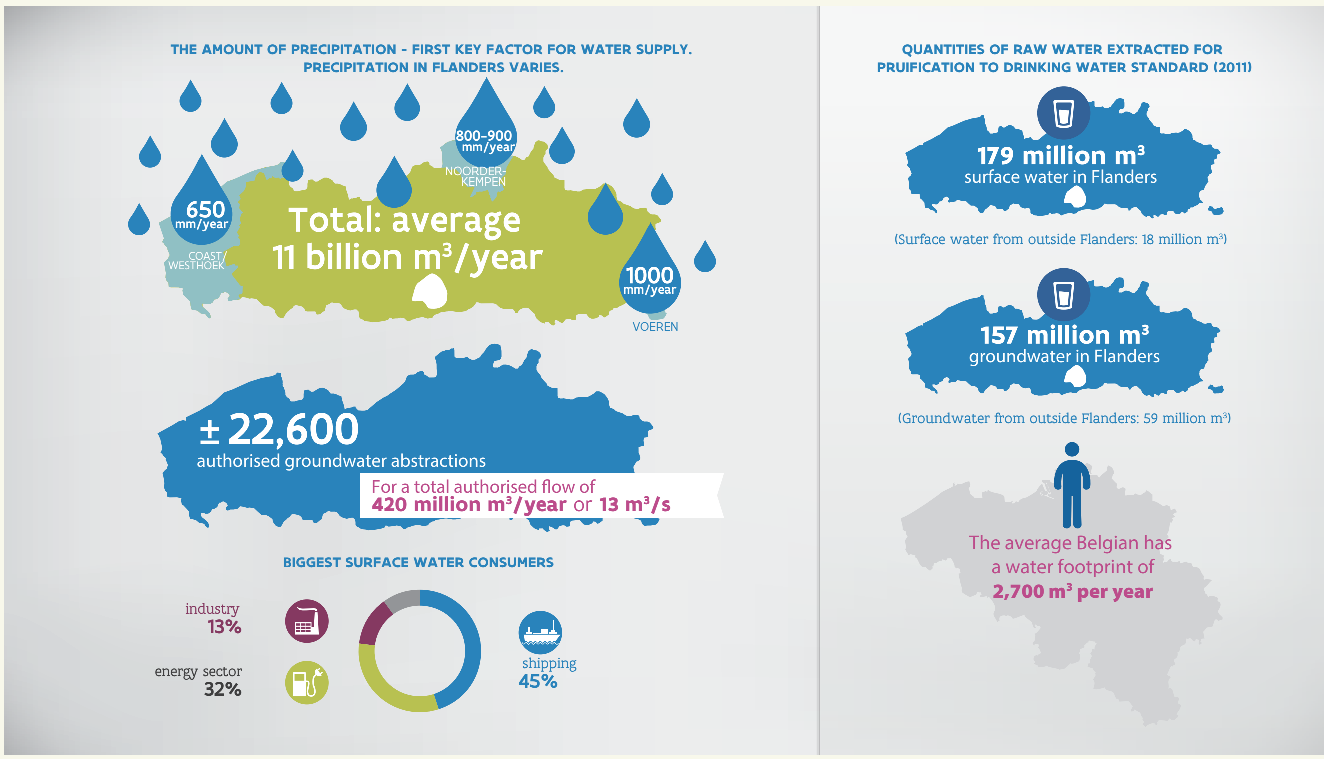
Water production or excessive input of polluted water also has an effect on biodiversity. Heavily drained grounds are no longer suitable for species that thrive well in wet areas.

Many of the habitat types for which Flanders makes an important contribution to the European Habitats and Birds Directives are particularly vulnerable to desiccation.

Interaction with other ecosystem services

The greatest value of this service is that it supports and enhances the provisioning ecosystem services. Thus good water quality supports the supply of water, wood, food and energy crops. In addition, clean water improves soil fertility and provides recreational opportunities. A sufficient supply of good quality water is essential for the functioning of the entire supporting ecosystem, and thus indirectly for all services.

Some figures from the Technical Report



Like to learn more about this subject? You can read all about it in Chapter 15 of the Technical Report.

Some ecosystems – particularly forests – purify the air by filtering out pollutants. In this way, they have a considerable impact on our health, as Flanders is one of the most polluted regions of Europe. Fine particulate matter is especially bad for our health and our quality of life. Ecosystems can make an important contribution to air purification, but the problem is most effectively tackled at source by reducing emissions of pollutants.

06

ECOSYSTEM SERVICES AND WELL-BEING

06. Ecosystem services and well-being

Ecosystems and species deliver our basic products such as food or water, and improve our environment, for example by pollinating crops, buffering noise or reducing erosion. All these ecosystem services have a big influence on our well-being. To benefit fully from ecosystem services, we need to focus on several policy areas at the same time. In addition to an ecosystem-based policy on forests, nature and agriculture, efforts in education, planning, health and well-being also help improve our use of ecosystem services.

6.1 Well-being in Flanders

We can talk about well-being at an individual and at a societal level:

- **individual well-being** depends on access to commodities such as food, housing and a safe environment, but also on physical and mental health, good social contacts and the possibility of self-development.
- **social well-being** depends on social justice, educational facilities, employment, security, mobility, freedom, social cohesion and environmental quality.

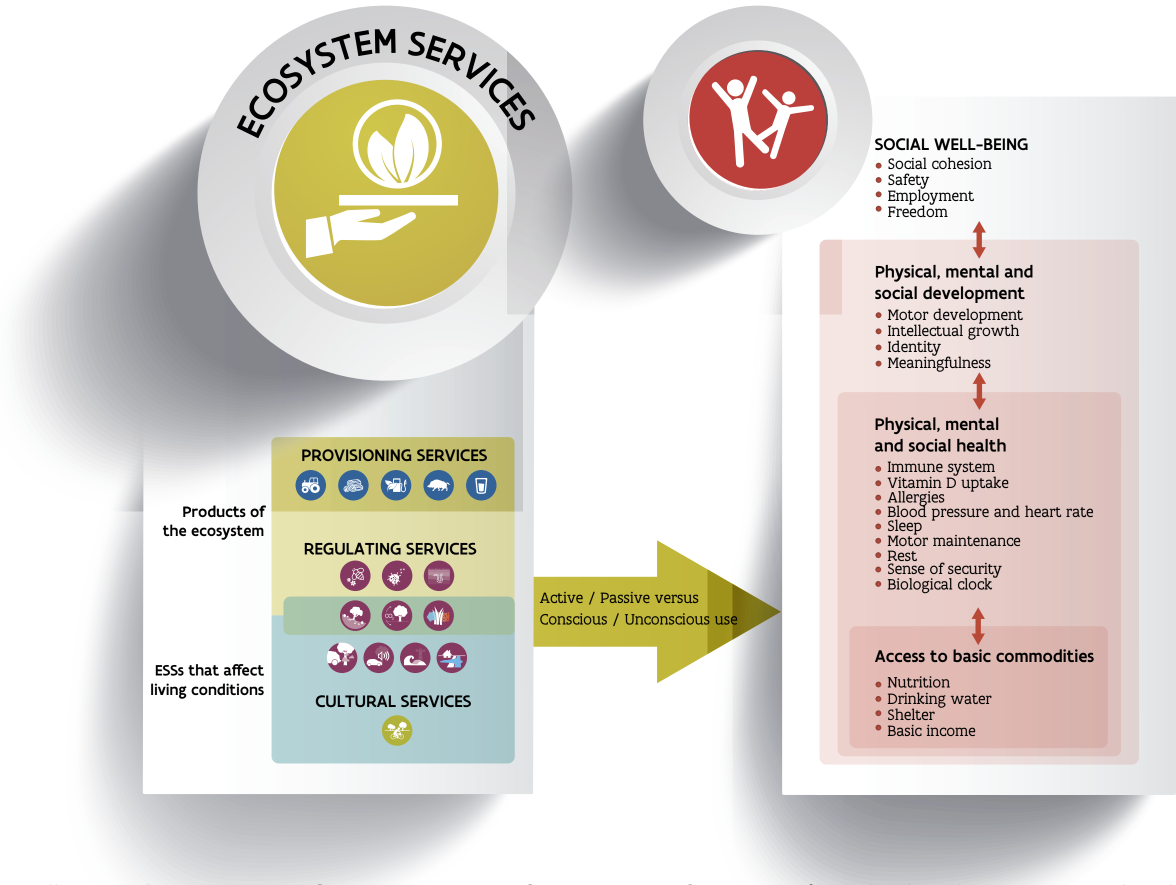
The two levels interact constantly, given that society is composed of many individuals.

Well-being in Flanders is evaluated every four to five years in the Belgian Health Survey of the Scientific Institute of Public Health. This survey assesses the participants' lifestyles, their socio-economic status and other factors that may affect their welfare. The 2013 survey shows that the main health problems faced by the Flemish (over the age of 15) are being overweight (48 percent), back problems (32 percent), sleep problems (29 percent), arthritis (17 percent), hypertension (15 percent), allergies (15 percent), depression (13 percent), neck problems (12 percent), and severe headaches (10 percent).

These factors work together. For instance, being overweight often leads to other health problems such as cardiovascular disease or diabetes. Fortunately, the impact of many ailments can be significantly reduced by adopting a healthier lifestyle. Many Flemish people suffer from back and neck problems because they sit still for too long (or with bad posture). Walking for at least half an hour a day would make a big difference, as it means that fewer stress hormones are produced as well as lowering the blood pressure. Furthermore, walking is good for mental health, as it provides a brief respite from daily cares.

Via provisioning services, ecosystems provide us in the first place with basic commodities such as food or timber. In addition, most regulating ecosystem services improve the quality of our environment, for example by regulating air quality and noise. Pollination, the maintenance of soil fertility and pest control all support the provisioning services. Three regulating services – the regulation of erosion risk, water quality and global climate – have a positive impact on our environment, but also support the provisioning services. Finally, space for outdoor activities is a cultural ecosystem service that is of crucial importance to our health and development.

FIGURE 14. THE INFLUENCE OF ECOSYSTEM SERVICES ON INDIVIDUAL AND SOCIAL WELFARE, DIVIDED INTO PROVISIONING, REGULATING AND CULTURAL SERVICES.



Below we illustrate the importance of ecosystem services for well-being with reference to two services: food production and space for outdoor activities.

6.1.1. Food production and well-being

Our diet at present consists largely of agricultural products. The production of these provides well-being at multiple levels.

Food production. Through their activities, farmers do not just earn a living: they also derive part of their way of life and identity from farming. Because of the health benefits of physical activity outdoors, Flanders also has more than seven hundred 'care farms', where the socially disadvantaged, ex-offenders or people suffering from burnout can perform meaningful work in a green setting and a safe, sociable community. Children with learning disabilities or autism also benefit from a stay at a care farm.

Food consumption. The three largest supermarket chains in Flanders have a market share of 70 percent. However, supermarkets cut the link between producer and consumer. Often, consumers are not really aware of where the products they buy come from, how fresh they are or how they were grown or produced. Some people are therefore turning back to food production on a small scale: farm products, farmers' markets, pick-your-own farms or growing their own vegetables. Those who grow their own vegetables usually have a fresher, healthier diet. They are involved in the seasonal process by which their food grows and are more aware of regulating ecosystem services such as pollination, water quality or soil fertility. Even a year later, children who had worked in a vegetable garden at school still took more notice of the origin and freshness of fruits and vegetables. Moreover, they were convinced of the benefits of a healthy diet.

Moreover, food performsa cultural and social function in our society, as is clear when one considers the importance of the daily family meal, or of traditional meals: birthday cakes, Christmas turkeys, Sunday lunch and so on. The slow-food movement arose as a reassertion of the emotional connection of the shared meal. Eating a meal together is seen as a shared pleasure and a symbol of hospitality towards one's neighbour. Slow food also seeks to preserve traditional foods and food production expertise from the pressures of globalisation and industrial food production.

6.1.2. Green space for outdoor activities and well-being

Effect on physical and mental health. Having an accessible green space in the neighbourhood encourages people to take exercise outdoors. This reduces the risk of cardiovascular disease, improves physical strength and enhances sleep. It can have a beneficial effect on allergies and asthma, as these disorders are sometimes the result of excessively hygienic living conditions and insufficient contact with nature. We also strengthen our immune system through regular outdoor exercise. Again, sunlight controls our biological clock and ensures that our body produces vitamin D. A walk in the woods, or even in a city park or on a green promenade, improves our mood and can reduce feelings of anxiety or anger. On days off, many people seek out nature in order to actively unwind. This need not necessarily involve exercise. Nature photographers, landscape painters and gardeners also experience the recreational effect of nature. This is particularly important at a time when many people are cut off from nature, and therefore miss out on its beneficial health effects.

Social bonds. Societies need a certain amount of cohesion. This originates in living environments where people can communicate with each other. Green areas are ideal for this. Moreover, having greenery in the vicinity appears to be a key factor in people's satisfaction with their local neighbourhood. Attractive-looking streets also encourage people to spend more time outdoors, where they can get to know each other and create a sense of community. Many people also feel less secure in a deserted street than in a street where people are coming and going a lot, as this deters criminals. People often derive part of their socio-cultural identity from the place where they live. More and more people are aware of the valuable landscapes that we have already lost, and that are coming under further pressure from increasing urbanisation.

6.2 Developing a response in different policy areas

Government policy on forestry, nature, agriculture and water mainly focuses on the supply of ecosystem services. An ecosystem-based policy in these areas is essential in order to take full advantage of the benefits of nature. We discuss this in Chapter 8. In order to benefit fully from ecosystem services, however, we must also make efforts in other sectors and policy areas.

For instance, **education** is a key area. Children who discover nature from an early age tend to be healthier later on and use green spaces more often. Every child should have this opportunity. For children who are unable to join a youth movement, especially one involving nature-related activities, school is the best place for coming into contact with nature, for example by means of green playgrounds or regular trips to nearby nature reserves or play forests.

The Agentschap voor Natuur en Bos (Agency for Nature and Forest) is currently carrying out the 'Speelgroen' ('Green play') project, which aims to give children the chance to play freely in private forests, public forests and nature reserves. By integrating this concept in spatial planning, we can bring outdoor play areas closer to children, making it possible for them and indeed encouraging them to use such areas every day. For adults too, careful **spatial planning** in the living environment and the presence of greenery affect patterns of movement and spontaneous socialising. Well-designed green street elements can even reduce crime in urban areas, reducing the risk of impulsive aggression from neighbours or passers-by. Policy should therefore make nature accessible to everyone, in order to promote social cohesion and social control.

The policy areas of **health** and **well-being** can also contribute more to the appreciation and better use of ecosystems. Time spent in a green environment still tends to be disregarded as a form of therapy. For Flanders, no data are available, but Dutch GPs rarely advise patients with psychological complaints to take daily exercise in a green setting. Yet this would have noticeable positive effects on both mental and physical health. As most patients consult their GP first, doctors are in a unique position to recommend spending more time in a natural setting. For this to happen, doctors need to be made more aware of the benefits, so that they can pass on the message to the public.

Like to learn more about this subject? You can read all about it in Chapter 7 of the Technical Report.

Air purification as an ecosystem service

As a result of emissions from industry, households, agriculture and transport, the air in many places in Flanders is polluted. Emissions outside Flanders also contribute significantly to the problem. Fine particulate matter is especially bad for our health and reduces our quality of life. Certain ecosystems – forests in particular – have a purifying effect, thus improving air quality.

What is it?

The ability of vegetation or landscape elements to filter fine particulate matter and pollutant gases (sulphur dioxide, ozone, nitrogen oxides) from the air. Ecosystems purify the air by causing the deposition of gases and particles on vegetation and the soil surface. In forests in particular, more pollutants are deposited than elsewhere. Conifers are efficient removers of particulate matter, while deciduous forests absorb gaseous substances more easily.

What are the benefits?

The air purifying effect of ecosystems can promote our health. All Flemish people whose health is vulnerable make use of this service, including asthmatics, children, the elderly and people who do heavy physical work or exercise in polluted air. In cities and in the suburbs, both population density and concentrations of fine particulate matter and nitrogen oxides are highest, and hence too the demand for air quality regulation.

Air pollution is most effectively addressed by means of technological measures at source: reducing emissions of pollutants is by far the most effective intervention. If that is not readily possible vegetation can remove a certain amount of pollutants from the atmosphere. The advantage of ecosystems is that they can capture different pollutants simultaneously.

How important is it in Flanders?

In terms of fine particulate matter, Flanders is among Europe's most polluted regions. Recent studies show that particulate matter in Flanders leads to the loss of 79,500 healthy, good-quality life years (DALYs) every year. That represents 13,000 DALYs per million inhabitants. Fine particulate matter thus accounts for about 70 percent of the total disease burden caused by environmental pollution.

How does it relate to biodiversity?

Due to their increased volume and leaf surface, trees capture two to sixteen times more particulate matter than low vegetation such as heathland or grassland. As well as its total biomass, the forest's composition also plays a role. A good mix of tree species ensures that multiple pollutants can be captured: a forest with high biodiversity has more variety of species, structures and natural processes, ensuring that the air is purified more efficiently.

Thus conifers are particularly good at removing fine particulate matter, while deciduous trees are better at absorbing gaseous pollution. The age of the forest also plays a role. Because of their greater biomass and richer structural variation, older forests are better at filtering air. The filtering effect of a forest can also be harmful to biodiversity. Excessive capture of nitrogen from the air can lead to nitrate leaching and acidification, entailing biodiversity loss, soil degradation and a decline in the quality of groundwater.

Interaction with other ecosystem services

Air that has been made cleaner by vegetation and greenery coexists well with other ecosystem services, such as green space for outdoor activities, climate regulation, timber production, pollination or water production. This synergy is less clear in urban areas, where landscape elements mainly contribute to green space for outdoor activities and a more pleasant environment. The filtering capacity of forests can be detrimental to soil fertility. This is the case when so much nitrogen is captured that the thresholds for acidification and eutrophication in the soil are exceeded.

Some figures from the Technical Report

Like to learn more about this subject? You can read all about it in Chapter 19 of the Technical Report.

A bird watcher out on a walk may value a forest in a very different way from a jogger taking the same path. Likewise, expressing ecosystem services in terms of economic value can be problematic. As a result, it is very difficult to arrive at a common valuation of ecosystem services, and hence at a widely supported policy based on sustainable delivery of those services.

07

VALUING ECOSYSTEM SERVICES

07. Valuing ecosystem services

In order to maximise the benefits we obtain as a society from nature, we need a policy that recognises the value of ecosystem services. This is only possible if those services are correctly valued. In some circumstances it makes sense to express ecosystem services in terms of financial value, for example in order to make their importance absolutely clear. But valuation is much more than just an economic approach. To take account of the benefits of nature as a whole, we must also appreciate their ecological and social importance.

7.1 What is valuation?

What value do we attach to nature and the ecosystem services it provides? We can make a distinction between nature itself, our perception of it and the meaning or value that we assign to that perception. The last of these things is what we call valuation: the process of analysing our perceptions, in which we weigh up each characteristic against a norm or standard and express the result in a particular unit.

The way we perceive the world around us is determined by a number of **perceptual filters**. Our senses, alone or assisted by technical aids, largely determine (and limit) our experience of our environment. The value we then assign to that perception is in turn coloured by **value filters**. For example, these determine whether we regard something as good, bad, beautiful or ugly. Such value filters are often the result of our personal development or preferences (although these are influenced by contextual factors). A bird watcher out on a walk may value a forest in a very different way from a jogger taking the same path. What one person sees as a grassland of botanical value may seem like a field of weeds to someone else.

7.2 What kinds of values are involved?

The relationships between humans and ecosystems are extremely complex, and it is therefore not easy to value biodiversity, ecosystems and the services they provide correctly. In addition, the value of ecosystems and biodiversity can be defined on the basis of a variety of ethical foundations. The different value types that we discern in the process are hard to compare and cannot be reduced to a single unit.

At present, there is no theory that encompasses all value types and that is used consistently in all scientific disciplines. The Nature Report uses a broadvalue typology that has been developed by an interdisciplinary team of philosophers, ecologists, economists and social scientists. It deals in detail with the relationship between man and nature. The typology also gives plenty of attention to values that enrich human well-being without involving consumption, and to the well-being of future generations:

- **intrinsic moral values** include the value of non-human living beings for their own sake, regardless of their importance or usefulness to humans.
- **fundamental values** represent the basic requirements for life on Earth. Man is absolutely dependent on the biosphere, which makes survival possible. These values include all ecosystem structures, processes and functions. These can increase or decrease under the influence of human activities.

- **eudaimonistic values** represent the conditions for a good and decent life. They relate mainly to the higher aspects of life, quality of life and shared socio-cultural values; examples include outdoor recreation, meaningfulness or the experience of aesthetic value.
- **instrumental values** serve as a means to achieve a goal. They are replaceable (possibly even in the short term) by alternative means. For instance, we can replace natural forests with special plantations where timber production is maximised. Economic value falls into this category.

What is crucial is that we should not use valuation methods as purely technical tools, but view them as value articulating institutions. The method we choose determines which values and whose values we take into account, and to what extent. It follows that the selection of a valuation method is not ethically or politically neutral; neither is the result of a valuation method.

Different fields of knowledge use selective concepts to make values apparent and open them up for discussion. An example is the cost-benefit analysis, which is used in environmental economic studies and primarily considers economic values. In political or social debate, it is always important to formulate the assumptions that have been made and the choices of such concepts clearly. In addition, there must be room for balanced coverage of a variety of different approaches.

7.3 Social valuation

If we want to determine the importance of ecosystems for individual and social well-being, social perceptions and interactions play an important role. Social valuation is about the interests, preferences, needs and requirements that people express where nature is concerned. It examines the social impact and social benefits associated with changes in ecosystems and their services.

7.3.1 Social valuation methods

In the social sciences, many methods exist of expressing social values: focus groups, qualitative interviews and so on. With social valuation methods, the importance of ecosystems is not reduced to a monetary value: instead, the stakeholders' perspective is expressed. This is done in the form of rankings, scores, priorities or time given up. Social values can also be plotted on a map. Such maps tell us where ecosystem services are provided, used and appreciated: information that can be used in the management of ecosystem services or in spatial planning.

The social valuation of ecosystems can give visibility to intangible or immeasurable services provided by nature. It can also help us gain a more complete picture of the different dimensions of well-being and the influence of ecosystem services. Multiple methods of social valuation are also integrated into one large, participatory process. This sometimes helps stakeholders to gain a better understanding of their own arguments and values, and those of others. As a result, a bond of trust is created, and stakeholders become more inclined to work together.

7.3.2 Advantages and disadvantages of social valuation

The difficulty of social valuation is that every stakeholder has its own views, values and interests, and may lose sight of the common interest. Another possible disadvantage is that researchers need a wide range of skills to apply the research methods properly. A well-designed valuation requires transparency, a representative sample, balanced and non-technical information and good moderation techniques, among other things. Moreover it takes a relatively long time, and due to lack of expertise stakeholders do not always succeed in valuing all ecosystem services accurately. For instance, carbon storage is undervalued yet essential as an ecosystem service. Expert input is therefore often indispensable.

7.4 Economic valuation

7.4.1 Total economic value

Economic market transactions mainly relate to the aspects of the environment and ecosystems that can be traded and for which we can set a price. As a result, the value of ecosystem services that cannot be marketed is insufficiently taken into account in the pricing mechanism. The importance of these services for consumers and producers is therefore understated. To make it possible to include this value more effectively in economic decisions, a broader economic value framework has been developed: total economic value (TEV). This also takes account of ecosystem services that are not usually valued by the market, such as clean air or the collective interest in an attractive landscape, when quantifying economic value. The TEV framework also includes 'non-use value', such as the notion that other people can enjoy the benefits of nature, and that species and ecosystems continue to survive. The 'nature value explorer', a web based valuation tool which was commissioned by the Flemish government, is designed according to this principle (www.natuurwaardeverkenner.be).

7.4.2 Economic valuation methods

To express the different economic value types in monetary terms, a range of valuation methods has been developed.

The first series of methods values ecosystem services that are traded on the market. Market prices provide an indication of how much money people are actually willing to pay for certain services:

- **market price-based methods** are mainly used to value provisioning services, such as food or timber production.
- **production function methods** stimate the contribution of an ecosystem service to other services or to products traded on the market. For instance, pollination or natural pest control make the harvesting of crops and tree felling for timber possible.
- **cost-based methods** estimate the costs that would be incurred if we had to replace an ecosystem service with an alternative, or if we had to repair the damage caused by the disappearance of an ecosystem service. We usually apply these methods to regulating ecosystem services. For example, they were used to value carbon storage in the soil and in biomass in an economic valuation study on the benefits of the Natura 2000 network in Flanders.

A second group of methods estimates the economic value of ecosystem services based on the observed behaviour of economic agents in related markets. For example, the **travel cost method** estimates how much money individuals spend in order to visit a nature reserve for recreation purposes. The **hedonic pricing method** analyses the value of environmental features in the demand for goods or services for which there is a market. Thus the market price of of a city property will generally be higher when there is also a pleasant park or accessible forest nearby, which indicates that this park or forest carries an economic value.

A third group of valuation methods is based on the expected behaviour of economic actors, on the grounds of preferences they express in surveys or interviews. In these, they play a kind of 'game' that simulates the market, and in which they are supposed to act as they would in a real situation. Usually, surveys relate to one or more scenarios that would cause a change to the landscape and the associated ecosystem services. The **contingent valuation method**, for example, uses questionnaires to ask people how much they would pay for a greater supply of a particular ecosystem service. **Choice modelling or choice experiments** give people various choices, in which the researcher varies characteristics of an ecosystem or ecosystem service, such as vegetation type, water quality or recreational possibilities. The results can be used to deduce how much people would be prepared to pay for certain ecosystems or services.

The **group valuation** method combines one of the two previous methods with a participatory process. The underlying idea is that valuation is in reality a social process that only comes about through interaction with others. This method is increasingly being used to identify common values that cannot be fully detected in individual surveys.

Finally, **benefit transfers** are not really a valuation method, but are confined to applying the results of valuation studies in other contexts. Usually, quantitative data about a particular area are combined with values that were calculated in previous studies on other areas. By multiplying an area (or a change in area) by the value per area unit, an estimate can be made of the benefits or welfare effects of a given area (or a given change of area). For example, this can be expressed in 'health benefits in euros per hectare'. More recently, value functions have been calculated, which allow more contextual factors (e.g. demographics, ecosystem types, socio-economic characteristics) to be taken into account when applying values from one study site to another.

7.4.3 Total and marginal value

It is important to remember that economic valuation methods do not allow us to quantify the total value of ecosystem services or of ecosystems, but only the value of relatively small increases or decreases therein. In other words, such valuation methods estimate **the marginal willingness to pay**. This is the willingness of people to pay for one additional 'unit' of an ecosystem service (or ecosystem). This willingness is thus a kind of exchange value, in which one good (such as money) is exchanged for another (such as a certain amount of clean water or forest). For example, we may seek to determine how much compensation people would want to receive for a limited decline in the ecosystem service of water production. The complete removal of all the water on earth, however, would result in an infinite loss of value, as water is necessary for life on earth. To determine the economic values of ecosystem services accurately, we need to know:

1. which ecosystem services are relevant to a particular choice or decision problem;
2. how changes in an ecosystem alter the supply of ecosystem services;
3. how much people would be willing to pay per extra unit of each ecosystem service (the marginal willingness to pay);
4. how changes in the ecosystem service supply affect this willingness to pay.

Ecological science has taught us much about non-linear changes in ecosystems and species populations. In 1992, overfishing off the east coast of Newfoundland (Canada) led to a collapse of the cod population. As a result, 40,000 people lost their jobs and the welfare and well-being of coastal communities were adversely affected. A complete stop was put to cod fishing, but more than fifteen years later, the population has still not recovered. This example shows that human interventions in nature can cause disproportionate or even irreversible effects. Ecologists therefore seek to establish 'minimum threshold values' and ceilings for 'sustainable use' in order to preserve the integrity of ecosystems. When critical ecological threshold values are exceeded (or are in danger of being exceeded), policy should be conducted on the basis of moral arguments and ecological capacity, as people's willingness to pay takes insufficient account of how damaging the (imminent) scarcity of a stock of natural capital would be, and of the associated ecosystem services, which may be vital. This is explained in Figure 15.

FIGURE 15. THE POSSIBILITY/IMPOSSIBILITY OF ECONOMIC VALUATION OF ECOSYSTEM SERVICES AND ITS DEPENDENCE ON THE AVAILABLE STOCK OF NATURAL CAPITAL (BASED ON JARLEY J., 2008. THE ROLE OF PRICES IN CONSERVING CRITICAL NATURAL CAPITAL, *CONSERVATION BIOLOGY*, 22(6):1399-1408)

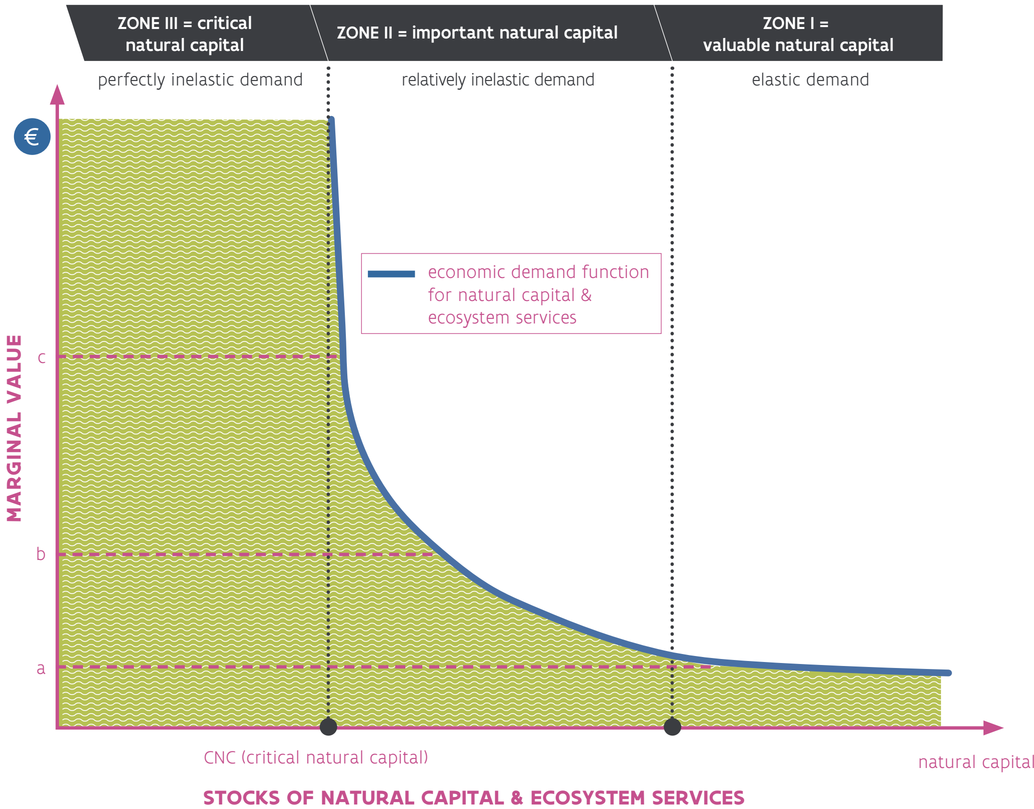


Figure 15 shows that the marginal change in the value of ecosystem services (Y-axis) is highly dependent on the available stock of natural capital (X-axis). The total value of the ecosystems is represented by the green shaded area under the blue demand curve. The further one moves to the left on the X-axis, the more natural resources are depleted. Their value therefore increases exponentially as natural capital is reduced to the point CNC. This is the stock of 'critical natural capital': the minimum amount of natural capital that we need to survive. Beyond this point, it becomes meaningless to continue assigning economic values to ecosystems and their services. At (a), small changes in the capital stock have only a limited impact on the marginal value of an ecosystem service. In Zone I it is therefore possible to determine what value people attach to an ecosystem service and how much they would be willing to pay for it. Of course we can only attempt to examine this if the four knowledge conditions mentioned earlier are satisfied. Yet small changes in natural capital can have significant consequences for society. At (b), the demand for natural capital is relatively inelastic, and therefore relatively insensitive to price increases. Even for significant price increases, consumers would be rather reluctant to give up the available capital stock, because the related ecosystem services are needed. In this zone, it is thus already very difficult to measure how much people would be willing to pay for an ecosystem service.

The critical natural capital is the minimum required to maintain the biosphere and its ecosystem services. Without a liveable climate, fresh air and plenty of food, all human activities are impossible. Above (c), the marginal value of ecosystem services is therefore infinitely high. Calculating economic exchange values in this zone is meaningless and yields no information that is relevant for policy-making purposes. However, it is relevant to determine what the most cost-effective investment is to restore the natural capital stock to above the critical minimum, i.e. further to the right on the X-axis. In circumstances where economic valuation is not meaningful, i.e. in Zones II and III, the valuation of economic benefits therefore does not offer a sound basis for a sustainable policy.

7.5 Does economic valuation lead to a more sustainable society?

As our stock of natural capital and ecosystem services diminishes, the welfare and well-being of future generations are endangered. It may be possible to reverse this trend by valuing ecosystem services economically and in this way giving them more weight in political and social decision-making.

At present, that weight is rather limited. In economic valuation, the distribution of welfare between present and future generations is determined by the discount rate. A discount rate is based on the assumption that we value immediate benefits more than future benefits. For example, the longer we have to wait for a sum of money we have given out on loan, the more interest we will charge and the lower the present value of this future cash flow will be. In economic cost-benefit analyses for Flemish environmental and nature policy, a discount rate of 4 percent is used for time periods of up to thirty years. A benefit of 100 euros which is only apparent or available after thirty years thus has a 'present value' of 31 euros. In other words, the current generation is only prepared to invest 31 euros in a welfare effect of 100 euros for the next generation. In such valuation studies, we valuethe consequences for the long term and the welfare of our children at less than one-third of the value of our own immediate welfare. At alternative discount rates of 3, 2 and 1 percent, the amount we would currently be prepared to invest would be 41, 55 and 74 euros respectively.

As this example shows, expressing ecosystem services in monetary terms raises important ethical questions and does not necessarily guarantee a fair distribution of natural capital between generations.

7.6 Using economic valuation in policy

How should policy-makers use knowledge of economic valuation? Some regard economic valuation as ethically objectionable: nature should not be protected for its actual or potential benefits for humans, but for its intrinsic worth. It is precisely for this reason that there is a broad consensus that economic valuation should be regarded more as an eye-opener, which we can use to make sectors other than environmental and nature conservation aware that the proper functioning of our society is dependent to a large degree on robust, resilient ecosystems.

Especially for small changes in ecosystems and their services, however, economic valuation is meaningful when alternative scenarios are being compared. It is important to take this valuation on board and take it into consideration in our political and consumer choices – not just for this generation but for the next generation too. If we assign less value to ecosystem services in our policy, the next generations will have fewer ecosystem services than the current, and hence less welfare and well-being.

The welfare and well-being effects of ecosystem services must not lie too far in the future however, as this would reduce the support – or the perceived need – for a policy based on ecosystem services. Nor should the critical thresholds be exceeded or even approached, as small changes can then have disproportionate, even irreversible consequences, which are so complex that we cannot predict them or make allowance for them.

Like to learn more about this subject? You can read all about it in Chapter 8 of the Technical Report.

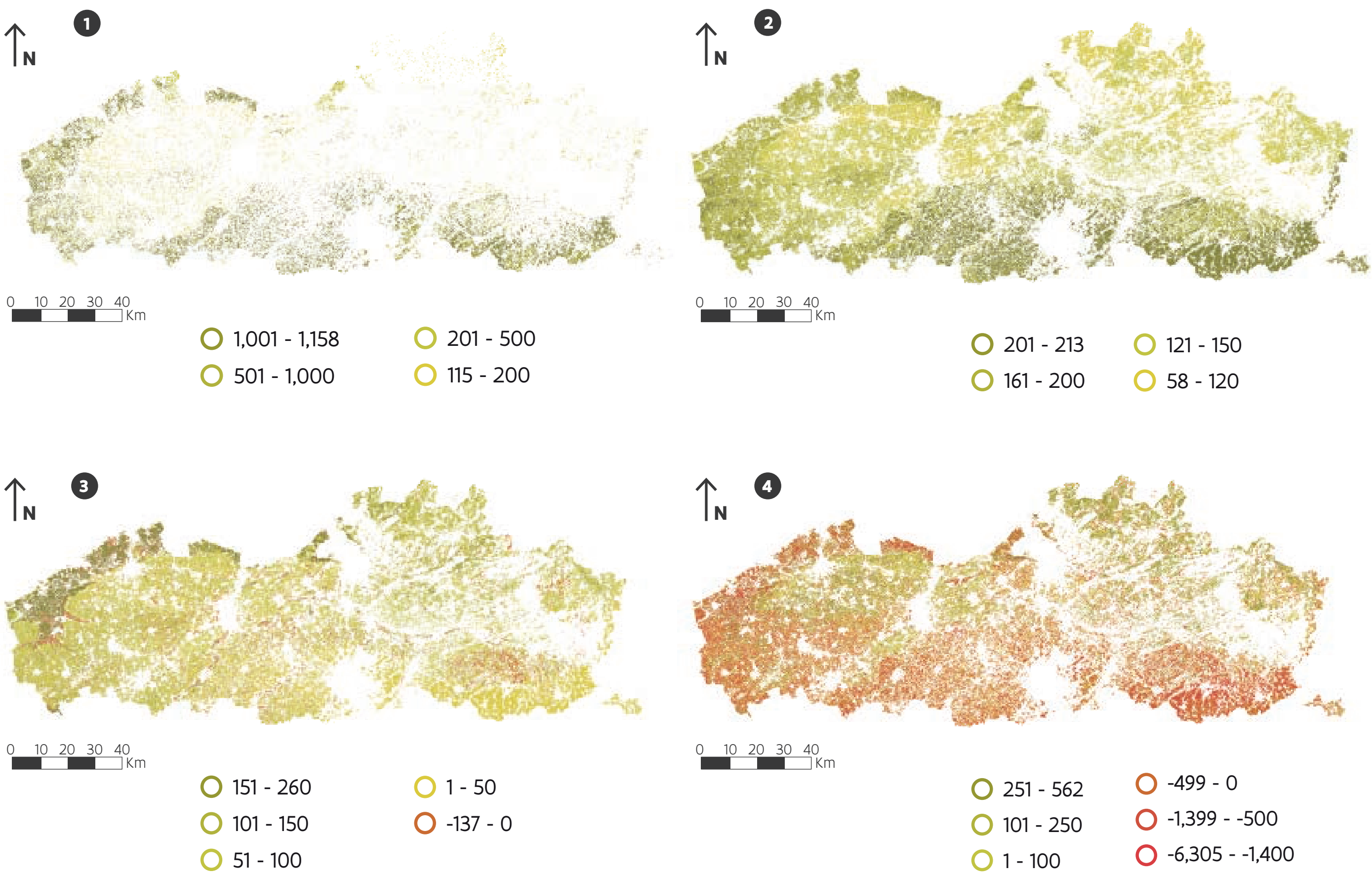
Investigating the economic value of non-marketed ecosystem services

If we took the economic value of non-marketed ecosystem services into account, land use and the landscape in Flanders might look somewhat different from what it is today. INBO investigated the benefits for agriculture and sustainable forest management of two marketed ecosystem services (food and wood production) and one non-marketed service (global climate regulation).

Below we compare the annual net economic benefits of the ecosystem service of food production in agricultural areas with the benefits of the ecosystem services of wood production and global climate regulation, if multifunctional forest management were applied at the same location.

The benefits and costs are presented in euros per hectare per year. The white areas on the maps are areas where farming does not occur, such as cities, forests and nature reserves. The Brussels Capital Region was not included in the case study.

FIGURE 16. (1) PRIVATE NET BENEFITS (IN €/HA/YR) FOR FARMERS FOR CROP CULTIVATION, WITHOUT SUBSIDIES; (2) BENEFITS OF INCREASED WOOD PRODUCTION (IN €/HA/YR) UNDER MULTIFUNCTIONAL FOREST MANAGEMENT INSTEAD OF FARMING; (3) BENEFITS OF CHANGE IN CARBON STORAGE IN SOIL AND BIOMASS (IN €/HA/YR) UNDER MULTIFUNCTIONAL FOREST MANAGEMENT INSTEAD OF FARMING AND (4) TOTAL NET BENEFIT (IN €/HA/YR) UNDER MULTIFUNCTIONAL FOREST MANAGEMENT INSTEAD OF FARMING.



The first map shows Flemish farmers' net operating income from crop-growing, disregarding subsidies received. Farmers cultivate a total of around 248,000 hectares of cropland (with potatoes, beet and cereals as the main crops). The highest incomes are in the clay and loam regions, which are well-suited for agriculture. Subsidies have been disregarded, as these are not an economic benefit of agricultural production, but a solidarity mechanism by which society redistributes its wealth via the government. Similar valuation maps have also been calculated for four different crop groups: maize, grass, vegetables and fruit.

The second map shows the economic value of wood production if sustainable, multifunctional forest management were practised on all farmland. By this we mean timber harvesting in accordance with the Flemish criteria for sustainable forest management, as defined in the management vision of the Agency for Nature and Forest. The highest benefits would be recorded in the clay region (such as Haspengouw and Flemish Brabant to the east and west of Brussels), and the lowest in the sandy region (including the Kempen region). Although the annual benefits from timber production are positive everywhere, they are significantly lower than the yield from field crops in the same place (expressed in euros per hectare per year). The current market conditions for Flemish farmers thus do not provide an economic or financial incentive to switch to sustainable, multifunctional forest management.

The third map shows the economic benefits of forest ecosystems compared with agricultural ecosystems for the ecosystem service of global climate regulation. The patterns are largely explained by the difference in carbon storage in the soil. The proportion of carbon storage in the aboveground biomass represents only a fraction of this. The map shows how a shift from agriculture to multifunctional forest management does not lead to higher carbon storage in all places. Annually ploughed fields capture relatively little soil carbon; by contrast, on permanent grasslands, where the soil is sometimes too wet for crop cultivation, carbon storage is very high.

In the West Flemish polders, sustainably managed forests instead of the current crop-growing would yield social benefits of up to 260 euros per hectare per year due to the additional carbon storage. In the wettest areas of the Ijzer Valley, conversely, such forests would lead to a reduction in carbon stocks, producing negative benefits of up to 140 euros per hectare per year. Afforestation is thus not equally useful everywhere as a mitigating measure against climate change, but is highly dependent on local ecosystem characteristics.

The fourth map shows the combined net benefits when the loss of food production (five crop groups) is deducted from the net benefits of increased timber production and the change in carbon storage. Even when only one non-marketed ecosystem service (climate regulation) is included in the valuation, it turns out that in some regions, multifunctional managed forests yield net social benefits – albeit modest ones – compared with current land use. Among other places, this is true in the Flemish sandy lowlands (e.g. parts of West and East Flanders between Bruges and Ghent), in the Antwerp Kempen region and in the north of Limburg. Here, converting farmland to multifunctional forest would thus not only be positive for conservation, but would also provide more social benefits. In these areas, it would be useful to examine the extent to which plots of land where afforestation has a high ecological value coincide with those where net social benefits can be realised. However, the existing market mechanisms give no incentive to private landowners to use the land differently: on the contrary, such a switch would represent an economic loss for them, as the market provides no reward for some of these benefits.

As indicated in Section 7.4.3, these values only apply to relatively small ('marginal') changes in land use. The figures therefore do not constitute an argument for converting farmland into forest on a massive scale in Flanders and making up for the lost food production with imports. However, they do indicate the locations where an emphasis on ecosystem services other than food production might have positive net social benefits, and where forest extension could be defended not only on ecological but also on socio-economic grounds.

Climate regulation as an ecosystem service

Considerable attention has been paid to global warming over the past decade. This process continues to occur around the world, and has negative effects on the human environment. Of course we need to reduce greenhouse gas emissions, but ecosystems too can absorb greenhouse gases from the atmosphere and thus combat climate change.

What is it?

The ability of an ecosystem to keep the climate stable. An important process here is the carbon cycle, in which plants take the greenhouse gas CO_2 from the air in order to grow; some of the carbon is then stored for a varying period in living or dead biomass. The amount of CO_2 an ecosystem can store depends on many factors, such as soil texture, the water cycle and vegetation. Some human interventions, such as tillage or the drainage of wet ecosystems, have a negative impact.

What are the benefits?

Ecosystems remove CO_2, the main greenhouse gas, from the atmosphere and can thus mitigate climate change. A more stable climate has many economic benefits for humans, including ecosystem services such as food or timber production.

But not all the benefits of a stable climate can be expressed in monetary terms. There are also environmental and social benefits. High biodiversity promotes carbon storage, both underground (organic material, roots and soil) and above ground (vegetation). Further, the stability of the soil and the water storage capacity of ecosystems increase as the carbon content in the soil rises. In this way, the resilience of ecosystems increases and they become more resistant to problems such as drought or disease.

How important is it in Flanders?

In Flanders, the carbon stock is the highest in wet, clay-rich soils. Forest and permanent grassland contain more carbon than farmland. More measurements are needed to determine the stock of carbon in peat, heathland, wetland and semi-natural grassland.

As a result of extensive urbanisation, a large amount of carbon is disappearing from the cycle, because when land is built on, the carbon-rich soil layer is dug up or covered over. The drainage of grasslands in order to increase the agricultural yield there has also decreased carbon stocks in Flanders.

Carbon storage in forest biomass may increase in the short term, due to higher CO_2 concentrations in the atmosphere and rising temperatures. However, the latter may also accelerate the decomposition of carbon in soils.

The capacity of soils in Flanders to store new carbon and thus help stabilise the global climate is relatively modest, but it is important to protect existing carbon-rich ecosystems. Furthermore, reducing our CO_2 emissions is an efficient way of combating climate change.

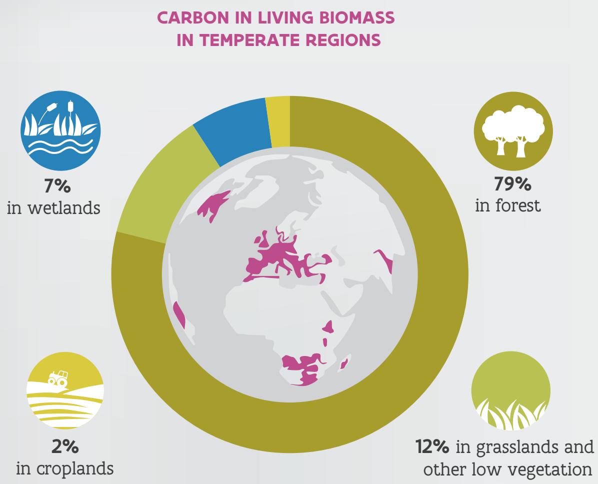
How does it relate to biodiversity?

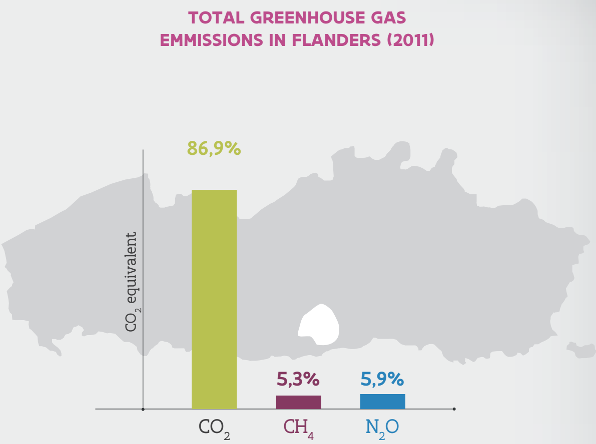
Higher biodiversity stimulates both underground soil life and above-ground vegetation, and hence too the storage of carbon. Forest and permanent grasslands store more carbon than farmland. Conversely, climate change threatens biodiversity on a global scale.

Interaction with other ecosystem services

There is a strong synergy between the ecosystem service of global climate regulation and other regulating, provisioning and cultural services. Climate regulation thus has a major impact on human well-being.

Some figures from the Technical Report





When forest, heathland or permanent grassland is converted to cropland, **20** to **40%** of the carbon stock is emitted into the atmosphere

The species composition of grassland affects the amount of carbon in the soil:
soils of species-rich grasslands store carbon **five times** faster than soils of monocultures (based on an experiment in the USA)

Like to learn more about this subject? You can read all about it in Chapter 24 of the Technical Report.

In recent years, nature, forestry, agricultural and water policy in Flanders has become more 'ecosystem service-oriented'. In the photograph, children are helping plant trees near the Kruibeke Polders, in a Sigma Plan project that combines flood protection with nature development.

08

A POLICY THAT TAKES ECOSYSTEM SERVICES INTO ACCOUNT

08. A policy that takes ecosystem services into account

Both we ourselves and future generations need to be able to receive the full benefits of ecosystems. We therefore need to move towards a policy that takes due account of the services they provide. Nature, forestry and water policy in Flanders has evolved in recent years towards such an 'ecosystem orientation'.

8.1 Sustainable management requires a policy oriented towards ecosystem services

Managing ecosystem services sustainably means maintaining or restoring the ecosystem and creating, preserving, restoring or optimising existing and/or desired ecosystem services. In this way, human needs can continue to be met, both now and in the future. To make such sustainable management possible, there is need for a policy that takes account of ecosystem services: an ecosystem service-oriented policy (ESS policy).

A policy can only be ecosystem service-oriented if it can take account of the importance of diversity. This diversity lies in first place in the ecosystem services themselves. Such services can rarely be brought under one umbrella, and their value too often lies in multiple areas. Conversely, ecosystem services can also be provided by different types of land use. Because ecosystem services interact with one another, ESS policy needs to optimise their supply and use. In doing so, it will take account of the diversity of social interests, of consequences which may occur a long way outside the region under consideration, and of the impact on future generations.

ESS policy can also reflect diversity in terms of processes. Such a policy can only take shape when actors from different policy levels and different sectors work together. It is also important for the interplay between the actors to take place throughout the policy cycle, using a variety of forms of participation and policy instruments. Policy processes must also take account of uncertainty and constant change. On the basis of monitoring and evaluating, the policy can be adjusted. Adjusting an ESS policy is a process that benefits from the shared knowledge and experience of ecosystem services of all actors.

In order to reflect this diversity of services, actors, levels and instruments, ESS policy benefits from a model of governance. The term 'governance' refers to the structures (or institutions) and processes by which we as a society take decisions and share our power and resources. Below we take a closer look at the characteristics and conditions of an ESS policy.

8.2 Characteristics of an ESS policy

An ESS policy has three fundamental characteristics. Such a policy:
- strives for robust ecosystems;
- recognises a wide diversity of scales (e.g. geographical, administrative and temporal);
- takes account of the interaction between the different scales and levels.

8.2.1 Working to create robust ecosystems

An ecosystem is robust if, despite changes and future uncertainty, it can continue to provide certain services for a certain group of users. Robust ecosystems are stable: they can deal with changes without their structures or functions being affected. They are also resilient, meaning that they can return to their original state relatively quickly after a disruption. Further, robust ecosystems have a high capacity for self-organisation or self-reorganisation. They are also good at building up and improving their ability to learn. Finally, robustness is about the distribution of ecosystem services between users. An ESS policy makes sure that the distribution of advantages and disadvantages is fair for all concerned.

8.2.2 Recognising the variety of scales and levels

In an ESS policy, we distinguish between a wide variety of dimensions or scales. In the first place, there is the **spatial or geographical scale** on which ecological processes take place. For instance, the breakdown of organic material takes place through complex cellular processes at local level, whereas climate regulation has a global dimension. The two processes are interconnected in that the decomposition of organic material emits CO_2, which contributes to global climate change.
The **temporal scale** is also important. Some processes take place over the short term, such as cellular metabolism, earthquakes and hurricanes. Other processes, such as soil formation, take place over the long term. Social phenomena, such as electoral shifts or changes in dominant economic or ecological paradigms and ideologies, also determine the temporal scale. The **administrative scale** has clear boundaries and organised political units and powers, with levels such as municipalities, provinces and countries.

8.2.3 Taking the interaction between scales and levels into account

Scales and levels interact with each other intensely. For instance, the administrative scale interacts with the geographical, and the municipal and provincial governmental levels also affect one another. How those interactions take place, and how strong they are, depends on internal and external factors. Thus, the decentralisation of policy may ensure that contacts between national and local governments become (temporarily at least) more intense, until power relations and responsibilities are clear. In the current policy, interactions between scales and levels are sometimes ignored. Among other outcomes this leads to short-term solutions that take their toll in the longer term, and ill-conceived local actions or individual choices that create large-scale problems. A policy oriented towards ecosystem services takes proper account of the interactions between scales and levels.

8.3 Requirements for an ESS policy

How can policy-makers successfully implement an ESS policy? Based on a literature review, we have defined a number of requirements. An ESS policy should score highly on the following points:

- an **integrated approach**, which acts on the different ecosystem services and drivers simultaneously and takes full account of the perception and valuation of those services;
- the **optimisation** of the desired ecosystem services, based on society's needs and with an eye to the long-term effects;
- the **landscape** as an important local spatial scale;
- the **precautionary principle** as the basis for decision-making, to prevent the natural capital stock from being reduced to below the critical natural capital;
- the alignment of **scales** (e.g. administrative and spatial);
- a variety of **forms of participation** used at different moments in the policy cycle;
- the number of **value types** taken into account;
- the imparting of **responsibility**;
- a **management approach** that aims to gain understanding and reduce uncertainty;
- the various social networks, institutions, organisations, laws and other bodies that make working and living together possible (**social capital**);
- the collective knowledge and experience provided by the various actors in relation to ecosystem service management and policy (**institutional memory**).

On the basis of these requirements, we have defined a set of nineteen indicators, used to 'measure' the ESS focus of policy.

8.4 Situation in Flanders

To what extent is nature, agriculture, forestry and water management policy in Flanders focused on ecosystem services? The Nature Report scrutinised the legal texts in these four policy areas and tested them against the set of indicators. The four policy areas are all moving towards a more ESS-oriented policy. Below, we discuss this assessment for water and forestry policy. Nature and agriculture policy are discussed in Chapter 10 of the Technical Report.

8.4.1 Flemish water policy

Water policy in Flanders has progressed considerably in recent decades. For a long time, the policy applied a strict distinction between the management of watercourses, the maintenance of water quality and the supply of drinking water. From the seventies and eighties onwards, the lack of coordination and clear legislation made change a necessity, and an region-specific and integrated search was launched for solutions.

- In **policy documents from the first period (1967-1971)**, no reference is made to ecosystem services. Each text focuses on a single function of the system: water supply and drainage in the 1967 law and wastewater treatment in the 1971 law. No attention is paid to optimising the other possible functions of watercourses. The texts are very monofunctional and the policy style is mainly one of command and control.
- The **Decree on Integrated Water Policy (2003)** represents a clear shift towards a more ecosystem service-oriented policy. The decree was issued in 2003 after criticism of the fragmentation of water policy, but also because it had been imposed by Europe. It led to the establishment of river basin committees on which civil society was represented as well as administrative bodies, and to a more regionally integrated water policy. Yet the mix of instruments in 2003 was still quite limited and the government retained a controlling role.
- **Water Policy Papers I and II (2005 and 2013)** set out a completed vision of integrated water policy. Cooperation between sectors and levels has become more important. Five guidelines are intended to improve the balance between the environmental, social and economic functions of water systems. In addition, the second paper explicitly refers to ecosystem services for the first time, and the government adopts a more facilitating role

8.4.2 Flemish forestry policy

Flemish forestry policy has evolved to a more ecosystem-oriented approach in recent decades. For a long time, forest management followed the Forest Code of 1854, which contained scarcely any elements of an ecosystem service-oriented policy. This changed in 1990, when policy focused on multifunctionality and created woodland owners' groups in order to establish contact between the many forest owners and Flemish policy-makers.

- The **Forest Code** was regarded as highly progressive in the nineteenth century, but focused almost exclusively on economic functions such as the production of timber, grazing and acorn harvesting. Overall, the Forest Code represented a dirigiste approach, with a strong emphasis on policing.
- The **Forest Decree of 1990** was a big step forward in terms of ecosystem service-oriented forestry policy. Multifunctionality, sustainability and the natural functioning of the ecosystem came to the fore.
- The **revised Forest Decree of 1999** pursued this approach further and introduced a number of important components of a policy focused on ecosystem services. The most important element is probably the forest groups, which create links between the government and the many forest owners.
- The **revised Forest Decree of 2014** mentions the term 'ecosystem services' for the first time, although only once in the context of the economic function. Overall, however, the focus on ecosystem services in this version of the decree is comparable with that in the previous revision. There would be room for further improvement if methods were used to weigh up the various values of ecosystem services against one another.

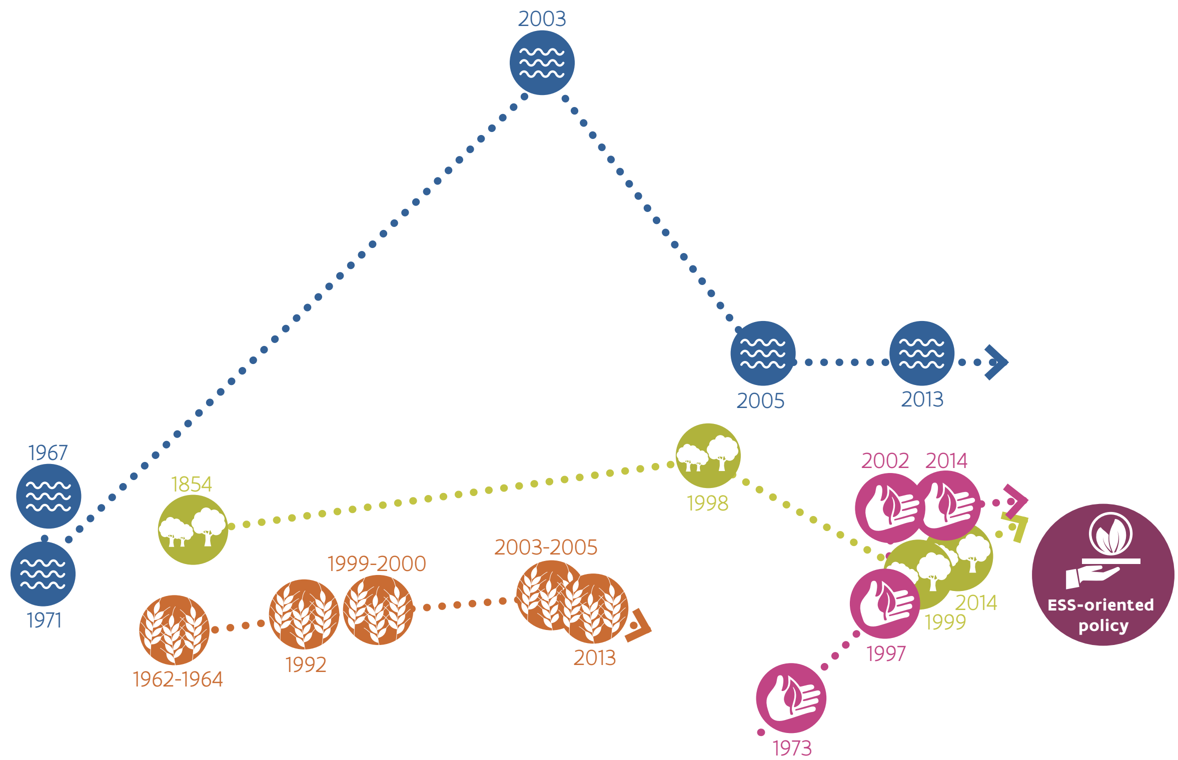


FIGURE 17. THE ESS FOCUS OF THE MAIN LEGISLATIVE TEXTS FOR FOUR FLEMISH POLICY AREAS: WATER, FORESTRY, NATURE AND AGRICULTURE. IN THIS FIGURE THE AXES HAVE NO MEANING. THEY ARE MERELY USED TO ORGANISE THE ITEMS IN TWO-DIMENSIONAL SPACE. THE DISTANCE BETWEEN THE POINTS AND THE REFERENCE TEXT ('ESS-ORIENTED POLICY') INDICATES THE TEXT'S ESS FOCUS. THE SHORTER THE DISTANCE, THE MORE ESS-ORIENTED THE TEXT IS. THE DISTANCE BETWEEN POINTS INDICATES THE EXTENT TO WHICH THEY SCORE COMPARABLY ON THE VARIOUS ESS INDICATORS. IF THE DISTANCE IS SMALL, THE LEGAL TEXTS HAVE A SIMILAR SCORE PATTERN. THE ARROW AT THE END OF EACH TREND LINE GIVES AN IDEA OF THE DIRECTION IN WHICH THE POLICY IS MOVING.

8.4.3 The ESS focus of four policy areas in Flanders compared

Figure 17 shows that all four policy areas are increasingly focusing on ecosystem services. In the Decree on Integrated Water Policy of 2005 and 2013, for example, it is clear that more aspects of an ecosystem service-oriented policy are included than in previous policy documents. These mainly relate to substantive policy changes, such as the emphasis on multifunctionality and the matching of scales. In process terms, for example with regard to participation, the policy has changed less. Forestry policy shows a similar trend.

Forestry policy and nature policy have the strongest ecosystem services focus of any policy area. Water policy also scores highly. Agricultural policy is the least focused on ecosystem services. This appraisal is not everything, and has its limitations. For instance, it is partly dependent on the assessor's estimates, although this subjectivity was kept under control by drawing up an assessment table, having the scores checked by the report's reviewers and fellow researchers, and finally by ensuring that the researchers concerned discussed their experiences together. In addition, the study was limited to the literal interpretation of the law. Further investigation of, among other things, case law and management practice, is needed in order to confirm the findings.

Like to learn more about this subject? You can read all about it in Chapter 10 of the Technical Report.

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ECOPLAN
Planning for Ecosystem Services

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