Official Norwegian Report NOU 2013: 10 Summary

Natural benefits – on the values of ecosystem services

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Report from an expert commission appointed by the Norwegian Government to the Ministry of the Environment on 29 August 2013.

Translation from Norwegian. For information only.

Foreword

Norwegian Official Reports (NOUs) are reports published by committees/commissions or working groups appointed by the Norwegian Government or by a ministry. NOUs contain recommendations to the Government concerning policies and measures, and they often form the basis for proposals that the Government submits to the Norwegian Parliament, the Storting. NOUs are often quoted and reproduced in Reports to the Storting and in other official documents.

In October 2011, the Norwegian Government appointed an expert Commission to assess and study the value of ecosystem services. The Commission was asked, among other things, to describe the consequences for society of the degradation of ecosystem services, to identify how relevant knowledge can best be communicated to decision-makers, and to make recommendations about how greater consideration can be given to ecosystem services in private and public decision-making. Stein Lier Hansen chaired the Commission. On 29 August 2013, the Commission submitted its recommendations to the Minister of the Environment in the form of a Norwegian Official Report entitled NOU 2013: 10 Natural benefits – on the values of ecosystem services *(Naturens goder – om verdier av økosystemtjenester)*.

In September 2013 the report was distributed for a broad public consultation among affected stakeholders, including the authorities, business and industry, academic communities and NGOs. After this consultation, the Government will consider how to follow up the work.

The Commission's summary and conclusions are presented in this document. Further information about the Commission's mandate and work is available here: *www.regjeringen.no/okosystemtjenester*.

Summary and recommendations

Background

Human beings depend on nature

The big and small ecosystems of the world deliver services on which we human beings depend, but that we do not always acknowledge or reflect on. Ecosystems form the basis for the production of food, medicines and many materials. They clean the air and water, store carbon, protect against floods, landslides, storms and erosion, and they provide us with opportunities for both spiritual and physical experiences. And, not least, if utilised and managed in a sustainable manner, they can continue to deliver these vital services for the foreseeable future.

The fact that human beings depend on nature is not a new insight. Nor is it a new phenomenon that we risk exhausting the basis for our own existence. The extent, intensity and pace of our impact on ecosystems, on the other hand, are relatively new. Both the rapid growth in the world's population and the technologies we have developed enable us to exploit and impact on ecosystems in a way that was not possible before.

Ecosystem services on the agenda

The concept of *ecosystem services* was put on the political agenda in 2005, when the UN presented its global ecosystem study *Millennium Ecosystem Assessment* (MA). More than 1,300 scientists were involved in the work on the study, which concluded that human activity has a clear and growing negative impact on the planet's biological diversity and ecosystems, and that the ecosystems' resilience and capacity have been reduced. The ecosystem services concept was adopted in order to highlight the fact that, in addition to having intrinsic value, nature contributes concrete services of direct and indirect benefit to human

well-being. One of the main findings of the MA was that 15 of the planet's 24 defined ecosystem services are in decline.

The Economics of Ecosystems and Biodiversity (TEEB) project is a follow-up to the MA. Among other things, it is inspired by the Stern Review, which shows the economic consequences of climate change and the economic arguments for climate policy. The TEEB project was intended to provide a corresponding description of the economic significance of biological diversity and ecosystem services, and the costs we incur by degrading the ecosystems and their ability to deliver these services. Like the MA, TEEB concludes that the exploitation of nature has now gone so far that the ecosystems' ability to deliver services has been reduced. There is a risk that the economic and social costs will grow at an increasing pace if we do not reduce our impact on the environment. People in poor countries are often directly dependent on nature, and they are often the people who are first and most directly affected when the weakened state of the ecosystems threaten their livelihoods.

Too cheap to consume nature

According to TEEB, our huge consumption of ecosystem services is largely due to the fact that the services appear to be free or cheap to utilise. The fact that natural capital is scarce, and that loss of nature comes at a cost, is therefore not taken into consideration when decisions about production and consumption are made. TEEB's main message is that the importance – and the scarcity – of ecosystem services must be made clear to everyone who utilises them. One pragmatic way of demonstrating this is to calculate the economic value of ecosystem services, when this is possible. Since we usually use and overexploit nature as part of our economic activities, it could make sense to also measure the costs of loss of nature in monetary terms. TEEB emphasises that laws, regulations, indirect taxes, subsidies and other framework conditions that public and private actors are subject to must reflect the scarcity and importance of the ecosystem services. National accounts and other overriding reporting systems must be developed to demonstrate the value of ecosystem services.

The Norwegian Expert Commission on Values of Ecosystem Services

The TEEB project was the immediate reason for the Norwegian Expert Commission on Values of Ecosystem Services being appointed in October 2011. In summary, the Commission's mandate was to assess:

- to what extent the concepts and conclusions from the TEEB project are relevant to Norway,
- the state and development of Norwegian ecosystems and ecosystem services,
- methods to demonstrate the importance of the ecosystems and ecosystem services,
- whether the framework conditions under which private and public decision-makers act adequately convey the importance and scarcity of ecosystems and ecosystem services.

The ecosystem services approach and its relevance to Norwegian environmental management

TEEB's approach has met with some criticism, particularly because of its clear focus on what nature means *to us*, and because of the importance it attaches to economic valuation. These are also the aspects of TEEB that the Commission has given most attention.

The ecosystem services approach helps to highlight nature's importance

Benefits of nature are often public goods that can be utilised for free. This gives each one of us little incentive to limit our use. Unlimited use can lead to overconsumption and to the degradation or total destruction of nature and the benefits of nature. Society must lay down rules to prevent important ecosystems from being degraded or lost. The ecosystem services approach and TEEB's contributions are characterised by their focus on what nature means to our economy and well-being. Nature not only has intrinsic value, but also contribu-

Box 1 Terms and classifications

The ecological and economic terms used in the report can be given several different definitions, and ecosystems and ecosystem services can be classified and grouped in different ways. The Commission has used the following definitions of the most important terms[1]:

Biological diversity: the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species (genetic diversity), between species and of ecosystems.

Ecosystem: a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit. In this report, we will discuss the following ecosystems: oceans, the coastal zone, freshwater, forests, wetlands, mountains, Arctic ecosystems and cultural landscapes, which is a collective term for open lowland and agricultural areas, as well as green areas in towns and built-up areas (urban ecosystems).

Ecosystem services: The direct and indirect contributions of ecosystems to human well-being. The term covers both physical goods and non-physical services provided to us by nature. The concept 'benefits of nature' is sometimes used as a synonym for ecosystem services. In this report, we use these four main categories: basic life processes (also called supporting services or ecosystem functions), regulating services, provisioning services, and experience and knowledge services (also called cultural services).

Natural capital: The stock of natural resources and ecosystems. If properly managed, natural capital can deliver ecosystem service flows in perpetuity.

Externalities: Costs or benefits resulting from production or consumption that are not credited or charged to those who cause them, and which they therefore do not necessarily take into account.

Public goods (common goods): Goods that are both non-rival and non-excludable, meaning that one person's use of the good will not reduce its availability to others, and that nobody can be prevented from using it. Many of the benefits of nature are non-rival as long as their total use is small, but become rival as their use increases. Clean air and a beautiful view are in principle examples of public goods.

[1] The terms 'ecosystem' and 'biological diversity' are defined in the same way as in the Convention on Biological Diversity (CBD), while 'ecosystem services' and 'natural capital' are defined in the same way as in the TEEB project.

tes many services that it would be extremely costly to lose. The Commission finds that this approach sheds light on an important aspect of our dependence on nature, and that it provides an important and relevant additional argument for taking care of nature. Greater awareness of what fundamental and irreplaceable goods nature actually contributes can result in improved environmental management and a better understanding of the need for such management. Nature values must be demonstrated, but not necessarily in terms of monetary value.

The ecosystem services approach focuses on ensuring that everyone who makes decisions that could affect nature is aware of the importance of ecosystem services. There is broad agreement both in research communities and in the public administration that it is important to highlight this importance, but opinions differ as regards how and to what extent economic valuation should be used. In our view, TEEB takes a nuanced and pragmatic view of economic valuation, namely that some ecosystem services can and should be valued in monetary terms, while others can at best be highlighted quantitatively. Many ecosystem services can best be described in qualitative terms. This assessment of valuation and highlighting is also in line with the Commission's assessments. The Norwegian Nature Index can serve as a starting point for a quantitative description of the biological diversity that forms the basis for the ecosystem services.

Values in nature must be communicated through policy instruments and framework conditions

TEEB's message – that the importance of ecosystem services must be communicated to private and public decision-makers by means of laws, regulations, direct and indirect taxes and other policy instruments in order ensure that it is taken into account – is important. In our view, TEEB adopts a broad perspective on how different instruments can contribute to achieving this, and on the fact that different countries will need different solutions. However, some critics have interpreted TEEB's focus on nature's delivery of ecosystem services and on economic valuation as arguments in favour of using market-based rather than legal instruments, and some warn that such an

approach will make nature a commercial commodity to a greater extent than today. The Commission finds, however, that concerns that nature might become a commodity are probably exaggerated, at least in relation to environmental management in Norway. Norwegian nature management is today dominated by legal instruments. As we will discuss in more detail below, it could be an option to introduce more economic policy instruments as a *supplement* to the current legal instruments, but this does not depend on whether ecosystem services are assigned a monetary value or highlighted in some other way.

The ecosystem services approach – a useful supplement

In summary, the ecosystem services approach can, in our opinion, be a useful supplement to Norway's environmental and resource management in order to show more clearly why protecting nature is important to our own well-being. TEEB's message that the importance of the benefits we receive from nature should be clear to decision-makers at all levels, and that the framework conditions should be designed to take account of the scarcity and value of these services, is self-evident and relevant to Norway. Norway already has a relatively extensive regulatory framework relating to impacts on ecosystems and the use of ecosystem services, and the topic of discussion in this report is therefore more whether the regulations are good enough, and, particularly, when and how the ecosystem services approach can help to improve management.

Challenges and limitations of the ecosystem services approach

The ecosystem services approach can be viewed as a supplement to ecological, ethical and social science arguments. The Norwegian Nature Diversity Act is based on nature being assigned fundamental values such as utility and use value, experience value, value in relation to sense of identity and belonging, ecological value and intrinsic value. In certain situations, values in nature can be strengthened by highlighting utility values in parallel with nature's intrinsic value, while, in

other situations, it will be more expedient to apply the two types of values separately. As in any other environmental and natural resource management, there are challenges relating to the ecosystem services approach. Ecological complexity, ethical considerations, conflicts of interest and short-term thinking are particularly relevant. There is a distinction between economic valuation aimed at demonstrating the values of nature and the facilitation of new markets for ecosystem services at the expense of legal instruments.

The ecosystem services approach must also be seen in a broader social and management context that takes account of Norwegian management traditions and environmental policy instruments, and that strengthens the basis for better cooperation between sectors and more coherent (ecosystem-based) management.

The state and development of Norwegian ecosystems

Adequate knowledge about the state of ecosystems condition and their ability to deliver services, and how human activities affect this ability, is a necessary precondition for good nature management. It has therefore been an important part of the Commission's mandate to obtain such an overview. The starting point for the review has been existing knowledge and statistics. No new studies or assessments have been carried out of Norwegian ecosystems or ecosystem services. A brief summary of our consideration of the state and development of the Norwegian ecosystems follows below. We also describe the most important impact factors. The review is inter alia based on the Norwegian Nature Index and red lists for endangered species and habitat types. The state of the ecosystems will determine what ecosystem services they can deliver and the quality of these services, and we provide some examples of important services.

Oceans and the coastal zone – important to fish and other seafood, biochemicals and genetic resources for new industries, and for nature experiences and recreational purposes etc.

The state of the Barents Sea and the Norwegian Sea is generally good, except for certain fish stocks and seabird populations, while the state of the North Sea and Skagerrak shows a clear negative impact from human activity. The state of coastal waters varies greatly, with reduced kelp forests and small stocks of coastal cod. The impact on the marine ecosystems is caused by economic activities in the areas in question, including fisheries, shipping and petroleum activities, and external influences, such as polluted water from rivers, long-range transport of air pollution and greenhouse gas emissions.

Greenhouse gases cause increasing sea temperature and ice melting, ocean acidification, species shifts and many other ecosystem changes. Climate change is already influencing certain key species and marine life, particularly in the Arctic and areas around Svalbard.

Harvesting has the greatest direct impact on fish and sea mammals, and it is important that fisheries take place within biologically justifiable limits. It is also important that resources are harvested carefully in order to avoid unnecessary harm to ecosystems. Among other things, it is important to avoid damage to coral reefs and other vulnerable seabed areas from bottom trawling.

Changes in land use are the most important threat factor in the coastal zone. Such changes can include building on these areas, land reclamation and the transformation of nature areas for other purposes. This affects the coastal ecosystems in various ways, not least important spawning and rearing grounds for coastal fish stocks and the coastal landscape that is important for recreational purposes and nature experiences.

Aquaculture in coastal areas has negative environmental consequences in the form of pollution, wild fish being infected with salmon lice and other diseases, and escaped farmed salmon mixing with wild salmon populations. Pollution affects the marine ecosystems, e.g. through over-fertilisation of the coastal zone and input of environmen-

tal toxins and littering, and it is important to continue national and international efforts to reduce discharges.

The different impact factors often interact. For example, the kelp forests along the coast of Norway are negatively affected both by the increase in sea temperature and by over-fertilisation and siltation. The introduction and spread of invasive organisms have increased significantly in recent decades, and continued follow-up is important.

Freshwater – important for drinking water, flood control and recreational purposes etc.

The most important threats to the ecosystems in rivers and lakes are agricultural run-off, fish farming, municipal sewage systems and industry, physical encroachments and changes in land use or water flow, and the introduction and spread of invasive organisms. About one third of the total lake area has been affected by hydropower developments. The establishment of new hydropower installations, particularly small hydroelectric power plants, has increased significantly in recent years. The cumulative development can have a significant impact on biological diversity and the landscape, and this will have consequences for fish, outdoor recreation, nature experiences etc. Encroachments in the form of roads, drainage and land reclamation represent a particular threat to small bodies of water.

The level of acidification of freshwater still exceeds the tolerance limits in 10 % of Norway's land area, although the acidification situation has improved over the past 10 to 15 years. Pollution resulting from the input of nutrient salts (over-fertilisation) remains considerable, particularly in densely populated areas and in areas with intensive agriculture. This allows algae to flourish, which has negative effects on drinking water, bodies of water used for swimming and people's well-being, among other things.

Wetlands – important for flood control, carbon storage and nature experiences etc.

Changes in land use have had a significant impact on Norwegian wetlands. At least one third of the original marshlands below the tree line is currently being used for agricultural and development purposes. Marshland has been drained by means of ditches in order to increase agricultural areas and forestry production from the mid-18th century until the turn of the millennium. This has increased food and timber production, which was the goal of Norway's policy, but it has also reduced biological diversity.

Wetlands have also shrunk as these areas have been utilised for roads, sports grounds, building land and hydropower development. As a result of climate change and a decrease in grazing, wetlands are also becoming increasingly overgrown. Many drained marshes do not retain water as they would have done in their natural state. The water thus reaches the rivers more quickly, and the water level in the rivers rises more rapidly than it would otherwise have done, which increases the risk of floods. Building on wetlands also reduces carbon storage and results in a loss of habitats for waders and migratory birds.

Forests – important for timber, bioenergy, biochemicals, carbon storage, water purification and outdoor recreation etc.

Forest management by stands, which involves clear felling, nursery grounds and forest roads, is to a large extent shaping the Norwegian forest landscape of today. Some high-lying forest areas have large areas of cabins and alpine skiing facilities, while the traces of former summer pasture farms between the forests and mountains have been erased in many places. In many lowland areas around towns and built-up areas, new residential and industrial areas have replaced forests.

Forestry influences biological diversity and the forest landscape in many ways, and it is important to continue efforts to find out how to reduce the negative impact and how to preserve more ecosystem services and safeguard user interests. It is particularly important to adopt a critical perspective on the use of alien species of trees in forestry, as

this could affect e.g. biological diversity, ecological functions and the forest ecosystem's productivity over time. Encroachments on forest areas by building forest road split up the forests and can be a problem in relation to e.g. biological diversity and the feeling of wilderness, but will be positive for forestry and for some of the people who use the forest for recreational purposes.

Climate change in the form of higher temperatures and precipitation will influence the species distribution in the forest landscape and can affect the forests' productivity, both directly and indirectly via pathogenic organisms on trees and other organisms. Climate change can, for example, cause changes in the frequency and location of insect infestations, with considerable potential consequences for trees and other species.

Mountains – important for nature experiences, outdoor pursuits and grazing etc.

In recent decades, mountain areas have been subjected to various physical encroachments and increased levels of activity, including hydropower and wind power development, power lines, roads and cabins. This affects both the biological diversity and the mountain landscape, and thus also the mountains' importance for outdoor recreation and nature experiences. An increase in motorised transport is also changing many mountain areas' qualities as travel and tourism destinations, and it also has an impact on the flora and fauna.

Climate change is making the climate milder and increasing the length of the growing season. This means that the tree line will move upwards, which could have a major impact on species adapted to a mountain environment, and could cause changes in the food web. Climate change also reinforces the regrowth process.

The number of holiday homes has risen sharply in recent years in mountain areas within three or four hours' travel from the big towns and cities, and in many areas, there have been conflicts and problems striking a balance between nature and outdoor recreation interests, on the one hand, and development interests and motorised transport in nature, on the other.

Arctic ecosystems – important for fish and seafood, biochemicals, genetic resources and nature-based tourism etc.

The greatest threats to biological diversity and many ecosystem services in Arctic ocean and coastal areas are climate change and ocean acidification. The wetlands on Svalbard are also vulnerable to climate change. Long-range transport of environmental toxins remains a significant challenge to the species at the top of the marine food chains in the Arctic.

The impact of fisheries could increase in step with commercial species of fish moving further north, for example into Svalbard's coastal waters. Svalbard's coastal waters are becoming increasingly accessible due to the reduction in sea ice, and cruise activity is increasing.

The decrease in sea ice also results in more activity and more possibilities for developing and exploiting the Arctic, not least in petroleum activities, shipping, fisheries and mining. This could affect biological diversity, ecological functions and biological resources in a variety of ways, particularly through pollution (including acute discharges) and encroachments both on land and at sea.

Open lowland and agricultural areas (cultural landscape) – important for food, grazing, soil, natural heritage and local identity etc.

The agricultural landscape has undergone major changes as a result of rural depopulation, farm closures, increased earning demands, new agricultural methods and the discontinuation of traditional management. This affects the landscape as well as biological diversity. The varied, area-intensive agriculture based on outlying fields has been replaced by more specialised and intensive farming using a smaller area, and former agricultural areas are becoming overgrown since they are no longer used. Extensive overgrowing is changing the landscape. Harmful invasive organisms and pollution are also affecting agricultural areas and could threaten both biological diversity and agricultural production. Different types of farming can help to maintain biological diversity in the agricultural cultural landscape.

Building on agricultural land due to the increased area needs of growing towns and transport networks is an important factor in the impact on the agricultural landscape.

Green areas in towns and built-up areas (urban ecosystems) – important for flood control, recreational purposes and well-being etc.

An increasing proportion of the world's, and Norway's, population lives in towns and built-up areas. This causes intense pressure on green areas nearby. Growing urbanisation and centralisation make it extremely important to ensure that urban open spaces and outdoor areas are of a high environmental quality, among other things by preserving green structures, outdoor recreation areas near residential areas, rivers and streams and other nature areas in and around towns and built-up areas. The amount, composition and quality of green areas are all important for recreation and for people's physical and mental health and quality of life. Many areas also contain biological diversity and various environmental and cultural qualities.

Many Norwegian towns and built-up areas are located on the coast or near rivers, which makes them vulnerable to climate change effects such as floods, surface water overflow and landslides. This involves a risk to life and material assets, and it is important to investigate in more detail whether and how natural and adapted ecosystems can be used in climate adaptation. This could entail more active use of natural watercourses and green structures in towns and built-up areas.

A relatively good state – a great need for research

In summary, in the Commission's opinion, the state of Norwegian ecosystems is relatively good, but Norway's biological diversity and Norwegian ecosystems are also under pressure from many directions. Land use and land use change as a result of building on these areas, rezoning and splitting up of areas are probably the most important negative impact factors. The areas without major infrastructure development in Norway (INON) are shrinking: Norway lost more than 1,000 square kilometres of areas without major infrastructure

during the period from 2003 to 2008.[1] Climate change and ocean acidification, pollution, environmental toxins and invasive species are also factors that influence this development, along with the lack of cultural landscape management. This also puts more pressure on the ecosystems' ability to deliver ecosystem services.

The review has also identified major gaps in our knowledge and a great need for research and knowledge development.

The Commission's recommendations from Chapter 4 The state and development of Norwegian ecosystems

- The monitoring of Norwegian ecosystems, populations and species should be strengthened in order to make it possible to identify changes in the ecosystems and to ensure a better scientific basis for assessing developments and possible measures. Establishing monitoring of ecosystems that are currently not being monitored is particularly important. The Commission would particularly like to point to the following monitoring needs:
  - Good time series are important, and monitoring schemes that can provide such time series should be ensured and continued where relevant.
  - The coastal zone, open lowlands and wetlands ecosystems are deemed to have the most inadequate monitoring systems. The monitoring of biological diversity in the ocean environment is also insufficient in relation to the volume and extent of the ocean areas.
  - In general, the monitoring of basic life processes and species that are not currently harvested is inadequate and should be strengthened.
  - It is important to monitor ecological infrastructure, i.e. the connections between (valuable) habitats in different ecosystems.

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[1] All areas at least one kilometre away from the nearest major infrastructure development, see www.miljodirektoratet.no/inon/. A new survey of the state of INON areas will be conducted in 2013.

  - National monitoring of land use and land use change is not sufficiently developed. This is the most important factor affecting land ecosystems in Norway, and it is also where we find the greatest challenges related to striking a balance between different ecosystem services.
- Our knowledge of Norwegian ecosystems should be improved. We see a particular need for more knowledge about the following:
  - Marine ecosystems, particularly knowledge about ecosystem connections (including lower trophic levels).
  - Soil, and the importance of biological processes in soil as basic life processes.
  - Arctic ecosystems, where the effects of climate change, ocean acidification and environmental toxins will be particularly important.
  - Ecosystems in open lowlands and the importance of landscape management to maintaining biological diversity as a basis for ecosystem services.
  - The overall impact of land use and land use change, climate change, invasive organisms, pollution, over-exploitation and other human activities on species, populations and ecosystems.
  - The survival and dynamics of small fragmented (and isolated) populations and the need for ecological infrastructure.
  - The importance of biological diversity to maintaining ecosystem functions over time.
  - How climate change will alter the conditions for natural diversity and ecosystem services, and the ecosystems' importance to climate adaptation.
  - The effects on ecosystems of possible climate measures, including bioenergy and forestry measures and various forms of *geoengineering*.[2]
- Knowledge about the importance of key drivers, impact factors (particularly land use change) and developments in different sec-

[2] Techniques used to manipulate the Earth's climate system, often by removing greenhouse gases from the atmosphere or by preventing the Earth from absorbing solar radiation.

tors should be improved. Relevant topics include the impact on ecosystems of the transport sector, energy sector, population growth and development pressure in and around big towns and cities.
- Analyses of fundamental drivers behind key factors impacting on Norwegian ecosystems are important, among other things in order to improve our understanding of underlying conditions. This also includes improving our understanding of the relationships between goals, measures and policy instruments and how different players react to different policy instruments.
- More insight is needed into knowledge based on experience of ecosystems.

The Commission's recommendations from Chapter 5 Status and trends in Norwegian ecosystem services

- Knowledge about biological diversity and ecosystem services in Norway must be improved, and a special research programme should be established to look into biological diversity, ecosystem functions and ecosystem services and connections between them. Some research should be interdisciplinary to enable work on how to better integrate considerations of biological diversity and ecosystem services in decision-making processes. We see a particular need for more knowledge about the following:
  - The quantitative scope of primary production and what natural and anthropogenic factors affect it.
  - The importance of the state of ecosystems and biological diversity in relation to maintaining the ecosystem functions (basic life processes) and the importance of this to the production of ecosystem services.
  - Ecosystem services that are particularly important to human well-being and economic development, e.g. for ecologically sustainable food production, raw materials and fibres, and genetic resources and various regulating services.
  - Ecosystem services that are particularly important to human well-being and public health, including recreation, nature-based

tourism, nature experiences, local identity and natural heritage, and related distributive effects (such as accessibility).
    - Ecosystem services that are particularly important to climate regulation, including their importance to the albedo effect, carbon absorption and storage in natural systems on land and water, and boreal forests and other natural and semi-natural ecosystems' function in the absorption or emission of greenhouse gases.
    - Ecosystem services that are particularly important to climate change adaptation and public safety, including the importance of different ecosystems in an overall perspective when the climate changes. This includes the ecosystem services water flow regulation (incl. flood control and surface water management), erosion protection, natural disaster prevention, pest control and biological control.
    - Habitats and ecosystems' robustness and flexibility in relation to changes and impacts, and how the different elements in an ecosystem interact.
    - Possibilities for and limitations on exercising environmental control in this area.
- More insight is needed concerning local experience-based knowledge about ecosystem services.
- The mapping of ecosystem services in Norway must be improved in order to provide a better basis for knowledge-based management, including weighing the use of ecosystem services against each other. This will require systematic monitoring of the development of key ecosystem services.
- Large-scale Norwegian assessments and studies of ecosystems, ecosystem services and their importance, modelled on the UK National Ecosystem Assessment (UK NEA[3]), should be conducted, preferably for the country as a whole, or, alternatively, for selected regions and/or selected ecosystems. Such studies should include analyses of selected drivers, impact factors and connections that

[3] A description of and link to the analysis are available here: http://uknea.unep-wcmc.org/

affect ecosystem services and the population's well-being. Examples of topics include ecologically sustainable food production (both from the sea and from agriculture), climate change adaptation, water-related services, nature-based tourism and health aspects of outdoor recreation.

- There is a need to increase capacity and to develop institutions that are capable of broadening our understanding of the interaction between human beings, nature and society, and providing fundamental knowledge about the connection between biological diversity, ecosystem functions (basic life processes) and important ecosystem services. In order to achieve this, an interdisciplinary research community should be established that covers the above-mentioned topics as well as economics and social sciences. The Stockholm Resilience Centre[4] in Sweden is one example of such an interdisciplinary research centre.

The Commission's recommendations from Chapter 6 Norway and ecosystems in other countries

- It is important that we understand and have relevant knowledge about the effects of our participation in a globalised world. However, the effects of Norway's interaction with other countries can be diffuse and difficult to identify, and our knowledge is incomplete. We recommend that the effects of Norwegian economic activities on ecosystems in other countries should be studied.
- Norwegian development assistance can to a greater extent be used to improve environmental management expertise and ecosystem management capacity in developing countries.

4 http://www.stockholmresilience.org/

Demonstrating values to improve management

Demonstrating by means of economic valuation

We concluded earlier that the state of Norwegian ecosystems is relatively good. However, Norwegian ecosystems are also under constant pressure, and the impact factors are direct and indirect effects of production, consumption and other economic activities. TEEB explains the degradation of the world's ecosystems by stating that their contributions to our well-being and economy are ignored in a system where price signals are the primary basis for decisions. Degrading nature is free for the individual, but comes at a cost that must be paid by the public at large and/or by future generations. Demonstrating the economic value of the benefits of nature can open our eyes to the contributions nature actually makes and highlight the importance of well-functioning ecosystems. In principle, measuring more things in monetary terms will also enable us to make more informed decisions when weighing ecosystem services against each other, or when weighing ecosystem services against other benefits.

The advantages of economic valuation are emphasised in connection with socio-economic analyses in particular, and in demonstrating a country's actual natural capital and how it is used and, possibly, changed.

Pursuant to the Norwegian government's Instructions for Official Studies and Reports, socio-economic analyses must be carried out for all major public projects such as roads, energy projects, hospitals etc. in order to obtain an overview of all effects of the project. If all the effects can be measured using the same unit of measurement, for example money, it will, in principle, be possible to sum up the positive effects and compare them with the negative ones. Such a calculation could provide decision support when deciding whether the project should be realised or not, or, alternatively, which project alternative to choose (e.g. which route to choose for roads). One of the most important arguments in favour of using economic valuation of effects on nature and the environment in socio-economic analyses is that the effects would otherwise be less clear, given that other cost-benefit components are measured in money.

A similar case can be made for developing national accounts. If natural capital, and the flow of services we derive from it (i.e. the ecosystem services), were incorporated into the national accounts, that would show the often close connections between economy and nature. That would give us an overview of which sectors and activities depend on which ecosystem services, and how the use of ecosystem services affects the stock and value of natural capital. It would show how political decisions affect nature, both directly and indirectly, by influencing production, consumption, investments and other activities. Under the current national accounts system, which only includes natural capital traded in actual markets (timber, petroleum, hydropower etc.), we run the risk of depleting and degrading the remaining natural capital without this appearing in any accounts.

Challenges relating to economic valuation

The practical, methodological and theoretical challenges relating to economic valuation are considerable, however. Our review shows that only a relatively small number of studies have been carried out that have valued ecosystem services in Norway in monetary terms. The number of studies and the level of knowledge about economic values vary between ecosystems, but for most of the known and used economic valuation methods, we have only a few examples of use. Several of the studies have also contributed to research and methodology development. It is our assessment that new studies should focus on how economic valuation can help to improve ecosystem management.

Because most of the economic valuation studies were carried out as case studies in limited areas, it is difficult to draw conclusions about the actual economic importance of ecosystems and ecosystem services in the national context. The Commission has therefore not attempted to make such estimates.

Basic life processes – demonstrating values in quantitative and qualitative terms most important

There are many matters of principle to be considered in relation to economic valuation of the benefits of nature and the use of such estimates. We have discussed these challenges in some detail in the report, and will limit ourselves here to pointing out that some processes in nature are so fundamental to life on Earth that it would be virtually meaningless in most management contexts to estimate their economic value. In our opinion, economic valuation must be used when it can contribute to better and more informed decision-making, and, in many contexts, qualitative and/or quantitative descriptions will give decision-makers better and more relevant information.

Regardless of the area of application, we believe that the assessment of ecosystems and ecosystem services, and the changes to them, should always start with a qualitative and preferably also a quantitative description.

Economic valuation as a supplement to quantitative and qualitative considerations

That being said, we would like to emphasise that some services are *also* well suited to economic valuation. In our opinion, more estimates should be provided on the economic value of ecosystems and ecosystem services than are available at present. We would like to point in particular to services with a direct effect on human well-being and the economy, such as water purification and flood control. Experience and knowledge services, such as outdoor recreation, are another example. Mountains, forests, coastal areas, cultural landscapes, parks and green areas in and around towns and built-up areas are under continuous pressure for development. Economic valuations of the importance of such ecosystems to human health and well-being can provide an important additional argument for preserving the ecosystems, although estimating such values is particularly challenging.

Economic valuation most relevant in socio-economic analyses

In our opinion, economic valuation is most relevant as a supplement to quantitative and qualitative assessments in socio-economic analyses and similar areas of application. Socio-economic analyses are normally carried out for projects with moderate effects, and rarely for projects that could cause, or prevent, collapse of ecosystems. Nor is it straightforward to calculate the monetary value of all the other effects valued in socio-economic analyses. For example, estimates of the economic value of effects on life and health etc. must necessarily be based on a number of presumptions and assumptions, just like economic valuation of nature and the environment. Economic valuation of ecosystem services is therefore a method that ensures that values in nature can be treated in the same way as other effects in socio-economic analyses. As in the case of other effects, it is nevertheless important that the assumptions on which the estimates are based are described, and that it is made clear how changes in these assumptions could influence the result.

Need for better quantitative and qualitative assessments

There is also significant room for improvement as regards qualitative and quantitative descriptions and assessments of the importance of ecosystem services, and we mention many such points for improvement in the report. Among other things, it is our opinion that Norway should become more involved in ongoing work in the UN to develop ecosystem services accounts in physical units that are consistent with the national accounts. We also believe that more indicators should be developed for the state of the ecosystems and ecosystem services, that clear targets should be set for these indicators, and that they should be included in Norway's sustainability reporting in the National Budget. Developing new and improved indicators could, for example, be relevant for ecosystem services relating to climate adaptation, recreation and public health. We also feel that the description of the effects on ecosystems and ecosystem services in socio-economic analyses must be improved and made more comprehensive, and that the

services' importance to human well-being and the economy must be clearly stated. The ecosystem services approach and its classification of services can serve as an expedient means of structuring such overviews.

The Commission's recommendations from Chapter 8 Highlighting values and economic valuation

- Ecosystem functions are fundamental to all life on Earth through processes such as primary production, decomposition and nutrient cycling. Confronted with such basic life processes, we recommend that the norm should be to highlight these values qualitatively and/or quantitatively in ways that convey the unique nature of the processes.
- The consequences of political decisions for the ecosystem services must be made clear to decision-makers at all levels. We recommend that this should primarily be done by means of qualitative descriptions, alternatively quantitative estimates and assessments where appropriate. We also take the view that it is necessary to focus to a much greater extent than at present on the contributions of ecosystem services to human well-being when describing the effects of policies or measures, and that these effects must be systematically included in analyses and decision-making processes.
- Economic values should be estimated for more ecosystem services than at present in order to enable the value of these services to be included and taken into account in assessments on a par with other economic values. In connection with communication, education and information about scientific issues, economic value estimates should be used *in addition to* qualitative and quantitative information, because it can be effective to refer to monetary value to illustrate the importance of naturally produced services.
- We should look more closely at new valuation methods that involve increased use of collective reflection on the valuation of public goods, and where participatory processes and multicriteria analyses could be useful approaches.

The Commission's recommendations from Chapter 9 Socio-economic analyses as decision-making support

- Decisions with long-term and potentially serious environmental consequences should be made on the basis of safe minimum standards, ecologically safe limits and the precautionary principle. Socio-economic analyses such as cost-benefit analyses, cost-effectiveness analyses or cost-effect analyses provide important information by shedding light on several relevant aspects of the assessments, and they are useful in the development of concrete policies.
- Socio-economic analyses can play an important role in elucidating and comparing positive and negative effects of decisions with moderate effects on ecosystems and/or ecosystem services. The ambition should be to estimate the value of environmental effects in monetary terms so that they can be weighted in the normal way against other priced effects. Effects for which no economic value can be stipulated must nevertheless be highlighted and assessed as non-priced effects.
- It is important that socio-economic analyses highlight uncertainty and potential irreversible consequences, and that the potential advantages of postponing environmental encroachments are made clear to decision-makers.
- Regardless of whether a price has been calculated for an environmental good or an ecosystem service, a socio-economic analysis should shed light on factors that will influence its future value. There are good arguments for assuming that many environmental goods will become more scarce and more valuable over time.
- Where calculated prices exist based on surveys of the willingness to pay, these prices should, as a rule, be adjusted on the basis of the expected development in GDP per capita. This can be supplemented with sensitivity estimates in order to highlight uncertainty and illustrate its importance.
- Better methods should be developed both for assessing and comparing different non-priced consequences and for weighing priced and non-priced consequences together in socio-economic analyses.

The Commission's recommendations from Chapter 10 Economic estimates of the value of ecosystem services in Norway

- Mapping and assessment of ecosystem services, demonstrating values and, if relevant, calculating economic value estimates, as has been done for Norwegian marine areas, should also be considered for other ecosystems. Such mapping could, for example, be carried out for ecosystem services from forests, open lowlands, agricultural areas and green areas in and around the major towns and cities, where there is currently considerable development pressure. Such mapping must be seen in connection with possible large-scale Norwegian studies on ecosystems and ecosystem services (cf. the Commission's recommendation to Chapter 5).
- There is a need to both test and develop methods to demonstrate the importance of the ecosystem services, as well as to give the public administration practical experience of using the results. The Commission would like to point to the following in particular:
  - The development and testing of economic valuation methods, other approaches and combinations of methods and approaches must continue.
  - It should be tested whether using economic value estimates can help to improve ecosystem-based management and increase our understanding of the need to preserve natural ecosystems in practical administration and management, for example at the municipal level.
  - More primary valuation studies are needed for different ecosystem services in Norway.
- Work should continue on methods and systems that are capable of clarifying *nature's contribution* to ecosystem services that depend on anthropogenic input factors. Relevant examples include agriculture, aquaculture and forestry.

The Commission's recommendations from Chapter 11 Accounts and indicators for better management

- A single or a small number of *overall* indicators must be developed for conditions in nature that are important to Norway. These indicators must be developed and presented in connection with the development and presentation of overall policy in order to highlight the connections between nature, economy and policy.
- The current approach with a broad set of indicators should be continued. The indicators can be measured in monetary terms or physical dimensions, depending on what is most relevant in the different contexts. The comprehensive set of data on which the Norwegian Nature Index is based can serve as a starting point for the further development of indicators for ecosystem services.
- Sustainability indicators in the environmental area should be reassessed, and, as a minimum, supplemented with indicators relating to land use change and fragmentation. The urban population's access to green areas and land use changes along the coast are also good candidates. The indicators should also be linked to the effect they have on the state of the ecosystems and their capacity to deliver ecosystem services.
- The Norwegian Nature Index should be considered as a physical indicator of the ecosystems' capacity to deliver ecosystem services for services where biological diversity is crucial. The index must be supplemented with complementary data that elucidate important ecosystem services, and a review of how the data sets are to be combined into independent informative indicators for ecosystem services is required.
- In order to improve the integration of indicators and policy formation, concrete, quantified management targets should be set, both for the indicators included in the set of sustainability indicators and for the indicators included in the set of ecosystem service indicators. This is necessary in order to measure whether implemented measures are sufficient. Quantified targets could also help to increase the focus on what is measured.

- Norway should participate more actively in the UN's work on developing ecosystem services accounts linked to the national accounts, as well as pilot and satellite accounts in physical units for some ecosystem services with a view to developing more complete satellite accounts for ecosystem services and the state of ecosystems.
- Endeavours should be made to improve integration between disciplines in the preparation of physical as well as economic indicators, so that the ecosystem services approach can help to 'bridge the gap' between disciplines.

Demonstrating values by means of framework conditions and policy instruments

The framework conditions must give the right incentives

It is important to describe and quantify ecosystem services, and, if relevant, value them in monetary terms, but, in addition, consumers, manufacturers, developers, the authorities and other economic agents must actually take these values into consideration when making decisions about what to manufacture, consume, build etc. and how to do so. The consequences these decisions have on ecosystems are often unintentional, and almost always 'externalities' – that is, the costs are borne by somebody other than the decision-maker. It is usually necessary for the authorities to adjust the framework conditions to ensure that sufficient account is taken of values in nature. The economic agents must be steered through information, regulations, direct and indirect taxes and other policy instruments towards taking account of the fact that their use of the benefits of nature has a cost.

The place of the ecosystem services approach in an already comprehensive system of policy instruments

Norwegian economic agents are already subject to many administrative, economic and legal framework conditions introduced to protect biological diversity and the ability of ecosystems to deliver services. These framework conditions are an important reason why we were

able to conclude earlier that the state of Norwegian ecosystems is relatively good. The question is therefore whether a clearer focus on ecosystem services in the use of policy instruments could produce better results in the sense that environmental policy goals could be achieved faster, safer and/or at a lower cost. The Commission has not discussed this in detail, as that would require, among other things, a thorough review of the very comprehensive framework conditions that currently apply, but we will nevertheless point to certain areas where an ecosystem services approach seems expedient.

We wish to draw particular attention to schemes involving payment for ecosystem services, which, in brief, means that someone (often local or central authorities) pays someone else (often landowners) to deliver one or more specified ecosystem services instead of using the ecosystems (land) for other purposes. This type of scheme is not uncommon internationally, and is used, for example, to conserve forests for carbon storage. It has similarities with the current Norwegian voluntary forest conservation scheme. In our view, schemes involving payment for ecosystem services should be developed and used more widely and for more ecosystems and services. Using wetlands to control floods, and forests and soil to store carbon, are relevant examples. In the open lowland cultural landscape, there are places where landscape management and a reduction of regrowth could ensure extremely rich biological diversity, which is important to agriculture, and provide more open landscapes that people enjoy and appreciate. Pursuing a stronger ecosystem services approach in the development of the many policy instruments used in relation to the agriculture industry could safeguard such services.

Above, we identified changes to land and land use as the most important sources of negative impact on Norwegian ecosystems. The regulatory framework for land use is extensive and is administered by the municipalities. An ecosystem services perspective on land use planning indicates that larger areas should be seen as a whole, since neither ecosystems nor the services they deliver follow municipal boundaries. It is very important to ensure that the municipal sector has the resources and expertise necessary to attend to the big and important task of administering land, and thereby also ecosystems.

We also believe that the practical application of resource rent taxation should be reviewed, and that a nature tax, possibly earmarked, should be considered.

Climate change constitutes a serious threat to several ecosystems, and it is important that Norway contributes to reducing global greenhouse gas emissions. However, the wish to reduce Norwegian emissions, for example by planting forest for carbon offset and producing renewable energy, must not be fulfilled at the expense of the need to preserve biological diversity, ecosystems and the ecosystems' ability to deliver services.

The ecosystem services approach does not favour economic policy instruments

In conclusion, we wish to underline that an ecosystem services approach does not, in principle, favour a certain type of policy instrument. The fact that nature delivers services that are useful to human beings is not in itself an argument for or against the use of economic policy instruments, or for or against the use of legislation and regulations. If a service has been assigned an economic value, that does not mean that economic instruments should be preferred over legal ones. On the contrary, if an ecosystem has been found to deliver services of particularly high socio-economic value, that could be an argument in favour of strong legal protection. It is also fully possible to introduce payment for an ecosystem service without having a value estimate in advance. Regardless of the approach, the choice of policy instruments must strike a balance between cost-effectiveness, management effectiveness, legitimacy and purely practical considerations, as is already the case for the use of policy instruments. It is necessary to take a closer look at whether the present organisation of the policy instrument system in environmental and resource management is expedient, given the goal of more ecosystem services-based management.

The Commission's recommendations from Chapter 13 The basis for environmental and resource management

- In order to ensure sustainable management of ecosystems and ecosystem services, a review should be carried out of the expertise and capacity in and the division of responsibilities and policy instruments between different institutional levels and between different public agencies in the field of environmental and resource management.
- The precautionary principle, as set out in the Nature Diversity Act, must be adhered to.

The Commission's recommendations from Chapter 14 Dissemination of knowledge, involvement and legitimacy

- The authorities must ensure that the general population becomes more knowledgeable about what nature means to our well-being and to the economy. Communication strategies should be developed and implemented in order to achieve this. These strategies should focus on all the goods nature provides for us rather than on threats and destruction. The ecosystem services approach is well-suited to such a positive approach. Such a strategy could include the following elements:
  - utilising the engagement and knowledge of non-governmental organisations,
  - emphasising local meetings where the benefits of nature are discussed and where different uses of ecosystems are considered and weighed against each other,
  - initiating and making use of local, experience-based knowledge through dialogue, cooperation and active involvement,
  - making dissemination of scientific knowledge a much higher priority than it is today.
- In order to improve knowledge about nature's value to human health and well-being, the environmental and educational authorities should have educational material produced for use in primary

and secondary schools. Teachers' competence should be improved.

The Commission's recommendations from Chapter 15 Policy instruments in land management

- New schemes involving payment for ecosystem services should be tested in order to increase forest conservation to the extent recommended from a natural science perspective. A scheme whereby forest conservation agreements are auctioned should be tested in order to see whether this model could increase the amount of conservation, or ensure the conservation of more valuable forests, per *krone* spent.
- It should be considered whether more ecosystems can be safeguarded through schemes involving payment for ecosystem services. Wetlands are a good candidate. Wetlands provide important climate-related ecosystem services and form part of the natural infrastructure that acts as a buffer against the effects of floods and other extreme weather conditions. The scheme could also be relevant to the cultural landscape.
- Before encroachments are permitted in natural areas protected under the Nature Diversity Act, it must be considered whether it will be possible to facilitate ecological compensation, which means that the developer/owner establishes areas to replace important natural areas that are lost or lose their function as a result of a project. The Commission assumes that clear criteria to be developed that specify how projects must be designed in order to be acceptable as ecological compensation.
- The planning system should be reviewed with a view to better demonstrating the value of ecosystem services. This is particularly relevant in relation to the national expectations of regional and municipal planning and the Regulations on Environmental Impact Assessment. It should also be considered whether the topic is suitable for government planning guidelines.

- Methods must be developed to assess projects' overall impact as required by the Nature Diversity Act and the Regulations on Environmental Impact Assessment.
- In some areas, planning needs to become more comprehensive and intersectoral, for example by devoting more attention to the landscape perspective and the ecological infrastructure. Intermunicipal plans, regional plans developed by the county authorities and more strategic impact assessments prepared by the central government are all relevant models. The plans can be ecosystem-based (cf. management plans for ocean areas) or more thematic (cf. the strategic impact assessment of offshore windpower in Norway). In particular, it should be considered whether central government impact assessments should be conducted for energy projects, aquaculture and mining.
- Work should be initiated to map geographically and demonstrate ecosystem-based values and services for use in municipal land use planning and land management. This should be considered in the context of existing landscape assessment methods used in municipal land use planning.
- Expertise in municipal planning and environmental work must be strengthened. Municipalities' awareness and knowledge of the ecosystem services they manage must be improved. Municipalities' awareness and knowledge of how the ecosystem services can be used, for example in climate change adaptation, must be improved. Intermunicipal cooperation should be encouraged.
- A system should be considered whereby economic incentives are offered to municipalities that safeguard biological diversity and pertaining ecosystem services. The possibility of using a model whereby the municipalities' environmental efforts and results are used as criteria when block grants are allocated should be reconsidered.
- A national nature tax should be considered in order to ensure that the tax system sends the right signals about the value of biological diversity and ecosystem services. The study must include an assessment of whether the revenue from this tax should be earmarked for a special national fund, and of how such a fund should be organised and what its objective should be. The possibility of a fund

administered by the new Norwegian Environment Agency should be given special consideration. Its purpose would be to contribute to better and more precise knowledge about how we can best manage our ecosystems in Norway in order to prevent loss of ecosystem services in the short and long term.
- The practical application of resource rent taxation in Norway should be reviewed.

The Commission's recommendations from Chapter 16 Policy instruments to combat climate change, pollution and over-harvesting

- Measures to counteract climate change must be considered in relation to their effects on biological diversity and other environmental values.
- National policies must be designed to ensure that we meet our international obligations to reduce emissions, for example the agreements concerning sulphur dioxide (SO_2) and nitrogen oxides (NO_x) under the Gothenburg Protocol.
- The effects of the regulation pursuant to the Nature Diversity Act should be evaluated when more experience has been gained of the regulations relating to the import and release of invasive organisms.
- The principle of sustainable use must continue to form the basis for the harvesting of biological resources.
- It is important that Norway continues to map the seabed in Norwegian waters, to identify connections between environmentally harmful fishing activities and various ecosystem services, and to implement measures to counteract any negative consequences.

The Commission's recommendations from Chapter 17 State subsidies for business and industry

- It must be a goal for economic policy instruments in all sectors that they are designed in such a way that they promote environmentally friendly production/activities, including ecosystem services provi-

sion, and prevent negative environmental consequences such as the destruction of ecosystems and ecosystem services.

- State subsidies to industries should be reviewed, and the consequences of important measures and policy instruments that influence ecosystems and ecosystem services should be identified. A thorough assessment of and comparison between any negative consequences for ecosystems and ecosystem services and the expected positive effects must be carried out. Subsidies that do not have significantly greater positive than negative effects must be discontinued. This review should cover both direct aid and aid in the form of tax reductions.
- Particular attention should be devoted to agricultural subsidies. Agricultural subsidies should contribute more to preserving ecosystems as a basis for the production of ecosystem services in future. It must be a goal for state subsidies for agriculture that they are designed in a way that promotes environmentally friendly production and prevents negative effects on the environment.
    - The grants scheme for harvesting trees in steep and inaccessible terrain must be discontinued.
    - More agricultural aid should be organised as payment for ecosystem services. Examples include payment for the protection and restoration of e.g. wetlands and farm ponds, and for cultural landscape management.
    - More of the policy instruments used in relation to agriculture should stimulate the management of prioritised habitats in the cultural landscape and selected cultural landscapes.
- The Norwegian-Swedish green certificates scheme must be evaluated and its consequences for ecosystems and ecosystem services identified. The effects of Norwegian renewable energy production on European power consumption and greenhouse gas emissions must be studied.

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