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Mainstreaming biodiversity and ecosystem services – Norwegian and European Experiences

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Preface

The Norwegian Environment Agency (NEA) has ongoing cooperation with the Chinese Research Academy of Environmental Sciences (CRAES) on the project “Mainstreaming Biodiversity and Ecosystem Service Values into Policy-making in China”. As part of establishing a common knowledge base for the project, this report aims to describe Norwegian and European experiences with mainstreaming of biodiversity and ES into policy, decision-making and planning, with an emphasis on specific case examples.

The work on the report was led by Henrik Lindhjem, with contributions from co-authors Kristin Magnussen and Haakon Vennemo. Ståle Navrud has provided internal review of the report.

The project manager from NEA was Kirsten Grønvik Bråten, who together with colleagues Marie Sneve Martinussen and Borge Håmsø, have provided important comments and inputs to the report. Further, we would like to acknowledge constructive comments from Professor Zhang Fengchun and from participants at the project workshop 31. March 2016 in Beijing, where a draft of the report was presented.

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Executive summary

There is a growing interest and urgency both in China and Norway to better integrate (mainstream) concerns about biodiversity and the benefits people obtain from nature (ecosystem services – ES) into policy-making, planning and decision-making. Economic valuation of such benefits to demonstrate their importance for human welfare is viewed as an important tool for achieving this goal. This report first presents the concept of mainstreaming; and outlines possible policy instruments and applications where biodiversity and ES, and their economic values, can be mainstreamed/integrated. Then several examples from Norway and other European countries are presented in order to demonstrate how the provision of more and better information and incentives can increase biodiversity conservation. The potential relevance of the examples to the Chinese context is discussed.

Background and motivation

The Norwegian Environment Agency (NEA) has ongoing cooperation with the Chinese Research Academy of Environmental Sciences (CRAES) on the project "Mainstreaming Biodiversity and Ecosystem Service Values into Policy-making in China (2015 -2017)".

The aim of the project is to "Promote the mainstreaming of biodiversity issues into policy-making, planning and decision making through linking biodiversity and ecosystem services (ES), and where possible economic valuation, as a contribution to improve the management of biodiversity and ES."

The most important arenas for mainstreaming (or integration) in the Chinese context are envisaged to be:

(1) Payment schemes: such as payments for ES, eco-compensation, etc.;
(2) Tools for trade-off analysis to help balancing economic development and environmental protection, and
(3) Performance assessment systems on different government levels, supplementing GDP with environmental targets.

To better understand how mainstreaming of biodiversity and ES values can be integrated into policies and decision-making in practice, a good place to start is learning from ongoing initiatives in different countries. This report aims to contribute to that.

Objectives of the report

As part of establishing a common knowledge base for the project, this report aims to describe Norwegian and European experiences with mainstreaming of biodiversity and ES into policy, decision-making and planning, with an emphasis on specific case examples. The assignment is divided into two parts:

(1) A broad overview of how Norway has mainstreamed biodiversity and ES into government processes, and
(2) A more specific description and evaluation of relevant examples of tools and instruments ('techniques') for mainstreaming.

The main emphasis is put on part (2), while part (1) will show the bigger picture and indicate where instruments like the examples in part (2) fit in. Before going into the practical examples we discuss how to interpret the concept of mainstreaming biodiversity and ES and their values into policy, decision-making and planning. The purpose of mainstreaming, or integrating, values of ES and biodiversity into public (and private) policy, decision-making and planning is to contribute to reducing the current (in many places accelerating) loss of biodiversity and many important ES. A better knowledge base, including knowledge of economic values of biodiversity and ES, can help improve decisions. This means that that higher welfare for more people, compared to the status quo situation, will be achieved. We look primarily at efforts to promote biodiversity and nature conservation, and not at the full range of ES, although many ES flows will increase through the advancement of biodiversity conservation.

The concepts of ES and biodiversity

The concept of ecosystem services (ES) was brought into common use by the Millennium Ecosystem Assessment (MA), a global initiative set up in 1999 to assess how ecosystem change would affect human well-being (MA 2005). The MA defined ES as *"the benefits that people obtain from ecosystems".* This encompasses goods such as timber, and services such as air purification. Biodiversity[1] is typically placed in the middle of the natural system, reflecting the current evidence that biodiversity loss reduces the capacity and efficiency of ecosystems to produce many ES. There is some debate about the role of biodiversity in the production of different services. Some recreational activities and other cultural services may for example not be particularly dependent on a certain level of biodiversity. People may enjoy both use and non-use benefits of biodiversity, regardless of its role in the functions of ecosystems.

Biodiversity and ES often have no market value and are overused and degraded

One of the main problems is that many ES, and most of the biodiversity that is threatened, are public goods that are currently not traded in the market with prices and market transactions like private goods and services. Such public goods have no price to signal their scarcity, they are often perceived to be "free for all", and are then typically overused and degraded. This has been the case in countries woldwide, including both China and Norway, at least for some nature types and environmental problems. Hence, knowledge of the costs of degradation (or the flip-side: the benefits of nature protection) may be useful or even necessary to make better decisions. The economic values of changes in biodiversity and ES can be estimated by the use of internationally recognized environmental valuation methods. Different policy uses of economic value information will require different levels of accuracy in in the value estimates. For example, if the aim is to raise awareness, accuracy does not need to be high. If estimated values are used for litigation to determine the level of ES damage compensation or for determining the optimal level of environmental taxes, accuracy needs to be much higher.

Options for mainstreaming values of biodiversity and ES

Once there is reliable economic valuation information, there is the question of how and in what sense one can best mainstream, or integrate, such values in policy-making, planning and decision-making. Three main policy levels or instruments for mainstreaming have been suggested internationally (TEEB 2011) (see Figure A): (1) Providing information for biodiversity and ES policies (or policies and projects that have impact on biodiversity and ES), (2) Setting incentives to stimulate behavioural change, and (3) Regulating use of natural resources directly.

Providing information helps in measuring what we manage. Setting incentives is about setting the right price and other signals for different actors to change behaviour that is damaging or beneficial for biodiversity and ES. Finally, regulating use of natural

[1] Widely assumed to mean the number of different species present, but in reality is more complex.

resources directly is often more about direct regulation, e.g. in the form of establishing protected areas. All instruments can utilize information about economic values of ES and biodiversity.

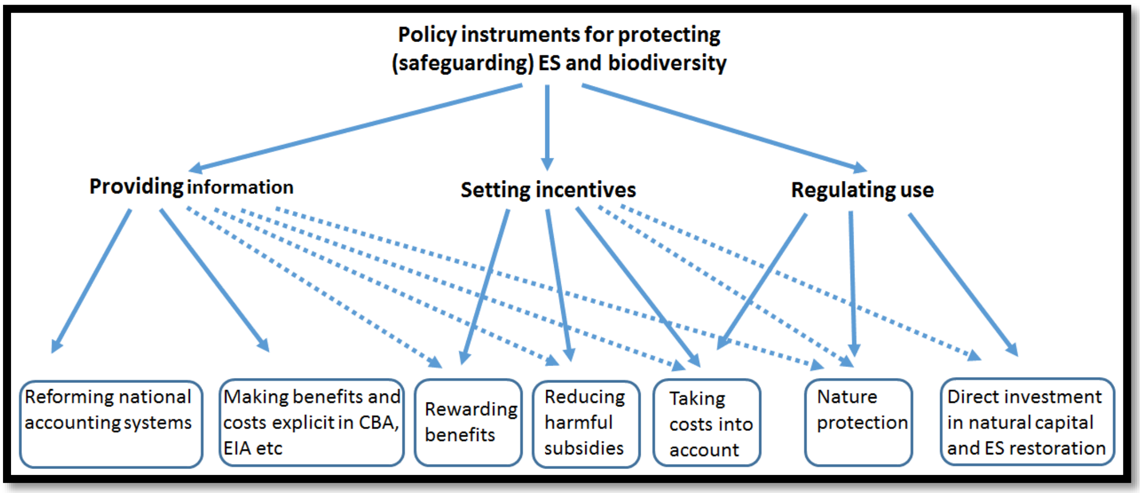

Figure A **TEEB's proposed options for mainstreaming values of ecosystem services and biodiversity into policy-making. Source: Adapted from ten Brink (2011)**

The three instruments can then be linked to a number of specific policy options, tools or applications, illustrated with the row of boxes at the end of the arrows that may utilize combinations of the three instrument types (as there is uncertainty about some links, some arrows are dotted). The types of instruments include among others, starting from the bottom left in figure A; reforming national accounting systems (beyond Gross Domestic Product,GDP), making benefits and costs more explicit in cost-benefit analysis (CBA) and environmental impact assessments (EIAs), rewarding benefits (e.g. payment for ES), reducing harmful subsidies, and so on.

Overview of mainstreaming efforts in Norway

Norway has implemented a number of initiatives along the lines in Figure A over the last few years with the aim to strengthen biodiversity conservation. In terms of providing better information to decision-makers, Norway has developed and maintains sustainable development indicators, including the pioneering of a Nature Index to provide an important basis for evaluating the state of biodiversity. Norway also has a relatively advanced system for requiring cost-benefit analysis (CBA) of large public investment projects, where ES are gradually being included in the considerations (see below). Norway recently also set up its own national TEEB committee to advance biodiversity and ES concerns in management across all sectors.

In terms of setting incentives, Norway has relatively few payment schemes or taxes and subsidies with a specific aim to stimulate biodiversity conservation. One important exception is the voluntary forest conservation program (see below). Recently, a Green Tax commission delivered its report, which recommended a new tax on the ”consumption of nature” or on different land uses with high biodiversity impacts.

Finally, in terms of regulating the direct use of natural resources, this has traditionally been the most important means for conserving and protecting nature in Norway. Recently, with the establishment of the Nature Diversity Act, Norway has an important legal framework for further strengtening the sustainable use and protection of biodiversity. Despite important mainstreaming efforts, Norway still has some way to go in terms of for example reaching a satisfactory level of nature protection, as also pointed out by the OECD. Certain nature types are somewhat degraded, and have seen a decline in recent years. Finally, it is also the case that economic value information has played a limited role in mainstreaming efforts so far, though this may be about to gradually change.

Specific examples from Norway and Europe

Figure B provides an overview of the three specific examples we have chosen for further analysis (green text in figure): (i) voluntary forest conservation in Norway, (ii) incorporation of ES and biodiversity in cost-benefit analysis and environmental impact assessments in Norway, and (iii) ecological fiscal transfers in Portugal and France. In addition, we provide a number of shorter examples (black text in Figure B) of other initiatives. The top layer of the figure makes the link to the options for mainstreaming in Figure A. Our main focus here is on setting incentives and providing information. The lower layer in Figure B relates the examples to the most relevant arenas for mainstreaming biodiversity and ES in China.

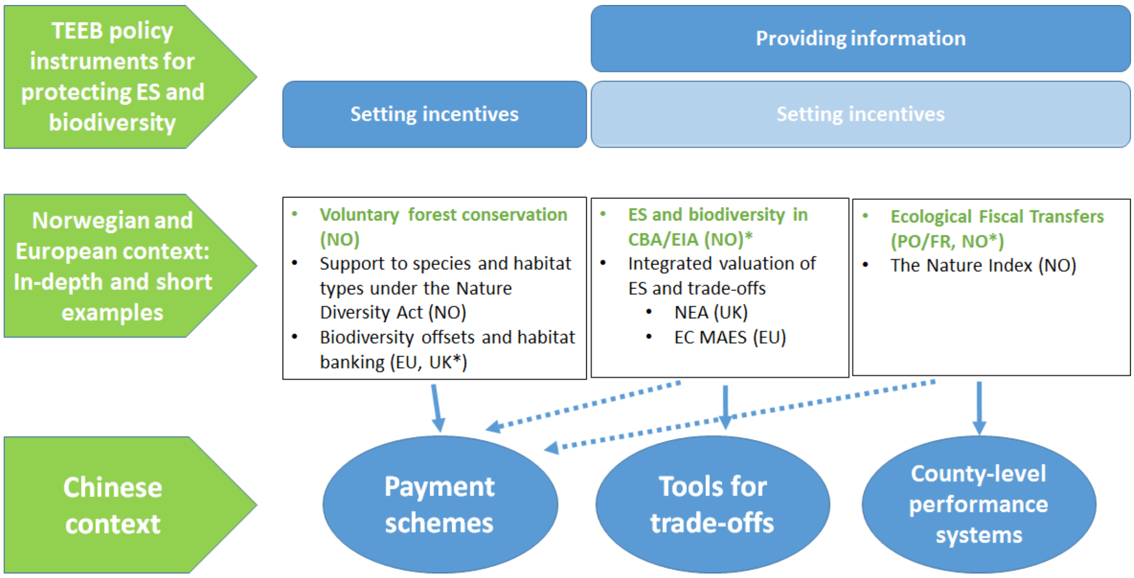

Figure B In-depth (green text) and short case examples of mainstreaming biodiversity and ecosystem services

Notes: NO = Norway, FR = France, PO = Portugal, UK = United Kingdom, EC = European Commission, EU = European Union, MAES = Mapping and Assessment of Ecosystems and their Services, NEA = National Ecosystem Assessment, * = Piloting or ongoing development/discussion of instrument.

Voluntary forest conservation in Norway

The Norwegian voluntary forest conservation program is a good example of a PES-like scheme aimed at preserving biodiversity. Compensation to forest owners for establishing nature reserves is paid on the basis of opportunity costs (in terms of the future loss of timber income) calculated using a standard formula. Biodiversity values are assessed using non-monetary biological criteria compared with conservation targets and gaps. No extra payment is made for biologically richer areas. The program has increased the number of forest reserves, and has been relatively successful in creating a climate of cooperation between government and the many small, private forest owners in Norway. However, the program could be strengthened both in terms of getting more conservation for the same (still limited) budget, and in terms of targeting and increasing the preserved area of forest types that are still underrepresented in the reserve network. The experiences from the program may be relevant for China’s efforts to draw “ecological red lines”, and establish a national spatial development and protection system. Incentives for establishing protected areas and managing them have been reported to be lacking in many parts of China. A compensation-based system similar to the Norwegian system may be able to overcome some of the incentive problems.

Mainstreaming biodiversity and ES in EIA/CBA in Norway

A good example of a tool for trade-off analysis (the second category in Figure B above) is the ongoing work on integrating biodiversity and ES information, including monetary and non-monetary values, into CBA and EIA. Compared to the forest conservation program, the aim is to reflect better the full ES framework, not just biodiversity. Currently; official, public guidelines on CBA and EIA use a methodology for considering impacts (typically environmental) that are not valued (i.e. non-priced impacts). This method is currently being supplemented with integration of elements from the ES framework, and with gradually increased economic valuation of ES, at least in some sector applications. For example, Vista Analysis is developing methodology for economic valuation of ES for the Norwegian Coastal Administration to value ES loss from oil spills from ships in economic terms. These ES values will be included in their CBA manual for assessment of prevention measures to reduce the probabilities of ship accidents with resulting oil spills. This is a good example of how a non-market valuation method (contingent valuation in this case) can be used in practice, and how it may improve decision-making. The implementation of the ES framework, and potentially increased economic valuation of ES into guidelines and practices, is an area of continuous development and improvement in Norway at the moment. Given the large number of costly infrastructure projects in China, and hence the need to give priority to the projects that provide the highest net benefits, the potential benefits of increased use of CBA is expected to be large. The ES approach may be useful in CBA as well as in combination with EIA. It should be noted that use of the ES approach does not necessitate the use of economic valuation of ES, though this makes it easier to compare with impacts that are typically monetized, such as investment and operational costs.

Ecological fiscal transfers in France and Portugal

The third category in Figure B of county-level performance assessment systems, which are of interest in China, has no obvious counterparts in Europe. Ecological fiscal transfers (EFT), which is a combination of incentives and performance assessment on the municipal level, may be relevant for county level performance assessment in China. Fiscal transfers from the central and regional levels to the local level is a feature of both the European and Chinese system of government. EFT is a branch of fiscal transfers in which the level of transfer depends on ecological objectives, in practice often targets for biodiversity conservation. The transfers are meant both to compensate local governments for their cost of biodiversity conservation, and to motivate local governments to volunteer for biodiversity conservation (i.e. the incentive aspect). It is the municipality or another local administrative unit that is the recipient of the ecological fiscal transfer. EFT is currently in use in France and Portugal, but is also considered for use in other countries in Europe (including Germany and Norway). The performance of EFT in terms of environmental effectiveness or cost effectiveness has not yet been assessed carefully, but it is a potentially promising instrument that may have particular relevance to China. China’s official strategy to move towards the ecological civilization, has specifically mentioned that economic policies including pricing, fiscal, taxation and financial policies should motivate and guide various entities to actively take part in the development of ecological civilization. In this context, EFT deserves close consideration.

Other examples

Finally, we also consider a number of shorter examples that demonstrate payment and incentive schemes, tools for trade-off analysis and county level performance and indicator systems. Two perhaps particularly illuminating examples of information for trade-off analysis and making policy priorities include the UK National Ecosystem Assessment (UK NEA), and the Mapping and Assessment of Ecosystems and their Services (MEAS) in the EU.

1. Introduction

1.1 Background and motivation

For the past two decades, Norway has successfully cooperated with China on various environmental projects addressing problems such as pollution, climate change and biodiversity loss. In June 2015, the Norwegian Environment Agency (NEA) signed a new contract with the Chinese Research Academy of Environmental Sciences (CRAES) on the joint cooperation project "Mainstreaming Biodiversity and Ecosystem Service Values into Policy-making in China". The project is scheduled to be implemented from 2015 to 2017. The project will combine research, case studies and the establishment of five pilot counties to improve the understanding of the value of biodiversity and ecosystem services (ES) and demonstrate how to mainstream these values in policy-making, planning and decision-making at the county level.

The aim of the overall project is to "Promote the mainstreaming of biodiversity issues into policy-making, planning and decision making through linking biodiversity and ES, and where possible economic valuation, as a contribution to improve the management of biodiversity and ES." The most important arenas for mainstreaming (or integration) in the Chinese context (and more generally) are envisaged to be:

- Payment schemes: such as payments for ES[2] (PES for short), eco-compensation, paid use of natural resources etc.
- Tools for trade-off analysis: the development of tools to improve trade-offs between biodiversity conservation and economic development in pilot counties
- Performance assessment systems: a county-level performance assessment system that is currently based on contribution to GDP.

"Eco-compensation" refers to many new ideas and methods central and provincial governments in China are investigating primarily to improve supply-side and demand-side management of water resources. This includes many experiments with market-based environmental policy tools. Paid use of natural resources is similar to PES, except targeting materials, not ecosystem services.

Regarding the third arena for mainstreaming, China is currently using gross domestic product (GDP) as a single criterion for the assessments of the performance of governments, sectors, and individuals working for the government. The assessments include annual assessment, term assessment (for the whole period of the term of service of an official, usually every five years), assessment for the officials who are about to be promoted or transferred, and other assessments. China recently emphasizes that the environmental factors (including biodiversity) should be mainstreamed into the criterion systems.

[2] An international concept referring to a voluntary conditional agreement between at least one 'seller' and one 'buyer' over a well-defined ecosystem service – or land use presumed to provide that service.

In order to further the mainstreaming agenda on these three fronts, international experiences may be very relevant to China.

1.2 Aim of the report

The second of five components[3] of the joint project is the establishment of a common Chinese and Norwegian knowledge base in this area. Important outputs from this component are one report assessing existing performance assessment systems and two reports describing techniques for mainstreaming biodiversity and ES into policies, decision-making and planning. One will be focused on China, and the other on Norway and Europe. The latter report will be the task of the current assignment.

The aim of this report is to describe Norwegian and European experiences with mainstreaming of biodiversity and ES into policy, decision-making and planning, with an emphasis on specific case examples. The assignment is divided into two parts:

(1) A broad overview of how Norway has mainstreamed biodiversity and ES into government processes, and

(2) A more specific description and evaluation of relevant examples of tools and instruments ('techniques') for mainstreaming.

The main emphasis is put on part two, while part one will show the bigger picture and indicate where instruments like the examples in part two fit in. Before going into the practical examples we discuss how to interpret the concept of mainstreaming biodiversity and ES and their values into policy, decision-making and planning. We primarily focus on efforts to promote biodiversity and nature conservation, and do not look at the full range of ES (though many ES flows will increase through the advancement of biodiversity conservation).

1.3 Outline

In the next chapter we first briefly discuss how to interpret the concept of mainstreaming biodiversity and ES and their values into policy, decision-making and planning. Three generic (policy) instruments or arenas for mainstreaming are identified, where economic value information may be useful: (1) Providing information, (2) setting incentives and (3) regulating use of natural resources directly. Within these categories there are a number of more detailed mechanisms and tools that can be used.

In chapter 3 we provide a brief overview of how Norway has approached the issue of mainstreaming biodiversity (and ES), i.e. part one of the report. As noted, we focus in particular on nature and biodiversity conservation policies, rather than policies that may affect the full range of ES. We also make some observations about experiences and effects of these mainstreaming efforts and how economic valuation information has been used.

Chapter 4 first makes the link between the three most important arenas of mainstreaming in the Chinese context (as mentioned above), and a number of case examples from

[3] The other four components are: (1) Project management, (3) Valuation of biodiversity and ecosystem services, Mainstreaming biodiversity into policy-making processes, (5) Capacity building and dissemination of results.

Norway and Europe more generally. We go more into depth on the following three examples:

1. The voluntary forest conservation program in Norway, a payment for ecosystem service (PES)-like scheme;
2. The use of Environmental Impact Assessment (EIA) and cost-benefit analysis (CBA) as a tool for trade-off analysis; and
3. Ecological Fiscal Transfers in Europe, an intragovernmental fiscal transfer mechanism based on nature protection performance.

We also provide shorter examples from Norway and Europe of information provision and incentive setting. For each of the more detailed examples, we provide some thoughts on the relevance of the experiences for the Chinese context.

2. Mainstreaming biodiversity and ES values: Principles and practice

This chapter first defines the concept of ecosystem services (ES) and biodiversity, and discusses and motivates why it is seen as important to better try to include the values of biodiversity and ES in policy, decision-making and planning. Note that we do not cover the full range of ES, but focus our main attention on the conservation of nature and biodiversity (through which many, though not all, ES will also increase in abundance, see below).

We then provide a short overview of the main non-market valuation methods and the methodological and practical challenges of measuring biodiversity and ES values. Finally, we interpret and discuss the concept of mainstreaming such values, through the instruments of providing information, setting incentives and regulating use of resources, an approach used by The Economics of Ecosystems and Biodiversity" (TEEB) initiative.

2.1 Defining ecosystem services and biodiversity

The concept of ecosystem services (ES) was brought into common use by the Millennium Ecosystem Assessment (MA), a global initiative set up in 1999 to assess how ecosystem change would affect human well-being (MA 2005). The MA defined ES as *"the benefits that people obtain from ecosystems".* This encompasses both goods, such as timber, and services such as air purification. The MA divided these services into four categories:

i. ***Supporting services:*** These are services, such as nutrient cycling and soil formation, which are needed for the production of all other services.

ii. ***Provisioning services:*** Products obtained from ecosystems, such as food or timber.

iii. ***Regulating services:*** The benefits obtained from the regulation of ecosystems, including services such as purification of water, flood control, or regulation of the climate via carbon sequestration.

iv. ***Cultural services:*** The benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences.

Following the MA, a number of national and international initiatives have emerged, including "The Economics of Ecosystems and Biodiversity" (TEEB), launched in 2007[4]. The TEEB centres on economic valuation and aims to help decision makers recognise the economic benefits of biodiversity and ES and the growing cost of ecosystem degradation (TEEB 2010).

In Europe, in 2011, the European Commission adopted the Biodiversity strategy to 2020. Target 2 of the strategy has as its aim that:

"by 2020, ecosystems and their services [will be] maintained and enhanced and [to] assess the state of ecosystems and their services in their national territory by 2014, assess the economic value of such services, and promote the integration of these values

[4] http://www.teebweb.org/

into accounting and reporting systems at EU and national level by 2020" (Maes et al. 2014).

To this end, the Mapping and Assessment of Ecosystems and their Services (MAES) initiative was set up, and produced a framework for ecosystem assessment to ensure a harmonised approach across the EU (MAES 2013).[5]

MAES uses the Common International Classification of Ecosystem Services (CICES) system for classifying ecosystem services. CICES builds on the MA and TEEB approaches but aims for a system more suitable for accounting. Compared to the MA classification above it includes the regulating and supporting services in one category with the name "regulation and maintenance services", by doing so trying to avoid double counting of overlapping services. There are some other differences in subcategories of services etc., but the main ideas are the same.

The conceptual framework of MAES (also reflecting the thinking of MA) is shown in the much-cited "butterfly", see Figure 2.1, depicting the connection between natural and socio-economic systems and how these interact to produce services, benefits and (monetary and non-monetary) values for human well-being, with feedback to the natural system.

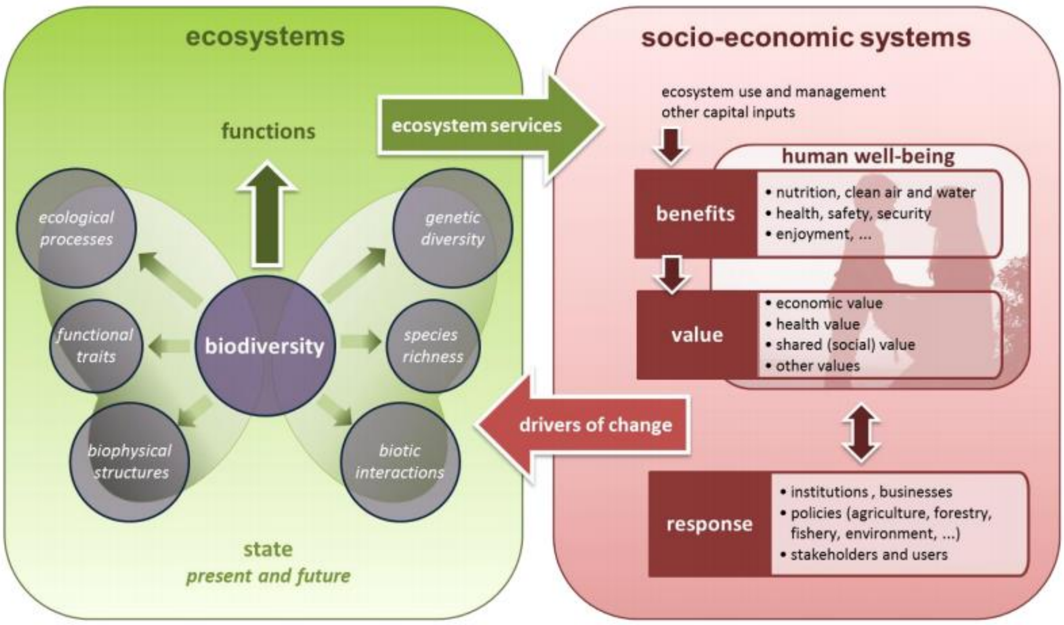

Figure 2.1 The conceptual framework drawn up by the MAES initiative. Source: MAES 2013)

Biodiversity[6] is placed centrally in the middle of the natural system, reflecting the current evidence that biodiversity loss reduces the capacity and efficiency of ecosystems to

[5] This work also contributes to progress towards assessing ecosystem services on a global level, coordinated by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) established by the UN in 2012.

[6] Widely assumed to mean the number of different species present, but in reality is more complex (EEA 2015). The definition used by the Convention on Biological Diversity, which is also used

produce many ES (Cardinale et al. 2012). There is some debate about the role of biodiversity in the production of different services. Some recreation and other cultural services may, for example, not be particularly dependent on a certain level of biodiversity. A biologically relatively monocultural park, for instance, may give important recreation services. In this framework, biodiversity may also be placed as part of cultural services, as people may enjoy both use and non-use benefits of biodiversity, regardless of its role in the functions of ecosystems. In this report we look particularly at mainstreaming biodiversity values. When conserving biodiversity, other services giving both use and non-use values will follow (though some services not dependent on biodiversity will not be included).

The MAES initiative also makes clear that ES represent *"the realized flow of services for which there is demand"*. Thus, its 'natural capital' might encompass stocks – a forest for example – but the provisioning service itself is the flow of harvested timber, as shown in Figure 2.2. In some cases a 'flow' is harder to quantify – enjoyment of a beautiful view, for example – but the basic concept remains the same: an ES is only an ES when it is providing a realised benefit to people. Figure 2.2 also illustrates the natural abiotic assets and flows as part of the concept of natural capital, for example wind and solar energy. CICES also includes abiotic elements in its classification system.[7]

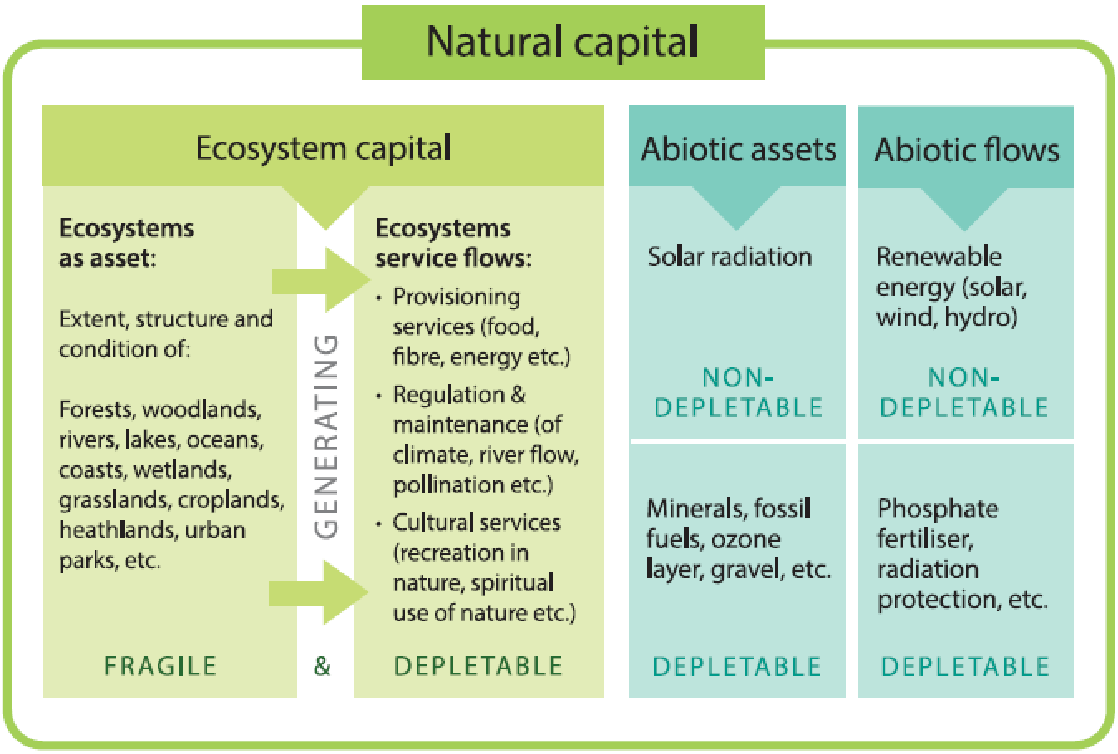

Figure 2.2 Adapted from EEA (2015), illustrating the different components of our natural capital, encompassing both ecosystem stocks and service flows.

within the EU MAES framework, is this: "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, between species and of ecosystems".

[7] http://cices.eu/

2.2 Interpretation and purpose of mainstreaming biodiversity and ES values

We have now provided the essentials of the ES and biodiversity concepts. The purpose of mainstreaming, or integrating, values of ES and biodiversity into public (and private) policy, decision-making and planning is to contribute to reducing the current (in many places accelerating) loss of biodiversity and many important ES (especially non-market, non-provisioning). A better knowledge base, including knowledge of economic values of biodiversity and ES, can help improve decisions. That means decisions that achieve higher welfare for more people compared to the status quo situation, within the bounds and limits of the ecosystems. Many scientists argue that that economic growth and development have been given a higher weight compared to biodiversity and important ES to date, and that the current path is not sustainable on a global scale (e.g. Rockström et al. 2009). At least this is the opinion of the MA (2005) and a number of researchers and policy-makers.

One of the main problems, as is well known, is that many ES and most of the biodiversity that is threatened, are currently not direct parts of the market economy with prices and market transactions on par with other goods and services. Hence, when such public goods do not signal their scarcity and value and therefore are perceived to be “free for all”, they are typically overused and degraded. This has been the case wold-wide, including both in China and Norway, at least for some nature types and environmental problems (e.g. Norwegian forests according to the Norwegian Nature Index[8] and environmental pollution and biodiversity loss in many areas of China). Hence, knowledge of the costs of degradation (or the flip-side: the benefits of nature protection) may be useful or even necessary to make better decisions.

2.3 ES and biodiversity non-market valuation: From promise to practice

To counter the grave trends in biodiversity and ES loss TEEB and other national and international initiatives (for example under the auspices of the Convention on Biological Diversity) have increased awareness and have started to move governments and other actors from the current situation in the direction of ”recognizing” values, via ”demonstrating” to ”capturing” values in decision-making (TEEB terminology). The last stage of capturing values has still some way to go in most countries.

In order to be able to reach the stage where values of biodiversity and ES are more fully integrated in decision-making, a better knowledge base of the (economic) values of ES and biodiversity is desirable.[9] Many of the relevant services and biodiversity can only be valued economically by use of non-market valuation methods (Champ et al. 2002). These typically include revealed preference (RP), stated preference (SP), and benefit transfer (BT) (sometimes termed value transfer) methods (Freeman 2003). RP methods use observational data on decisions people make in markets to estimate the value placed

[8] The Nature Index (NI) was established to provide an overview of the state and development of biodiversity in the major ecosystems in Norway, the marine, freshwater and terrestrial ecosystems, and thereby measure progress towards the goal of halting the loss of biodiversity. More on this in chapter 3.

[9] We focus primarily on economic valuation methods and values in this report, though TEEB and other literature also mention the possibility of using non-economic valuation methods for some of the more intangible values. EC (2015) for example recognize the need also to consider integrated valuation, the inclusion of different value domains.

on changes in ES flows, and include among others the travel cost method (TCM) to estimate recreation benefits (a cultural ES). Note that the RP methods by definition can only value use values, since the methods are based on tracking people's behaviour in markets that reveal some form of use related to biodiversity or ES.

SP methods use data generated from questionnaire surveys eliciting people's contingent preferences in constructed (hypothetical) market scenarios, and include contingent valuation (CVM), choice experiments (CE), and variants of these. The aim of the SP methods is to estimate the affected population's willingness to pay for the public offer, directly or indirectly, to obtain a positive stream of ES or biodiversity benefits or avoid further reduction. In other words, they give up a part of their income, which can provide them other goods and services, for obtaining an increase in an ES or avoid a decrease. The SP methods, in contrast to the RP methods, can include both use and non-use values. The latter value type is often found to be important in nature conservation, especially in including many species and types of biodiversity with no obvious role or ”purpose” in producing services in the ecosystem.

The third group of (secondary) valuation methods is BT (Johnston et al. 2015; Navrud and Ready 2007; Lindhjem and Navrud 2008). BT uses value information from existing studies or data in the literature to transfer to a relevant policy context in need of such information. BT is a much-used method in practice and may be precise enough in some contexts. In recent literature, BT methods have explicitly focused on use in ES valuation (see e.g. UNEP 2013, Johnston and Wainger 2015, Ferrini et al. 2015).

While the economic valuation methods have been tried and tested for many years, applications using the ES framework fully are relatively recent, as noted by TEEB (Kumar 2010). In the last 10 years or so, there has been an explosion of valuation studies using the ES framework. Even if many of these studies provide reliable information about welfare implications of ES and biodiversity loss, the academic literature also calls for more careful validity testing and triangulation of the methods to achieve a higher level of precision and credibility, especially for SP methods since these are hypothetical by nature (Kling et al. 2012, Haab et al. 2012).

In addition, challenges remain in conducting ES and biodiversity valuation studies that are specifically designed for decision-support and cost-benefit analysis (CBA), not just awareness raising in general (Kumar 2010), and that deal directly with issues that arise in practical contexts (Börger et al. 2014). This is also the case in Norway, though more applied and practical valuation studies for policy use are being conducted. Scientific uncertainty, spatial explicitness and temporal stability of values, definition of affected populations and aggregation over both ES use and non-use values, are important questions in practice (Luisetti et al. 2011; Raheem et al. 2012; Sanchirico et al. 2013).

One specific challenge in the context of this report is that biodiversity in itself may not always be straightforward to value (see e.g. Lindhjem et al. 2015 and Lindhjem and Navrud 2011 for an attempt at valuing forest biodiversity conservation programs in Norway). In the cases biodiversity is important for certain services, it may be a better approach to value the associated services rather than biodiversity in itself. This also avoids double counting. In the case biodiversity primarily provides non-use values, choosing a stated preference method that value biodiversity directly is the only choice.

Moving research into resolving both methodological and practical challenges in ES valuation is seen as one of the most important frontiers of ES research (Guerry et al. 2015, TEEB 2010) and economic valuation research in general (Pearce 2005).

Even though the knowledge on monetary (and non-monetary) values of ES and biodiversity is still not complete or perfect in any sense of the term in any country, there is an urgent need to use what we have where relevant and to conduct new studies, designed specifically as support for policy-making, planning and decision-making. It is not possible to wait for value information to “become perfect”. As discussed more in chapter 3.4, the required level of accuracy of the value information can also vary with its use (so some uncertainty may be acceptable depending on the application).

Methodological issues in valuation and practical challenges in using and mainstreaming economic valuation information in different contexts, for example in the context of the county level realities in China, will have to be improved and solved through trial and error and continuous learning through pilots and testing. This is in the spirit of the CRAES and NEA cooperation project. It is important both to have the knowledge of valuation methods and what value information can (and cannot) tell us, and how to use such information appropriately in the right contexts and for informing the right policy instruments and decisions.

2.4 Towards mainstreaming and integration of values

While there is ongoing methodological development on how to measure and obtain reliable ES and biodiversity values, there is also an ongoing discussion on how and in what sense one can best mainstream or integrate such values in policy-making, planning and decision making. Since this is such a central topic of this report and the CRAES and NEA project, we try to clarify some of the ways in which valuation information may be used and how.

A simplified, generic illustration is provided in Figure 2.3. Decisions by private and public actors have impacts on ecosystems and biodiversity which in turn provide services and benefits that have value that in principle, and in many cases in practice, can be measured in monetary terms. These values can then in the next step in the figure provide information to institutions of various kinds. Once institutions learn and adopt this new information, the final stage is to design incentives that translate this information into price/value signals to all the private and public actors that make decisions that affect ES and biodiversity based on value signals and other factors.

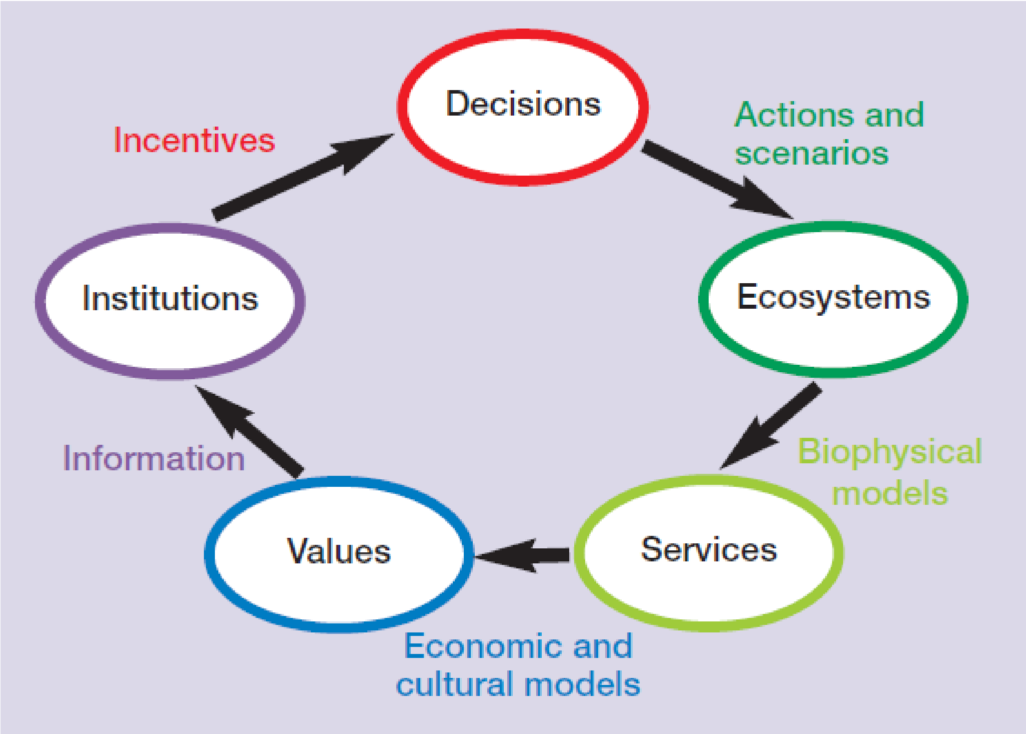

Figure 2.3 A simple framework showing how ecosystem services can be integrated into decision-making. Source: Daily et al. (2009).

A more specific and detailed framework for mainstreaming ES was developed by TEEB in their work on "The Economics of ES and biodiversity in national and international policy-making" (see Figure 2.4) (ten Brink 2011), and "For local and regional policy-makers" (TEEB 2011). The three main policy levels or instruments as seen by these authors are:

- Providing information for biodiversity and ES policies (or policies and projects that have impact on biodiversity and ES),
- Setting incentives to stimulate behavioural change, and
- Regulating use of natural resources directly.

Providing information helps in measuring what we manage. Setting incentives is about making the right price and other signals for different actors to change behaviour that is damaging or beneficial for biodiversity and ES. Finally, regulating use of natural resources directly is often more about direct regulation, e.g. in the form of setting up protected areas.

All instruments can utilize information about economic values of ES and biodiversity. The three instruments can then be linked to a number of specific policy options, tools or applications, illustrated with the row of boxes at the end of the arrows that may utilize combinations of the three instrument types (the reason for the dotted arrows). This include among others, starting from the left in the figure; reforming national accounting systems (beyond GDP), making benefits and costs more explicit in CBA and environmental impact assessments (EIAs), rewarding benefits (e.g. payment for ES), reducing harmful subsidies, and so on. There are a number of studies recently that provide good examples of mainstreaming, for example the high-profile UK National

Ecosystem Assessment (UK NEA) (discussed more in chapter 4) (a summary can be found in Bateman et al. 2013).

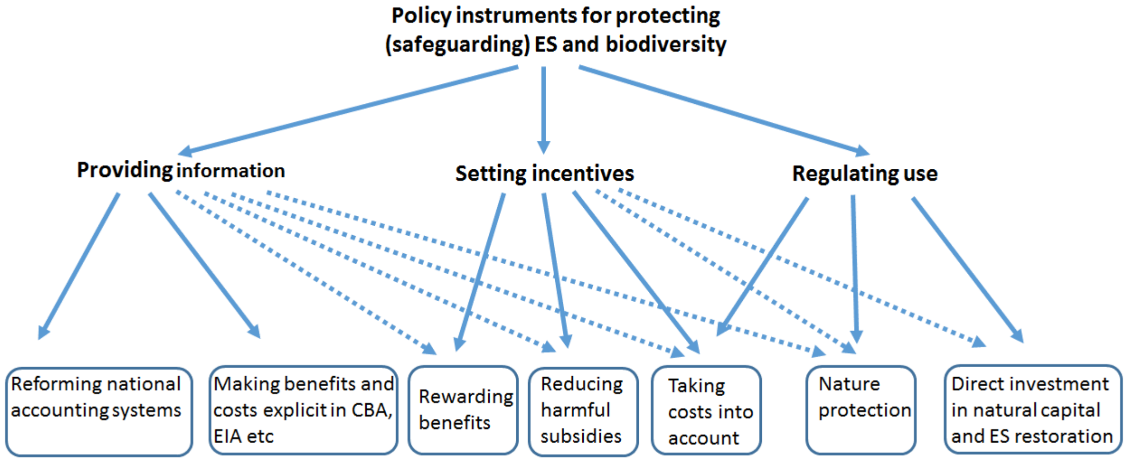

Figure 2.4 TEEB's proposed options for mainstreaming values of ecosystem services and biodiversity into policy-making. Source: Adapted from ten Brink (2011)

The three policy/decision-making contexts initially identified as most relevant in the Chinese context of the CRAES-NEA project (mentioned in Chapter 1) are linked with several of the specific policy options in Figure 2.4.

Payments may be interpreted as an incentive mechanism rewarding benefits (or compensating for damages). The tools for trade-off analysis are perhaps primarily an information instrument to improve the information basis for making decisions, for example specifically linked with (extended[10]) CBA (which is the main tool in economics for analysing trade-offs). But such tools can also be used as basis for setting incentive levels. All these applications will benefit from economic value information of biodiversity and ES. Finally, a county-level performance system as considered in China has a link to reforming accounting systems, although direct rewards to individuals working in government for reaching certain (environmental) targets is, to our knowledge, not common in western countries.

UNEP (2013) makes its own list of policy-making, planning and decision making contexts in which the economic valuation of ES and biodiversity may be useful. These very much correspond and overlap with the uses in Figure 2.4, including:

- Raise awareness of the value of the environment
- Reveal the distribution of costs and benefits of a project among winners and losers
- Design the most effective tools for environmental management
- Design appropriate fees for use of ES
- Calculate potential returns on investment for projects that impact the environment
- Compare costs and benefits of different uses of the environment
- Calculate values for ES and natural capital for input into green accounts

[10] As we discuss in chapter 4.3, standard CBA applications in Norway do not usually include monetary values of ES, though there is change under way to include more such values.

- Calculate environmental damages and set compensation

With this framework of policy instruments and applications for mainstreaming economic value information in mind, we proceed in the next chapter by giving an overview of environmental management and mainstreaming of biodiversity and ES and their values in Norway.

3. Environmental management and biodiversity & ES values in Norway

This chapter first provides an overview of the natural and socio-economic conditions and the institutional framework for environmental management in Norway, as a backdrop to the discussion of mainstreaming instruments. We then discuss the most important national initaitives and laws for providing information, setting incentives and regulating use. We focus primarily on biodiversity and nature conservation policies here, though many (if not most) policies will have an impact on the full range of ES.

3.1 Introduction: Norway's natural and socio-economic environment[11]

Norway comprises the western part of the Scandinavian Peninsula. Its borders are shared with Sweden, Finland and Russia. Norwegian jurisdiction encompasses vast ocean areas, including the island of Jan Mayen and the Arctic archipelago of Svalbard. Norway has a long rugged coastline which stretches over 2.500 km, broken by fjords and thousands of islands. Norway is also a mountainous country with many glaciers and some of the highest waterfalls in the world. The mountains draw Arctic terrestrial species all the way from the north to the southern part of the country. The climate is mild considering its high northern latitude, and Norway is the northernmost country in the world to have open waters. This is due to the Atlantic trade winds and the Gulf Stream. The latitude also results in great seasonal variations in daylight. The high mountain ranges, running north-south, also play an important part in shaping the Norwegian climate.

In terms of biodiversity, Norway cannot compete with areas as rich as tropical rain forests (or the variation found in China) for sheer numbers of species. However, the rugged topography and geological diversity, and people's varied uses, make for a highly varied natural environment. Geological forces have left their mark on the Norwegian landscape. Ice ages, glacial rebound and erosion have created jagged mountains, gentle U-shaped valleys, canyons, deep fjords, moraines and lakes. Hence, the result is a wide range of landscapes, ecosystems and habitats in a limited area, and some spectacular mountain and coastal scenery. These conditions also provide the basis for a large variation in ecosystem services from different nature types and habitats.

The distribution of area by land cover type is given in Figure 3.1, showing that mountain and forest areas are the dominant terrestrial land areas, and indicating their importance also for biodiversity and ES (in addition to the oceans not included in the figure). Almost 1/3 of mainland Norway is covered in forests and about 60 per cent of the species so far recorded are associated with forest habitats. Hence, forests have a special importance for biodiversity. Many other species are dependent on special conditions that are only to be found in cultural landscapes or in wetlands such as peat bogs. Through history, people have made use of most of mainland Norway for farming, hunting and other activities that still set their mark on the vegetation and species diversity today. The total number of species recorded in Norway has risen to about 44 000. The real number,

[11] Parts of this section are based on the public information website www.miljostatus.no

including those that have not yet been identified, is probably around 55 000 (www.miljostatus.no).[12]

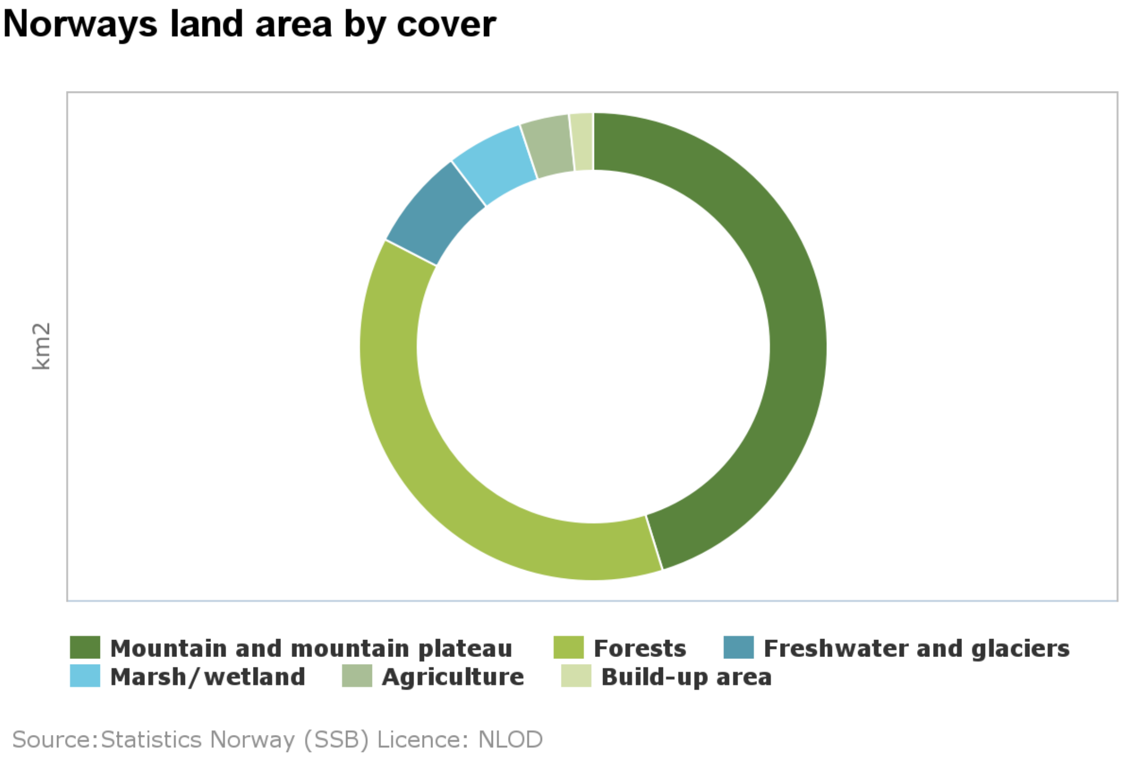

Figure 3.1 Land cover types in Norway

Although population (5.2 mill) and population density are low (ca. 16 per km^2) and more than 80 per cent of the population live in cities/villages, many species and habitat types are under threat in Norway (more on that below). The most important driver of biodiversity loss is land use change, including infrastructure development, new buildings, fragmentation of natural habitat and the (re)colonisation of open landscapes previously maintained by agriculture and grazing animals by trees and shrubs. In addition, climate change is a growing threat in Norway as elsewhere.

The Norwegian economy is open and mixed, with a combination of private and public ownership. The public sector has considerable ownership in key industrial sectors, such as in the oil and gas sector, hydroelectric energy production, aluminium production, banking, and telecommunications. Much of Norway's economy depends on the use of its natural resource base. For this reason, Norway is dependent on governmental regulation in order to balance economic and environmental interests, as we discuss below. The country is rich in natural resources, including oil and gas, hydropower, fish, forests and some minerals. The development of the hydroelectric energy sector at the beginning of the 20th century triggered industrial growth, particularly within the aluminium and ferroalloy industry, and fertilizer production. The discovery of large reserves of oil and gas in the late 1960s, gave further boost to the economy. Norway is the third largest shipping nation in the world, and aquaculture is currently the second largest export industry. Other economically important sectors include oceanic fisheries and forestry, though the latter is in relative decline (as is the oil and gas sectors).

[12] In comparison, the total number of species globally is estimated at around 13-14 million (according to www.miljostatus.no)

3.2 Institutional framework for environmental management in Norway

In 1972, Norway as the first country in the world established a ministry at cabinet level with special responsibility for environmental matters. Environmental awareness became a factor in Norwegian management at the end of the 1960s, at a similar time as for other Western countries. Local environmental problems due to hydro power generation were seen as some of the challenges the country had to face. There was focus on establishing protected areas, and cleaning up local sewage and eutrophication problems in the Oslo fjord and some inland waters, including Mjøsa, Norway's largest lake. Industry and point source pollution also became more strictly regulated under the Pollution Control Act, particularly in areas where there were health implications. While the focus initially was on pollution problems (and to some extent the protection of unique natural areas as national parks), biodiversity loss and extended nature protection (and very recently: the concept of ES) have with time gradually moved up the priority list.

Norway's environmental policies are closely linked with development in the European Union (EU), even though Norway is not a member. However, as part of the European Economic Area (EEA), it has agreed to transpose most of EU directives into national law. Exceptions are made for directives in agriculture and fisheries and some others, such as directives for nature protection. As a result, Norwegian environmental policy has in recent years been strongly influenced by the EU and has had some influence on EU environmental policy.

In the national context, responsibility for co-ordinating work on sustainable development lies with the minister of finance, aided by state secretaries ("deputy ministers") from various ministries. The Ministry of Finance co-ordinates policies on the economy, taxes, the budget and financial markets, and participates actively in structural and sectoral policy making. Sustainable development is seen as a core, long-term policy framework in which co-ordination and integration of economic, environmental and social policies are fundamental. The main objective is to make sustainable development central to policy making.

National environmental governance in Norway is organised in a hierarchical manner. At the top is the Ministry of Climate and Environment which is the leading government institution regarding environmental issues. Much of the work is delegated to a set of subordinated directorates:

- The Norwegian Environment Agency
- Directorate for Cultural Heritage
- Norwegian Polar Institute
- Norwegian Radiation Protection Authority
- The Norwegian Mapping Authority

The directorates generally buy services from research institutions and consultants to cover environmental monitoring and assessments. Much work is, furthermore, delegated to the County Governors, of which there are 19, and the 428 local municipalities also play an important role in the practical implementation of environmental policies, for example through Environmental Impact Assessments (EIAs) and land use planning on the municipal level.

Many of the important choices regarding biodiversity management can be found on the local level in Norway, as local communities according to Norwegian law and practice have the rights to manage local resources for often much-needed economic development, within the regulations set for spatial planning. However, many of the local natural resources are in many respects public goods of national importance, and there may be conflict of interest between the local and the national level in management of these resources. This is an important challenge for practical environmental management in Norway (NOU 2013).

In the next section we describe on an overall level how Norway include biodiversity and ES in policy-making, planning and decision-making, and the role of economic value information. We focus primarily on the national level initiatives (that of course also will have implications locally). In chapter 4 we go more into detail on a few specific examples from Norway (and Europe).

3.3 Overview of mainstreaming biodiversity and ES values in Norway

Sustainable development has continued to provide an overarching framework for environmental policy in general and its integration with economic and other policy areas in Norway. The Norwegian government and the Storting (the Norwegian Parliament) determine the ambitions of the country's environmental policy. The environmental policy has been divided into various fields, each with specific national objectives. The current list includes 26 targets, split between six priority areas: biodiversity, climate change, pollution, outdoor recreation, the cultural heritage and the polar regions. Indicators have been developed to make it possible to track developments and progress towards the targets (see below). The environmental directorates under the Ministry of Climate and Environment are responsible for assessing whether satisfactory progress is being made.

To reach these targets, a number of actions have been taken and planned through the instruments of providing information, setting incentives and regulating natural resource use directly, the three channels of mainstreaming discussed in chapter 2. Most targets have some link with ES. We will not go into detail on all instruments currently in use, but rather provide a brief overview of some important actions for mainstreaming of direct relevance for biodiversity and ES. We provide more detail on two examples in chapter 4.

Providing information for biodiversity and ES policies (or policies and projects that have impact on biodiversity and ES)

The set of instruments or applications under this heading is about making the impact on biodiversity and ES more visible, either as non-monetary or monetary value information.

On the national level Norway has since 2005 had a set of sustainable development indicators maintained and updated by Statistics Norway. In 2007 the Norwegian strategy for sustainable development was included in the National Budget for 2008, as a means for more closely integrating such concerns with economic planning and budgeting. The national indicator set is designed to provide information about status and progress with regards sustainable development. Currently there are 17 indicators, of which 9 are environmental or resource indicators. These include energy intensity, greenhouse gas emissions, local air pollution, health and environmentally damaging substances, loss of agricultural land, fish stocks, condition of protected cultural heritage buildings, and a specially designed nature index covering oceans and coasts, and terrestrial and freshwater environments. This Nature Index (NI) was first presented in 2010 to provide a basis to evaluate the state of biodiversity and to link the state to the management of nature. The NI is currently based on more than 300 indicators covering all major taxonomic groups and ecosystems. It includes 154 species of national management interest. The most recent report from 2015 tracks the status and trends in biodiversity, and also makes the link to ecosystem services (Framstad 2015). We discuss the NI more in detail in chapter 4.5. The environmental and resource indicators provide non-economic information, and do currently not include biodiversity or ES directly (though the NI is designed to capture important biodiversity aspects and also in its most recent version makes links with ES and accounting systems).

Statistics Norway has since the 1970s collected and maintained statistics on environmental impacts of economic activities. More recently in the 1990s the development of green accounts was suggested (and tried, at least at the research level) as a supplement to standard national accounts (or more accurately, as an environmental correction to national accounts). This has not been realised, and the environmental impacts are reported in non-monetary form as "satellite accounts" which together with the sustainable development indicators provide information about the status and trends of environmental and resource impacts.

In the last few years Norway has also participated in the development and piloting of a system of experimental ecosystem accounting together with the World Bank, FAO and the EU commission (United Nations 2014, Obst 2015).[13] The aim of this initiative is to include data on the flow of ES and how economic activities impact the quality and magnitude of the services, based on physical units but expressed in monetary values. A separate non-monetary accounting system is suggested for biodiversity. Testing in several countries is now ongoing.

A second example of an information tool and also a regulation is the system for closer consideration of impacts of public projects. In Norway, large investment projects, for example plans for railways or roads, of a certain size undergo a so called "choice of concept analysis". This system has elements that are similar to a strategic impact assessment (SEA). Further downstream, when project concepts are closer to implementation, Norway has a comprehensive system for assessing the full range of impacts, increasingly also biodiversity and ES impacts. According to Norwegian law (regulations on Environmental Impact Assessment, pursuant to the Planning and Building Act), EIA shall be carried out for projects of a certain size and character. The purpose of EIA is, according to §1 in the regulations: «..to ensure that impacts for the environment and society are considered in preparing plans, and when it is decided if, and on which terms, the plans are allowed to be carried out. The EIA system in Norway is similar to that in other countries.

Another important regulation is the so-called "assessment rule" ("utredningsinstruksen"), which states that all larger public projects shall be assessed sufficiently to enable good decisions for society. One of the tools much used for projects of some size is cost-benefit analysis (CBA). For CBA there are some guidelines issued by the Ministry of Finance in 2014 about how CBAs for public projects should be carried out. Further, guidelines for best practice CBA are developed from the Norwegian Government Agency for Financial Management (NGAFM 2014), and from time to time so-called expert committees are appointed in order to evaluate and suggest how CBAs should be carried out in the coming years. The most recent expert committee which gave their recommendations was in 2012, published in a public report series (NOU 2012). Both the EIA and CBA

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[13] Norway has contributed with financing for development, but without testing the system in Norway. Norway has also contributed resources to the international TEEB initiative and the international WAVES initiative (Wealth Accounting and the Valuation of Ecosystem Services), administered by the World Bank.

guidelines state how impacts on nature and ecosystems, and hence biodiversity and ES, could and should be taken into account. Normally, such impacts are currently included in the analysis as "un-priced" impacts, i.e. the seriousness of impacts is described by use of a rating system that is not based on economics. However, there are at present some processes of experiments and revisions of current guidelines for different government directorates in order to include the ES impacts more explicitly and for some impacts also value them in economic terms. The current system and the most recent thinking of including biodiversity and ES impacts are provided as one of the examples in chapter 4.3.

Finally, an important vehicle for providing information for the integration of biodiversity and ES values in decision-making in Norway was the public report from the Norwegian TEEB expert committee on the value of ecosystem services from 2013 (NOU 2013). This report provides analysis and information of relevance also for setting incentives and direct regulation of natural resource use.[14] There is some information on economic values of ES in Norway, however, a problem is the relative lack of such valuation studies in Norway. We provide a short summary of some of the report's recommendations in Textbox 3.1.

Textbox 3.1 The Norwegian TEEB committee 2011-13

In October 2011, the Norwegian Government appointed an expert Commission to assess and study the value of ecosystem services, a national follow-up of the international TEEB initiative. The Commission was asked, among other things, to describe the consequences for society of the degradation of ES, to identify how relevant knowledge can best be communicated to decision-makers, and to make recommendations about how greater consideration can be given to ES in private and public decision-making. 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.

The report makes a number of recommendations, including the increased use of economic valuation methods to demonstrate the values of ES and biodiversity conservation. The Committee also notes challenges associated with such methods, and recommend them as an important supplement to quantitative and qualitative considerations, including indicators and accounting systems. In Norway, there are large gaps in the knowledge of natural processes, ecosystems and services that also need to be in place to better assess the significance of services to people's well-being. The report also outlines a number of policy recommendations and discusses the role of economic and other (value) information in the role of such instruments. Government is currently considering various avenues of follow-up on the recommendations.

In December 2015 a government White Paper (titled "Nature for Life") provided a plan for biodiversity in Norway, the first such strategy in 14 years (St. Meld. 14 2015/16). This plan follows up some of the recommendations from the national TEEB committee report. It provides a broad- based strategy for "mainstreaming" the importance of biodiversity in policy, decision-making and planning. Non-monetary valuation of biodiversity and ES is not the most important tool in that respect, though the White Paper states that it will contribute to making values more transparent, and work for the development of valuation

[14] A summary in English is available at https://www.regjeringen.no/en/dokumenter/nou-2013-10/id734440/

methods, including economic methods. It is also stated that Norway will continue the support for development of accounting systems for ES and biodiversity.

Setting incentives to stimulate behavioral change

Incentives are about providing price signals about ES and biodiversity impacts to various actors to stimulate change in behavior. Norway was one of the pioneering countries to introduce environmental taxes and fees in the area of air pollution, including carbon tax on mineral oils (in 1991) and some harmful/toxic substances. Many of these taxes were (at least partly) based on information about the economic value of environmental damages. The value information was often based on national and international valuation literature relating environmental (and health) impacts from air and water pollution with certain pollutants.

However, in the area of biodiversity and nature management, economic instruments are relatively rarely used to date to stimulate conservation directly or “punish” behaviour that have negative biodiversity and ES impacts. Under sector laws and regulations (see next section) there are various support schemes, though not primarily designed for this purpose. One important exception is the voluntary forest protection program established in 2000, as a response to conflict with forest owners over the more traditional command and control approach to conservation. This programme has similarities with a PES program, we go more into detail on the program in the next section and in chapter 4.2. A more recent exception is an economic support scheme under the relatively new Nature Diversity Act (see next section) that stimulates the management of certain habitats and species.

A recent important national initiative was the report from the public expert committee on Green Taxation from December 2015 (NOU 2015). The mandate was to investigate the increased use of environmental taxes, combined with lower general taxation, to achieve a “double dividend” of better environment and strengthened economy. The report covers the most important environmental impacts, with its primary weight on local air pollution and greenhouse gas emissions. The report does also follow up on certain recommendations from the national TEEB report, and investigates instruments to reduce biodiversity and ES impacts. A central conclusion is to work towards better reflecting the full cost of environmental impacts in taxes and fees, i.e. getting the prices right. In the area of nature protection, the committee recommends further exploration of a proposed instrument that would levy a tax on the use of natural areas (“nature tax”) for various technical installations or other impacts to include the full cost of biodiversity and ES impacts. This tax would have to be (partly) based on estimates of the economic value of such impacts from new valuation studies (long term strategy) or by using benefit transfer methods from the international literature (short term, until more domestic valuation studies are available). The nature tax proposal is an important step forward for “mainstreaming” the value of biodiversity and ES impacts in Norway. Although it remains to be seen whether it will reach the stage of implementation.

Regulating use of natural resources directly

This section contains a brief overview of the main direct regulation policies of relevance to biodiversity, and many of the important ES. In June 2009, Norway established the Nature Diversity Act, which includes all previous laws related to land use and biodiversity in one act (see Textbox 3.2). This act is the most important legal framework for all foreseeable regulatory and economic instruments in the area of biodiversity conservation – both inside and outside protected areas. The act regulates two relatively new economic support instruments for management of priority species and selected habitat types (see short description in chapter 4.5). The act is also the primary instrument for Norway to follow up on its international commitments under the Convention on Biological Diversity, to which Norway is a signatory. Norway has also signed most (if not all) other international treaties, such as e.g. the Convention on International Trade in Endangered Species (CITES), the UN framework convention on climate change, RAMSAR, and the Bern Convention. However, despite having a close relationship with the EU as mentioned above, Norway has not yet adopted the EU Habitat Directive.

The prime "command and control" instrument used historically by the Norwegian authorities for biodiversity conservation purposes nationally is the establishment of protected areas, primarily based on appropriation of private land (against compensation) of biologically rich areas. This has a relatively long history in Norway. The first plan for creating national parks in Norway was passed in 1967. The legal and regulatory frameworks to protect biodiversity have been strengthened, and conservation efforts both in terms of the number of protected areas and the certification of forest production have increased since the 1970's. Since the use of command and control has met with strong opposition and conflict in recent years, especially from forest owners, it was superseded by a voluntary forest conservation scheme, as mentioned above. The command and control way of establishing protected areas is currently almost dormant, and it is unclear whether it will continue to be so. That depends primarily on the progress and results of the voluntary scheme, which currently seem promising. We present and discuss the voluntary forest conservation scheme in chapter 4.2.

There are a range of laws and regulations, within the broad category of "direct regulation" that may also potentially have bearings on activities (forestry and others) that have impacts on biodiversity and ES. Chief among these is perhaps the spatial planning apparatus (on local, regional and national level), including requirements for EIAs and CBAs etc., as we discussed above.[15] There are also a number of policy instruments that may affect biodiversity conservation and ES, which were introduced for other reasons. Many of these instruments that are chiefly handled by non-environmental ministries and directorates, may have negative "side effects" on biodiversity and ES. The perhaps most prominent sector policies worth mentioning here are:

- Forestry policy
- Agricultural policy
- Energy policy
- Infrastructure policy
- Regional development and distributional policies

Each of these policy areas contains both direct regulation and various economic instruments. Forestry policy is mainly aimed at promoting timber harvesting and has a much longer history than environmental policies in Norway. There are a range of economic instruments in operation aimed for example at increasing tree planting, thinning and other silviculture and harvesting in areas where harvesting costs are high. Agricultural policies are numerous and complex. Many of the economic instruments are targeted at increasing production, while some are directed more towards environmental

[15] There is for example also a specific law ("Markaloven") that has recently entered into force, governing the management of forests around Oslo for recreation purposes. Recently, areas have been singled out for protection based on a methodology that identifies both recreational and biological values, although not assessed or quantified in monetary terms. See: https://www.fylkesmannen.no/Oslo-og-Akershus/Miljo-og-klima/Marka/Markavern/

stewardship that may benefit biodiversity and ES (though such support is low compared to the total agricultural support).

Support for renewable energy and various types of infrastructure (roads, power lines etc.) is important, and projects in these sectors have potentially large impacts on biodiversity and various ES. Wind power development, for example, have impacts on the threatened sea Eagle populations along the coast, and other infrastructure such as roads and railways may make migration routes harder for various animals.

The main channel of including biodiversity and ES impacts in these areas are the work towards reducing environmentally harmful subsidies (such as support for construction of forest roads and harvesting in steep terrain) and capturing and mitigating impacts during the planning stages, before implementation. For this, the planning system mentioned above, that increasingly also is considering ES and biodiversity impacts should be able to make the environmental costs of projects and activities that have such impacts more visible in the decision-making process (see also discussion in chapter 4.3).

Textbox 3.2 The Norwegian Nature Diversity Act from 2009

The Nature Diversity Act (Naturmangfoldloven LOV-2009-06-19-100) is the most central law for nature management. The Act embraces all nature and all the sectors that manage or make decisions that have consequences for nature. The law defines explicit conservation objectives that need to be considered in all decision-making about nature. It has two main instruments to achieve it aims: through nature protection and through regulations for sustainable use.

1. **Aims to establish protected areas**

The Act has a general decision in § 33 about the purpose to establish protected areas that includes the protection of:

1. The range of variation of natural types and landscapes
2. Species and genetic diversity
3. Threatened nature
4. Areas with important ecological functionality for priority species
5. Larger areas of pristine ecosystems
6. Nature that has been shaped by anthropogenic use through time.

The Act defines four categories of protected areas that are relevant for forest protection each of them aimed at the different conservation objectives listed above.

National parks are aimed to protect larger areas of ecosystems or landscapes that have very limited anthropogenic intervention and that are representative of a particular type or that have particular characteristics. **Landscape protection areas** are aimed to protect natural or cultural landscapes of ecological or cultural value. Land-use forms at the time of establishment can continue. **Nature reserves** are established on areas that have natural values that are threatened, rare or vulnerable, that can represent a particular type of nature, or that have particular importance for biodiversity protection or for research. In nature reserves all human activities can be banned if the conservation objectives are threatened. **Habitat protection** aims at protecting areas that have an ecological function for one or more particular species. It can be used for all species either they are protected or not. Under all these forms, particular conservation objectives are defined when the protected areas are established.

2. **Aims about sustainable use**

The Law establishes that through regulation of use, the diversity of natural types is maintained within their natural geographical ranges, including their characteristic diversity of species and ecological processes. The aim is also that the structure, functions and productivity of the ecosystems is maintained. Use and management decisions will be based on scientific knowledge about species population status, the distribution of natural types, their ecological status, and about the effects of use on these conditions.

The principle of environmental and ecologically friendly techniques and praxis *§ 12* provides guidelines about the choice of techniques, practices and of the location of activities that will provide the best result for society. Generally, the best solution for the environment will be chosen even if it results in extra costs. In that case, the best alternatives for society will be chosen, weighing in the protection of biological diversity as an important factor. In the Law § 13, *the King of Norway has the authority to establish the quality standard for biodiversity*. The standard can be related to the occurrence of particular natural types or species, or other conditions that have relevance for the biodiversity. Source: Barton et al. (2012).

3.4 Experiences and progress to date?

In the previous sections we reviewed the way Norway has used combinations of different approaches to mainstream the importance of biodiversity and ES. In this section we first briefly discuss the status of progress and then consider the role of economic value information in Norway's work to date.

Effects of mainstreaming efforts

How does Norway perform in terms of biodiversity conservation? Are the mainstreaming efforts bearing fruits or is the level of ambition too low to make progress? We are not going to answer these questions, only make a few observations.

First, one way of capturing the status and progress of biodiversity conservation is through the Nature Index. Remembering that a value of 1 indicates a reference state (with no or little human disturbance) and 0 a seriously degraded state, the most recent report from 2015 concludes the following:

- <u>Status:</u> The index shows considerable variation. The highest values are recorded in freshwater (0.75) and marine ecosystems (0.62-0.72), while the lowest are recorded in forest (0.37) and open lowland ecosystems (0.47).

- <u>Trend:</u> The trend for pelagic sea bodies has been positive until 2010. For wetlands and open lowlands the trend is very clearly negative while there is a slight improvement for forests since 1990. For other ecosystems, there is no clear trend. There is further little variation across the country or sea areas.

Although these figures should be interpreted with care[16], they suggest that even though Norway has a large forest cover, which is important for biodiversity, the forest habitats are very degraded compared to a (near) natural state. Open lowland also has a relatively low value. Given both status and trends, this source of biodiversity information in Norway illustrates that there are challenges for further mainstreaming of biodiversity and ES values.

OECD's environmental performance review from 2011 for Norway states that the number of species threatened by extinction is relatively low by OECD standards (OECD 2011). The review generally supports the conclusions of the Green Tax Commission, mentioned above, in stressing the potential to reduce environmentally harmful subsidies, to scale back exemptions and increase revenue from environmental taxes. The country is given credit for a "strong analytical framework for integrating environmental, social and economic considerations". The OECD has in mind the National Sustainable Development Strategy and the indicators, discussed above.

In the specific area of biodiversity policy, OECD states that "*Norway has developed an ambitious biodiversity policy, and significant progress has been made to provide the means to achieve its goals. The new, innovative Nature Diversity Act (2009) brings together many biodiversity-related issues, and introduces new principles and tools for sustainable management of biodiversity. In addition, several sectoral laws have been revised and new laws enacted that strengthen biodiversity protection. The area of land under protection has increased significantly. Sea management plans could open the way for better protection of marine areas. More broadly, there has been substantial investment in expanding the biodiversity knowledge base, including the establishment of*

[16] There are both methodological and data availability challenges in using the Nature Index in practice.

a Biodiversity Information Centre. These activities have been supported by a substantial increase in public expenditure on biodiversity, especially in recent years."

Even so, the OECD also notes that Norway still faces major challenges in the conservation and sustainable use of biological diversity: *"Protected areas do not sufficiently cover all nature types; on land, the low percentage of forests under protection is of particular concern. Norway lacks overall targets and objectives for forest protection, though a voluntary forest protection programme is beginning to pay-off five years after implementation. The conservation of biodiversity within protected areas is not sufficiently secured. Increasing aquaculture, including cod farming, poses a threat to fish stocks, water quality and biodiversity in Norwegian coastal waters and possibly beyond. Although Norway's four large carnivore species (brown bear, lynx, wolf and wolverine) show a slight upward trend, they are all listed as threatened on the 2010 Red List. Protection targets are set at levels too low to maintain viable populations. Spatial planning has not been effective in halting the loss of large "wilderness" areas, nor in preventing building in coastal zones and along lakes and rivers.*

Hence, even though several new initiatives have been proposed and implemented since this 2011 review, many of the concerns noted by the OECD remain today. In that sense, it is likely that the values of biodiversity and ES have not yet been well-reflected in these areas, despite increasing policy efforts in recent years.

The role of economic value information

Even though there is still potential for improvement, some progress has also been made. It is difficult to assess the role of economic value information in the information provision, incentive setting and regulation of resource use, as discusse above.

Once a policy instrument has been designed and implemented, it is not always easy to assess in detail to what extent economic valuation information has been "actively used" or if value information has had any impact on the final design (even if such information has been "actively used" in some stages of the process). The conception and implementation of any policy instrument involves a political process that shapes the outcome, often substantially as compromises and deviations from the ideal instrument take place in negotiation rooms.

In this process monetary value information may provide one part and other non-monetary and monetary interests and values are also represented. In some cases information about the importance of biodiversity or certain ES may have played a part, but the information may not have been in economic terms.

Considering the situation in Norway reviewed above, it is clear that economic value information of biodiversity and ES has played a very little role in decision-making and policy development in this area.[17] In the area of biodiversity and nature management, various forms of direct regulation (e.g. spatial planning laws, nature protection) has been the norm. Often this means that no direct, economic valuation information has been used in the design of these laws and regulations. Even so, they reflect a value position of those who manage biodiversity and nature on behalf of the population. Hence, decisions such as these (e.g. the strength and ambition of laws) reflect an implicit value of ES and biodiversity, when these are affected.

[17] Though, as noted, economic value information played a part in the design of the pioneering environmental taxes on pollution in Norway in the 1990s.

It is important to remember that design of direct regulation may also benefit from explicit monetary (and non-monetary) value information, not just economic instruments. Hence, even if Norwegian regulation has developed without direct economic information, it does not mean that these regulations would not have been more efficient and in some cases stricter if appropriate and more transparent value information were available.

The lack of economic valuation information was at least the case before the international TEEB initative and the national public TEEB committee, where the economic sigificance and value of ecosystems was lifted and emphasized both in policy-makers' and the public's minds. Results from economic valuation studies were presented in that report, which contributed to awareness raising, if not (yet) providing direct basis for design of policy instruments. In the report from the Green Tax Commission, there was also a discussion of the economic valuation methods and available results as basis for setting a nature tax. Hence, such value information has increased in acceptability, though there are still few such studies commissioned for policy assessments/CBA and instrument design purposes (we return to an example of this in chapter 4.3).

Even if little economic valuation information has been used in shaping policies to date, the policy developments we have reviewed above do reflect the importance and non-monetary values placed on biodiversity (and indirectly ES). Further, the trend is that monetary value information is both sought and used more often, even though there is also some scepticism and reluctance towards letting economists measure such values based on the preferences of people (rather than experts).

A final note on the strengths and weaknesses of different instruments

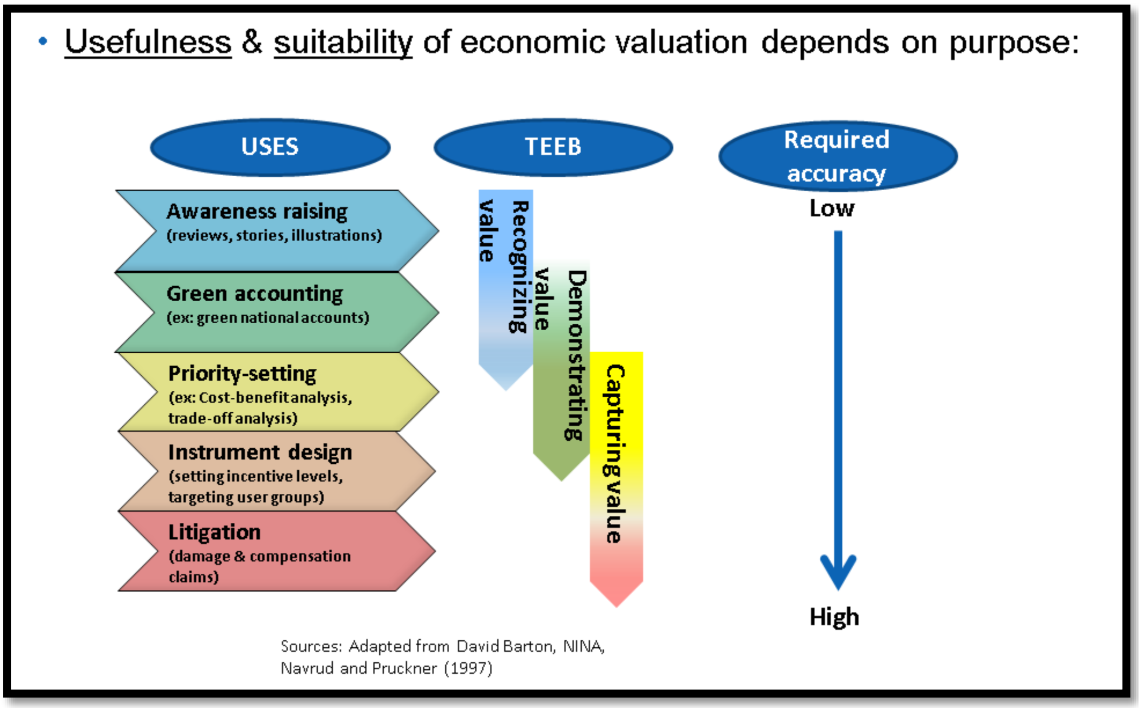
Each of the policy instruments (or combinations of them) disucssed above have their well-known theoretical and practical strengths and weaknesses in addressing different environmental problems (see e.g. Sterner 2003). Direct regulation is more suitable than tax or subsidies under certain conditions. For example, if the marginal costs of complying with a policy vary and the marginal environmental damages of land use activities are are fairly constant over the landscape, it may work well (i.e. be relatively efficient) to levy a tax on the damaging activity in order to align marginal costs across actors (see e.g. Vista Analyse 2015). This was discussed by the Green Tax Commission for the nature tax.

If instead, the marginal damages (or benefits) to ES and biodiversity vary a lot over the landscape, it may work better to use direct regulation or combinations of instruments etc. Assessing the optimal instrument both in theory and practice may be complicated, and assessing the impact of an instrument over time and in combinations with other instruments and regulations, even more so (Goulder and Parry 2008). We have not tried to do that here, and only point out that most countries likely need to combine economic instruments and information with some degree of direct regulation to achieve biodiversity and ES goals. And regardless of which instruments and combinations of instruments are chosen, economic value information may be useful in deciding level of ambition and specific design.

Finally, each of the policy instruments will have different requirements for the accuracy and reliability of value information for such information to be useful (Navrud and Prückner 1997). See Figure 3.4, where five types of uses of valuation information are distinguished at the left hand side. Each of these have different requirements for accuracy.

Green national or county/provincial accounting systems, for example, may require less accurate/precise information than design of incentive instruments (that in the case of taxation, for example, needs a firm legal basis). Hence, in some cases values that come from the literature (i.e. benefit or value transfer) may be good enough while in others a new primary, carefully designed RP or SP study would perhaps be desirable. This also means that while value information may have been utilised in the design of a specific instrument, it may not have been accurate enough or entirely suitable for the purpose. We discuss the role of economic value information in more detail in the next chapter.

Figure 3.2 Use of economic valuation information



4. Examples of mainstreaming from Norway and Europe

4.1 Introduction to the examples

In this chapter we provide an in-depth description of three case examples of mainstreaming biodiversity and ES and their values in Norway and Europe. Figure 4.1 provides an overview of the three examples (green text in figure) of voluntary forest conservation in Norway, incorporation of ES and biodiversity in cost-benefit analysis and environmental impact assessments in Norway, and ecological fiscal transfers in Portugal and France. In addition, we provide in section 4.5 shorter examples (black text in figure) of a number of other initiatives.

Examples and links with TEEB instruments and Chinese context

Figure 4.1 places the examples within the categories of instruments for mainstreaming discussed by TEEB (top line in figure) and introduced in chapter 2. Direct regulation is not included here, as the main interest is on more market-based or economic instruments. Setting incentives (or more broadly: conveying the real costs and benefits of policies or projects to decision-makers), for example, are related more or less strongly too all three types of examples. Dark blue in the figure indicates a primary purpose of the instrument. Both the use of EIA/CBA and the Norwegian Nature Index are concerned with providing better information (with or without monetary values) that may lead to more conservation.

The mid layer in the figure include our example cases. The lower layer in the figure relates these examples and the two TEEB instruments to the most relevant arenas for mainstreaming biodiversity and ES in China, as discussed in chapter 1 and 2. It is not meaningful to make sharp divisions between categories. Ecological fiscal transfers can for example be considered a county level performance system but at the same time this instrument is also about setting incentives (therefore the dotted arrow). Further, including ES and biodiversity in CBA/EIA is primarily a way to provide better information, but ultimately also about setting the right incentives for decision-makers.

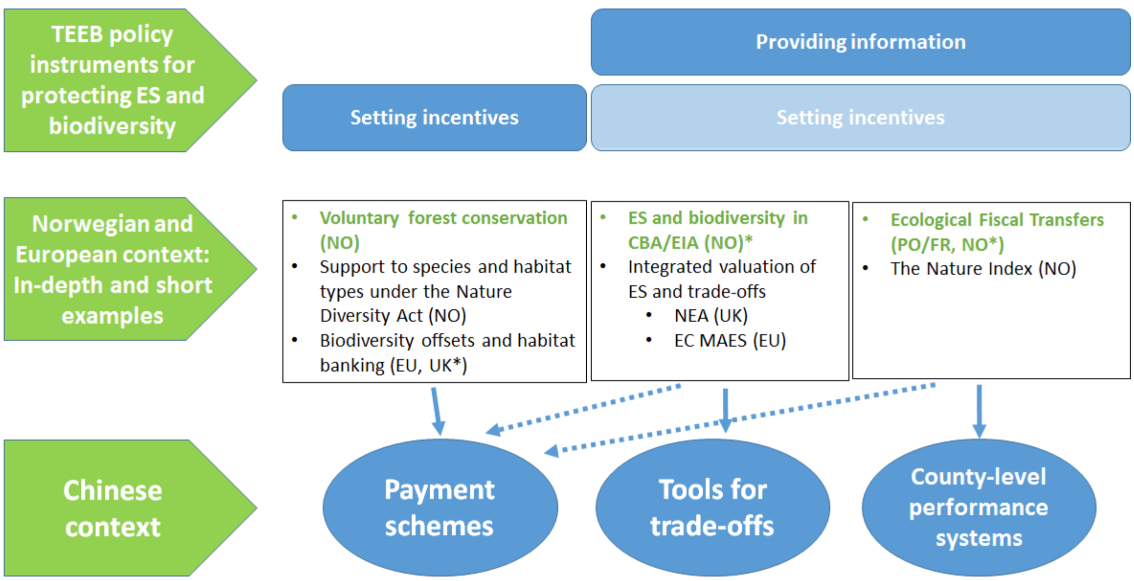


Figure 4.1 In-depth (green text) and short case examples of mainstreaming biodiversity and ecosystem services

Notes: NO = Norway, FR = France, PO = Portugal, UK = United Kingdom, EC = European Commission, EU = European Union, MAES = Mapping and Assessment of Ecosystems and their Services, NEA = National Ecosystem Assessment, * = Piloting or ongoing development/discussion of instrument.

Motivating choice of examples

Some of the examples (indicated by * in Figure 4.1) are under piloting or undergoing development and refinement to better include biodiversity and/or ES. In the first category of payment schemes, the Norwegian voluntary forest conservation program is a good example of a fairly successful, PES-like scheme aimed at preserving biodiversity. Considerations of ecosystem services more generally are not included to date. In this program payments (compensation to forest owners) are primarily paid on the basis of opportunity costs, and biodiversity benefits considered in choosing which forest plots to enrol in the scheme using qualitative criteria. The program is relatively well-documented (for example Lindhjem and Mitani 2015; Mitani and Lindhjem 2012) (see next sub-chapter). We also include in the first category of payment schemes a couple of shorter examples, first the support scheme under the Norwegian Nature Diversity Act for managing and protecting priority species and habitats, and the piloting of biodiversity offsets and habitat banking in the EU and UK (currently under implementation).

In the second category in the figure, tools for trade-offs, a good example from Norway is the ongoing work on integrating biodiversity and ES information (including monetary and non-monetary values) into CBA and EIA. Compared to the forest conservation program, the aim is to include the full ES framework, not just biodiversity. This is an area of continuous development and improvement at the moment, where the integration of the ES framework has only recently been operationalised. For example, Vista Analysis is working on methodology development for the Norwegian Coastal Administration to value cultural ES loss from oil spills from ships to include in CBA of prevention measures (Lindhjem et al. 2014; Vista Analyse 2016). This is a good example of how a non-market valuation method (contingent valuation in this case) can be used in practice, and how it may improve decision-making. Further, we have included two shorter case examples demonstrating spatially explicit, integrated valuation of biodiversity and ES: European Commission's initiative on the Mapping and Assessment of Ecosystems and their Services (MAES) and the UK National Ecosystem Assessment (NEA), both shining examples of how mapping and assessment (and economic valuation in the case of UKE NEA) of ES may help evaluating trade-offs, and provide useful information for decision-making.

Finally, the last category of county-level performance assessment systems has no obvious counterparts, to our knowledge, in Europe. Indicator systems, such as those discussed in chapter 3 for Norway, are related. Ecological fiscal transfers (EFT), which is a combination of incentives and performance assessment on the municipal level, is in place in for example France and Portugal (Ring and Schröter- Schlaack 2011). This may be relevant for county level performance assessment in China. EFT has also been floated as an idea for Norway, but not yet carefully been investigated. We therefore choose ecological fiscal transfers as our main example in this category. Finally, we include a shorter example of the Norwegian Nature Index, as a useful information and indicator/performance tool and a way to track status and trends in biodiversity. Eventually, this index may also be disaggregated to lower administrative levels (for example regions or municipalities) and connected more closely with ES mapping and performance assessment.

Structure and content of the case examples

The three in-depth cases follow the same structure:

- Background and aim of instrument
- Description of how the instrument works in practice
- Experiences and lessons to date (including use of value information, plans for refinement of instrument)
- Relevance for China

As noted in chapter 3, assessing the optimal instrument both in theory and practice may be complicated, and assessing the impact of an instrument over time and in combination with other instruments and regulations, even more so (Goulder and Parry 2008). It is also hard to assess if and how economic value information has played a role in the conception, design and implementation of an instrument. Even so, we are able to draw some tentative conclusions based on known theory/principles, available data, previous evaluation studies and impressions of actors involved. Overall success of an instrument is usually assessed by economists on the basis of economic efficiency (a policy's aggregate net benefits) and its close relative, cost-effectiveness (to reach a target at lowest possible costs). Other important criteria are the distribution of costs and benefits (equity) and the ability to address uncertainties (an important aspect in ES and biodiversity management). We try to cover some of these aspects in summing up experiences and lessons from the in-depth case examples.

4.2 Voluntary forest conservation (Norway)

Background and aim of policy instrument

Traditionally, the main regulatory instrument for biodiversity conservation in (coniferous) forests in Norway, in addition to the forest law and forest certification schemes, has been state appropriation of private forest land for forest reserves against compensation based on the value of the standing timber (i.e. opportunity costs were compensated). Conservation on private land is a very important vehicle for biodiversity conservation in Norway since around 90 per cent of the productive forest land is owned by private forest owners or (to a lesser extent) organisations. The traditional "command and control" conservation approach was the source of serious conflicts between forest owners, the state and environmental NGOs in the 1990s, as noted in chapter 3 (Bergseng and Vatn 2009). Conservation progress was slow.

A 2002 natural science evaluation of forest conservation showed uneven distribution of conservation areas with respect to geography, natural conditions and type of forest. Productive forest under conservation at the time amounted to only about 1 per cent of the total, while 4.6 per cent was deemed necessary to meet biodiversity conservation needs (Framstad et al. 2002).

As a response to the untenable situation and lack of progress, the voluntary conservation program was proposed by the Federation of Norwegian Forest Owners ("Norges Skogeierforbund") in 2000 and has enjoyed wide political support. Since 2003 nearly all new processes to conserve forest on private land have been in the form of voluntary conservation, not as traditional, mandatory conservation.[18]

[18] The last such conservation area of a relatively large size was established in 2009, the Trillemarka nature reserve.

By 2016 around 3 per cent of the productive forests are protected (a total of 162 km^2) in forest reserves, where no forestry is allowed. There are particular gaps in conservation areas in low-land, productive forests in the South and Central parts of Norway, where a large part of the coniferous, productive forests are located (see Figure 4.2). In the plans for 2016, a large new conservation area in Vikerfjell in Southern Norway has just been proposed.

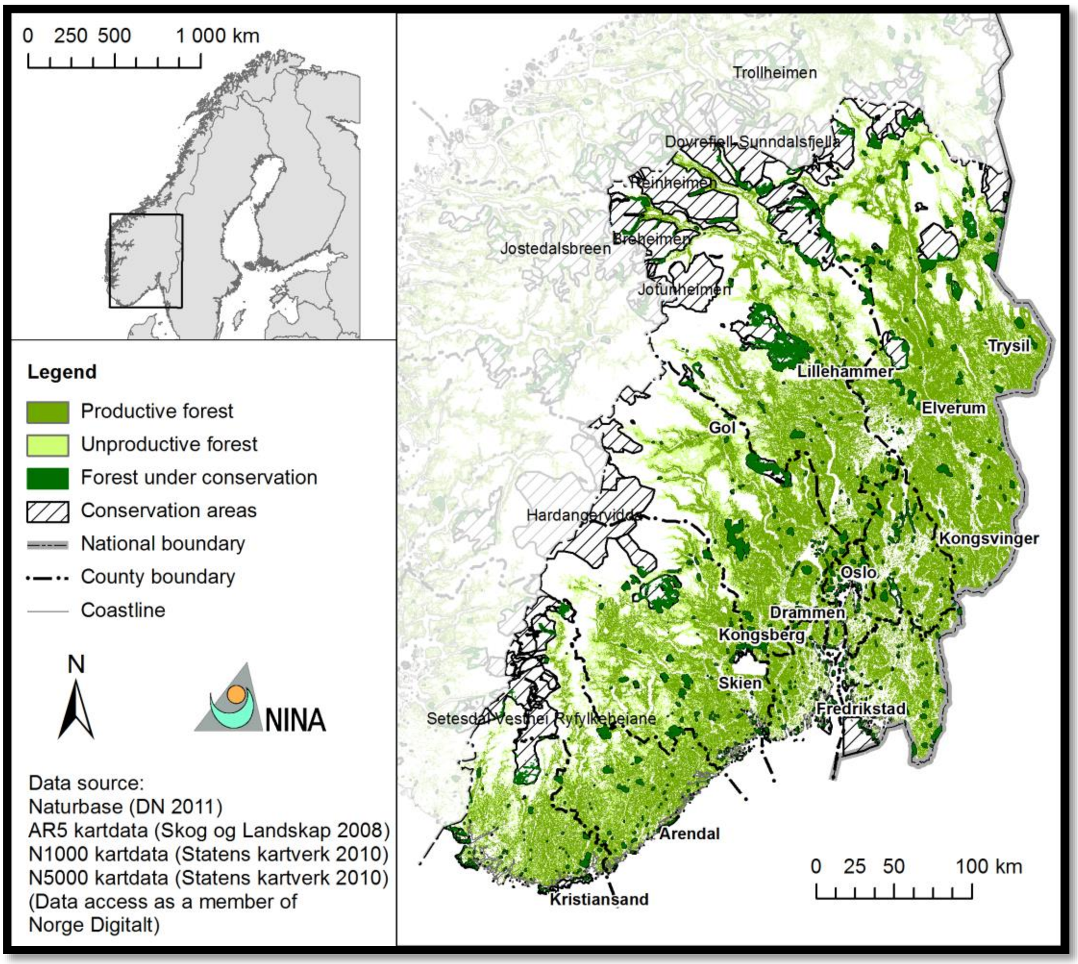


Figure 4.2 Forest cover and protected area network in South-Central Norway. Source: Barton et al. (2012).

Note: “Conservation areas” are the total areas, while “forest under conservation” is the part that is forest.

Description of policy instrument

Voluntary conservation processes differ from traditional conservation processes first and foremost in the start-up and early phases. From then on, voluntary conservation follows almost the same process as traditional conservation of nature reserves under the Nature Conservation Act. Traditional conservation starts with the compiling of inventories, assessment of conservation (non-monetary) values and drafting of proposals for conservation areas under the direction of the environmental authorities. Compensation cannot be considered before the conservation plan is finally approved. Voluntary conservation, on the other hand, begins formally by forest owners submitting a proposal of voluntary conservation to the County Governor. Prior to this a closed, informal process has been carried out involving the forest owner(s), Federation of Norwegian Forest Owners, County Governor's environmental department and Environment Agency. When the County Governor announces the start of the conservation planning process, forest owners and the County Governor will have agreed on the area's borders, conservation regulations and compensation (Skjeggedal et al. 2010).

The forest owner is then compensated using the same formula as for the mandatory scheme, usually through a present value based, one-time payment covering discounted timber revenues, subtracted harvesting costs. Compensation is calculated based on a felling plan for the two most mature felling classes at current timber prices (net of harvesting cost) within a 10 year horizon, applying a discount rate of 5 per cent. For the remaining timber in lower felling classes, an additional, standard value is calculated.

The ownership of the reserve remains with the forest owner, but he or she relinquishes all rights to forestry activities for perpetuity. Hunting, mushroom, and berry picking and other recreational activities that do not involve setting up permanent facilities in the reserve are allowed. In some areas, there are expectations of developing more commercial activities in the future, such as construction of recreational homes, or special tourism or hunting activities (Mitani and Lindhjem 2015). In addition to direct and indirect use values, the reserves also provide important non-use values for the public, including some forest owners.

This time feature of the voluntary program makes the Norwegian scheme quite unique since other countries' schemes, including agro-environmental schemes, for example, the "Trading in Natural Values" program in Finland or the Conservation Reserve Program in the USA, typically have time-limited contracts (Mäntymaa et al. 2009). This time feature is clearly good for conservation purposes once the agreement is made. However, it may require stronger incentives for forest owners to participate in the first place (Mitani and Lindhjem 2015). The rules of compensation are quite similar between the mandatory and the new voluntary approach: the main difference compared to mandatory conservation lies in the process steps and the central element of voluntariness (Skjeggedal et al. 2010).

It is the element of voluntariness and payment accoridng to opportunity costs (plus in practice a small markup, see below) that makes the scheme similar to a payment for ecosystem service (PES) program.

Experiences and lessons

The instrument has not undergone a full impact evaluation to assess conservation effectiveness. A recent assessment concludes that especially low lying, productive forests and endangered species and habitat types in Southern Norway (see Figure 4.2 above) are still highly underrepresented in the protected area network (Framstad et al. 2010). An important reason these areas are under represented is that they are still very valuable for commercial forestry and that voluntary conservation is not attractive enough. Another reason why some of these areas are not well-covered is that some of them may not be forestry areas, e.g. could be remnants close to urban areas where the main threats are urbanization and infrastructure development. Even so, compared to the traditional conservation approach, it is clear that the government looses some control over the conservation outcome using the voluntary approach.

Further, enrolling sufficient non-industrial private forest owners into the scheme will be crucial to achieving conservation objectives. The forest area is owned by ca. 120 000 indivual, private forest owners, many of which are organized in forestry organizations (the Federation of Norwegian Forest Owners is the biggest). A handful of them own large areas, while the majority of the holdings are small and owned by the non-industrial private forest owner category. Currently, the main obstacle to further progress of enrolling more forest owners seem to be lack of sufficient budget in the Ministry of Environment.

Regarding cost effectiveness, we do not have much quantitative information to base the assessment on. Compared to the mandatory scheme that preceded the voluntary scheme, there are indications that the voluntary scheme is less costly in terms of process and litigation costs (i.e. key components of transaction costs). This is due to the voluntary element of the process. The costs in terms of compensation payments compared to environmental values (“value for money”), are uncertain. One study indicates that compensation payments are slightly higher under the voluntary scheme (Skjeggedal et al. 2010), though the formula for calculation of the compensation payment has formally not changed. It may be that the attitude from the authorities is to be slightly more generous (for example to avoid conflict and keep the good cooperation environment), though this is not confirmed officially.

Given the high hostility and conflict level associated with the mandatory scheme, the voluntary approach has a higher legitimacy and acceptability among forest owners (which is of course as expected since the largest forest owner association proposed the scheme). However, among conservation NGOs and to some extent other stakeholders, the voluntary approach had a lower acceptability, at least initially. This is because they doubt that the remaining, prime areas (and areas of sufficient size) will ever be enrolled through voluntary means. Hence, they argue that the mandatory approach should be used in parallel to better cover gaps in the protected area network. There seem to be some movement on the forest owners’ position in this respect, although their general argument still mainly holds, that (re)introduction of the mandatory scheme will undermine trust and goodwill among forest owners to continue with the voluntary scheme. It seems that the Environment Agency and the political community in general, still put considerable faith in the mechanism as the main scheme to be used for the future. Hence, it seems that it is the low conservation budgets, rather than lack of biologically interesting offers, that now hinders progress in reality.

The voluntary scheme has many advantages, but as mentioned the conservation progress has been relatively slow compared to ambitions. A major hurdle is the low public budgets to compensate those forest owners who have submitted proposals for conservation reserves. Also the mapping of priority forests for conservation which is a pre-requisite set by the Environment Agency slows the process down. Maybe more effort could be put into a description of habitats or kinds of forest stands that forest owners could identify on their property (Skjeddedal et al. 2010). There may also be other ways to improve the scheme.

However, it is likely that increased budget is not enough on its own: additional measures/instruments or changes to the current voluntary scheme may be needed to address gaps in the conservation targets that as of now have been difficult to cover through the voluntary scheme. If the mandatory scheme is (re)introduced, transaction costs are likely to rise and legitimacy of the whole conservation enterprise may again be under threat. Hence, this may be counterproductive

Mitani and Lindhjem (2015) have studied the voluntary conservation program based on a large postal survey of non-industrial private forest owners in Norway. Since the program requires participants to relinquish all rights to forestry for eternity, including future generations, it is important for achieving an efficient conservation strategy to understand what drives strong enough motivations to participate on such terms. Their econometric analyses of forest owner's stated reasons for willing to participate (or not) suggest that forest owners' expectation of sustainable non-timber income enhanced by the program, positive attitude towards stricter conservation regulations, and lower share of mature forest have strong positive effects on the likelihood of participation. Even if participation is forever, forest owners are still willing to participate if the conditions and expectations are right and biologically such long lasting programs are much preferred.

To get the most biodiversity for their buck (i.e. increase cost-effectiveness), Mitani and Lindhjem (2015) suggest that conservation authorities should not only target but market the voluntary conservation program in specific ways. Those variables that a priori are not expected to be negatively correlated with high biodiversity values could be used for targeting first (e.g. relatively young forest owners not residing locally near their relatively small forest plots). Encouraging owners of mature forest plots, typically containing higher biodiversity values, need stronger convincing to take part, e.g. as their analysis shows one could give more weight to income-generating, non-timber activities in and around reserves.

Interestingly, their results are confirmed by the thinking of the public committee behind the new Nature Diversity Act in Norway from June 2009 (cf. Textbox 3.2). This committee recommended stimulating future conservation by allowing and providing support to income-generating activities both within and around forest reserves (Norwegian Ministry of Environment 2004). Results of the practical implementation of this intention remain to be seen, but Mitani and Lindhjem's results confirms that it may indeed be a good idea if long-term biodiversity conservation is to be substantially increased.

In anothoer study based on the same data, Lindhjem and Mitani (2012) find that many forest owners have preferences for conservation values on their own land, indicating that they could accept lower compensation than proposed by the forest conservation program. They also identify other characteristics of the forest owners and the their specific forest holdings that can be used for more cost effective targeting. They find for example that costs of reaching conservation goals could be saved by targeting small and relatively less productive forests and absentee owners first, before considering increasingly expensive forest areas. They qualify this conclusion by saying that this assumes that desirable biological characteristics are not substantially less likely to be found in such areas.

One market mechanism to exploit such charateristics to reduce conservation costs through targeing or "price discrimination" has recently been proposed, at least in academic circles. It involves combining the voluntary program with the cost effectiveness of auction mechanisms (Romstad et al. 2012). Conservation auctions have been tested and implemented in other countries, such as Australia and the USA. An auction would involve forest owners submitting compensation bids and competing on the level of compensation required and biological value of the land proposed as a reserve. In addition it is possible to provide a so-called agglomreation bonus if land areas are adjacent to each other (which is beneficial for biodiversity). Well-functioning auctions allocate conservation contracts to least-cost providers and lowers the compensation payments needed for landowners to voluntarily accept setting aside their forest for reserve (Vatn et al. 2011, Romstad et al. 2012).

Non-market valuation methods have not been used in the design of the current voluntary conservation mechanism. The compensation is based on an economic calculation of the opportunity cost of protecting the land and making commcercially viable forestry impossible for eternity. Further, the biodiversity values are assessed using non-monetary biological criteria in comparison with conservation targets and gaps, and no extra payment is made for biologically richer areas. Other additional ES that may be co-benefits of conservation are currently not assesed at all. In principle, offering higher rewards to forest owners that through their stewardship have preserved both biodiversity and important ES, for example recreation benefits, will result in a more dynamically efficient instrument. However, this is currently not under consideration in practice (except in the discussions refered to in chapter 3 on a more general incentive instrument called ”nature tax”).

Relevance for China

To strengthen ecological protection the State Council of China (2011) issued “State Council’s Opinions on Strengthening Environmental Protection” (GF [2011] No. 35). This document made clear that important ecological function areas, terrestrial and marine ecology sensitive areas, fragile areas and some other areas there should be drawn *ecological red lines* of protection. Later the Third Plenary of the 18th CPC Central Committee put forward ecological red lines as a key ingredient in the effort to construct an ecological civilization. The “Decisions on Several Major Issues of Comprehensively Deepening Reform” at the Third Plenary explicitly requested “to delineate ecological red lines and establish a national spatial development and protection system”. From before China has a number of protected areas, see section 4.4.

It has been reported that incentives are lacking to set up and properly manage protected areas, and a similar problem may arise with areas protected by ecological red lines. CCICED (2014) for example, tells of a protected mangrove forest in Qinmeigang near Sanya, Hainan where

> «Hotels have blocked and diverted flow from some lateral streams that formerly fed into the mangroves. Hotels discharge waste water into the nature reserve and considerable pollution emanates from ongoing construction of additional hotel complexes upstream of the reserve, including direct discharge of excess concrete and untreated sewage. One section of about 2 ha of the nature reserve has been opened up and is used to store rocks and other construction materials for the surrounding hotel developments. A pipe remains that was used for sucking dredged sand out of the reserves main river bed to be used in neighbouring construction» CCICED (2011, p 51)

The voluntary compensation based conservation scheme reported here is in principle able to overcome some of the incentive problems plaguing China’s protected areas and possible zoned areas. A proper monitoring system is of course needed in addition to making sure that the area is indeed conserved. Forests and land in China are not privately owned and the unit receiving compensation and entering into a contract for conservation will not be a private individual. But the scheme itself is independent of the exact nature of the contract parties. A contract could be made between the owner, whoever he may be (a local government unit perhaps) and the central or provincial government. In any case, in order to stimulate increased conservation, the opportunity costs incurred by the local party of conserving nature needs to be compensated.

China has its own experiences with PES-schemes, such as the sloping land conversion program, by some termed “the world’s largest” PES-scheme (Liu and Henningsen 2016). It may be possible to share experiences from these programs, as commonalities with the Norwegian forest conservation program are probably there.

4.3 Mainstreaming biodiversity and ES in EIA/CBA (Norway)

Background and aim of tool for trade-off analysis

As we discussed in chapter 3, according to Norwegian law (regulations of Environmental Impact Assessment, pursuant to the Planning and Building Act), Environmental Impact Assessment (EIA) shall be carried out for projects of a certain size and character. The purpose of EIA is, according to §1 in the regulations: «.. to ensure that impacts for the environment and society are considered when plans are prepared, and when it is decided if, and under which terms, the plans are to be carried out.

We have also described (in chapter 3) the so-called "assessment rule", which states that all larger public projects shall be assessed sufficiently to ensure good decisions for society, the rules for Cost-benefit analysis (CBA) for public projects stated by the Ministry of Finance in 2014 and the guidelines for best practice CBA developed from the Norwegian Government Agency for Financial Management (NGAFM 2014).

The Norwegian Public Roads Administration (NPRA) is responsible for many large road projects all over Norway. Road projects typically involve large costs and benefits to society - and potentially substantial environmental impacts. NPRA has worked particularly on combining the tools of CBA and EIA for their road projects, and has developed guidelines – called Manual V712 - for incorporating CBA as well as EIA regulations and guidelines (NPRA 2014). Several other public agencies have adopted NPRA's guidelines as their own, particularly the methodology for EIA. This has been done either by adapting NPRA's guidelines to other sectors, or by referring to that NPRA's guidelines can be used to assess environmental impacts in CBA (and EIA).

NPRA's manual for CBA and EIA therefore is important. This is not only due to the fact that road projects is an important part of Norwegian infrastructure projects, which may impact the environment in many ways, but also because the EIA/CBA methodology serve as important inspiration and is used in several other sectors and projects.

In the following sections we will provide a brief description of which environmental impacts are included, and how they are included in the present edition of the NPRA manual. Then we go on to discuss how the ecosystem services approach could be included in the methodology, how NPRA is working in this field at present and how other government agencies and other government directorates, such as the Norwegian Coastal Administration, Jernbaneverket (Norwegian Government's Agency for Railway Services) and Statnett (the system operator in the Norwegian energy system). All these agencies currently use NPRA's manual or similar manuals to assess the environmental impacts of their infrastructure projects. They also presently carry out pilot projects with the aim to include ecosystem services and/or more pricing of environmental impacts in CBA. As such, this case example is broader than both the voluntary forest conservation program above and the ecological fiscal transfer example in the next section. Both of these have as their primary purpose to increase nature protection for the benefit of biodiversity.

Description of tool

According to the guidelines from NGAFM costs and benefits of projects and measures should first be quantified in physical units, and then valued in monetary units as far as possible, either by use of market prices (if these exist) or by use of valuation methods developed for non-market goods and services (as discussed in chapter 2). Whether an effect should be valued in monetary terms or not depends on whether this is justifiable, professionally and considering the costs of conducting costly primary valuation studies compared to the benefits of receiving this “extra” information. The impacts that are not valued in monetary terms must be assessed and highlighted. These impacts should be quantified to the extent possible, and the impacts that cannot be quantified should be assessed qualitatively.

NGAFM’s guidelines recommend what they call «the plus-and-minus method”, this is equivalent to the method which the NPRA (2014) recommend and which they call the «impact fan» (”konsekvensviften”), or, alternatively, a qualitative, verbal assessment and statement for these non-priced impacts.

The plus-and-minus method is based on NPRA’s manual V712 (NPRA 2014), and is effectively a non-monetary valuation or rating method. The manual identifies five categories of environmental impacts:

- Landscape/aesthetics impacts
- Recreation and local community impacts
- Nature and biodiversity impacts
- Cultural heritage, monuments and cultural environment impacts
- Natural resources impacts

Consequences (or impacts) are assessed on a scale ranging from very negative impact (- - - -) to very positive impact (+ + + +). The impact of a project or measure is a function of “value” and the scope/size of the effect. The value of an area or resource is a measure of how valuable the affected place (area or resource) is, while the scope/size deals with the size of the change (impact) that the project or measure leads to for the area or resource in question.

The value of an area or resource is graded as either small, medium, or large, and the size is graded from large negative, via medium negative, and little/no change, to medium positive, and large positive. In manual V712 there are guidelines for how the geographical area for non-priced impacts should be delimited, and there are detailed descriptions of the grading of value and size for the main environmental impacts in the bullet list above, to be considered. The consequences (impacts) of a project or measure is compiled by use of the “impact fan”, see Figure 4.3.

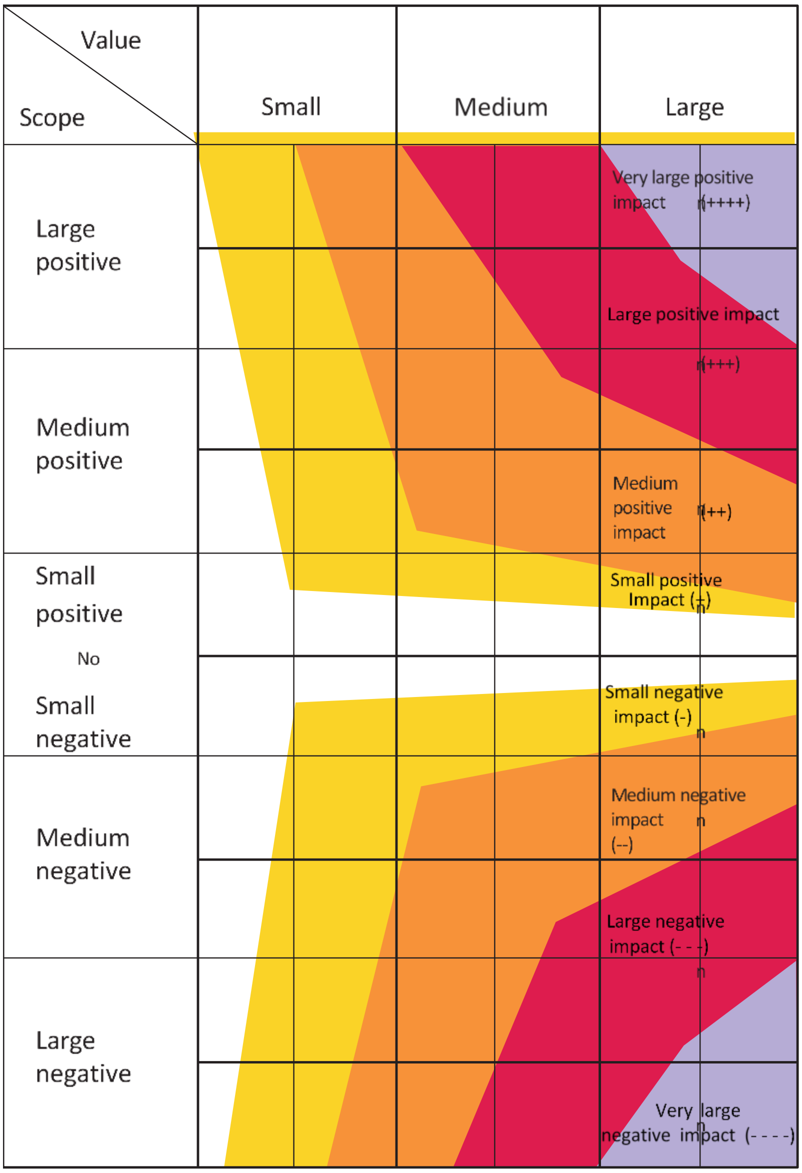


Figure 4.3 «Impact fan» («konsekvensvifte») for non-priced impacts. Source: NPRA (2014). Left axis: Large positive to large negative scope of impact from top to bottom, Right axis: Small, medium, large value. The combination of the two dimensions yield an overall impact or consequence.

NGAFM (2014) states that this method (in principle) may be used for all non-priced impacts, not just environmental impacts.

Lessons learned

The advantages of this method is that it gives a systematic, unified and professional compilation of non-priced impacts, highlight non-priced impacts and give a rather pedagogic description of these impacts.

From an economic point of view an advantage of this methodology is that it highlights that the positive and negative impacts should be assessed with respect to size and value. This is an approach which parallels the approach for assessment of priced impacts in economic analyses (i.e. unit price/value times the units affected is the total economic value).

On the other hand, there are some potential disadvantages, mainly related to misuse of the method, e.g. by lack of documentation of how value and size is assessed or lack of objective assessment of value and size. According to NGAFM (2014) a verbal description of non-priced impacts may be used as an alternative. However, they stress that even if a verbal description is used, a thorough assessment and description of the value and size of the impact in question should be the basis for the assessment. Each environmental effect is evaluated according to the value/significance of the resource impacted and size of impact, in order to define the consequence (impact) – using the “impact fan”.

The ES framework as such is rarely included in existing Norwegian guidelines and manuals for CBA or EIA, but substantial work is currently ongoing in order to include and operationalise this approach and to value more of the environmental effects in monetary terms. Most of the work is taking place in research and case studies. It will be important and necessary to be able to incorporate this approach in guidelines and handbooks later on, and then in actual standard practice in project assessments.

Ongoing development and improvements

The present version of V712 (NPRA 2014) does not mention the term “ecosystem services”. The current version (edited in 2014) was published too soon after the NOU (2013) which recommended use of the ES approach as a supplement to Norwegian environmental management (see chapter 3).

As we described in the former section, the methodology with plusses and minuses represent a comprehensive and systematic tool for handling environmental impacts. It is open to discussion to which degree the un-priced environmental effects are taken into account in project decisions. Some would argue that the priced effects are given too much emphasis in decision-making, and that environmental concerns, that are often left unpriced, are not given enough weight. However, the rather few publications that have studied this, suggest that road projects are not prioritized according to the cost-benefit ratio, and that “other” considerations are more important for decision makers.

There is also some discussion about whether the current system for un-priced impacts are appropriate for use in cost-benefit analyses, as the system is based on expert judgment on how landscape, biodiversity, natural resources etc. are effected, and not so much on how the population’s preferences are affected. However, no-one has come up with an alternative system which is generally accepted.

More recently, there is a growing interest in incorporating the ES approach in nature management and in methodology used in nature management and in projects with environmental impacts. There also seems to be a growing interest in the pricing of environmental impacts. We will give some examples of ongoing methodological work in this area in a few Norwegian governmental agencies, as mentioned above.

NPRA revises and updates their manual V712 for CBA and EIA more or less continually, and they are now preparing a new revision, planned to result in a revised manual in 2017. The work is in progress, and there is not yet a revised draft available. However, from Vista Analysis’ work as an editor for the revision, we know that NPRA probably will continue to use the plusses-and-minuses method as the core approach for assessment of environmental impacts in CBAs of road projects. However, they are currently investigating if and how the ES approach can be included in their manual, as a supplement to the expert judgement. It is not yet decided how this approach will be implemented, but probably they will continue with including environmental impacts as non-priced effects. Exceptions are made for air pollution, including nitrogen oxides

(NOx), particulate material (PM), and climate gases (CO2-equivalents), and noise. These impacts have been included as priced effects in several editions of the manual.

The Norwegian Coastal Administration (NCA) presently work to introduce ES as their approach for assessment of environmental impacts, and efforts to include more pricing of environmental impacts. NCA has a preliminary manual in CBA (NCA 2007) in which environmental impacts are treated as un-priced effects, using the same methodology as NPRA. NCA is in the process of revising their manual in CBA. One difference from NPRA is that NCA does not have the aim that their manual should fulfil the guidelines for EIA in addition to CBA. This makes the task a little less complicated, and NCA can emphasise the economic perspective to a larger extent than NPRA.

Vista Analysis presently work with NCA in order to suggest methods for including the ES approach and if possible pricing of ES as part of their CBA guidelines. This work is in progress. However, so far the work has emphasized screening of which ES may be affected by NCA projects, and using priced ecosystem services effects as an alternative to the common framework for un-priced effects. So far, a two-step screening process is suggested, and for the less important/hardly impacted ES, the ES are still treated as un-priced effects with 0, one or two plusses or minuses. For those ES which may be important for decision making, we suggest some prices which may be used, based on benefit transfer of these ES. However, the final report from this project is still in progress (to be finished during May 2016). A large economic valuation (stated preference) study has been conducted to estimate the welfare loss associated with ES impacts caused by accidental oil spills from ships along the Norwegian coast. This study aims primarily to cover the impact of such oil spills on cultural ecosystem services, especially recreation and non-use values associated with conserving clean sea and coasts. Commercial values, for example impacts on fisheries and tourism sectors, are covered separately. The value estimates will be used to assess the benefits of safety and prevention measures conducted by the NCA to ensure safe passage for ships along the main transport routes. We provide more detail about this study in Textbox 4.1 It is one of the best recent examples of a large scale valuation study for the use in CBA in Norway.

Textbox 4.1 Economic valuation of ES impacts from accidental oil spills from ships along the Norwegian coast for use in cost-benefit analysis

Vista Analysis is working on methodology development for the Norwegian Coastal Administration to value ES loss from oil spills from ships to include in CBA of prevention and safety measures (Lindhjem et al. 2014; Navrud et al. 2016; Vista Analyse 2016). This is a good example of how it could be done in practice, and how it may improve decision-making. When an oil spill occurs, the flow of ES will normally be reduced for a period of time, as shown in Figure 4.4. This loss can be reduced through oil recovery, cleaning and restoration efforts (as indicated in the figure), but in any case there will be a residual loss. This loss depends among other things on the size and type of oil spill, weather and currents, habitats and sea areas affected, and the number of species of birds, mammals and other marine life that will be affected.

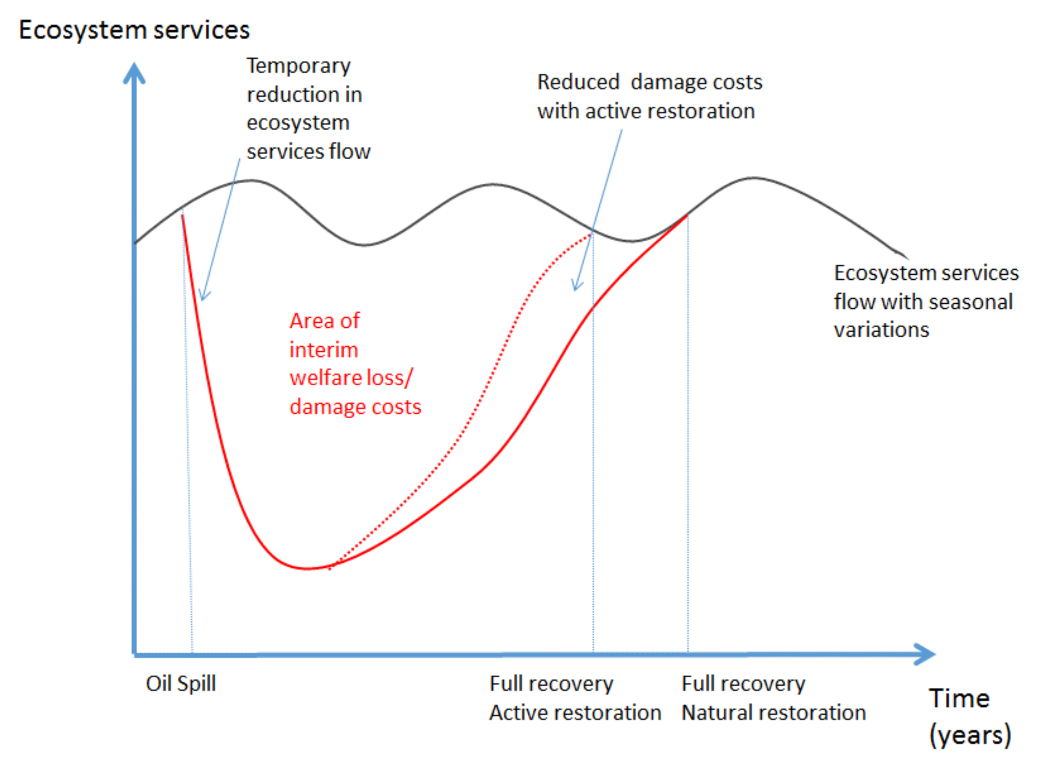


Figure 4.4 Temporary loss of ES from an oil spill gives a corresponding welfare loss

To estimate the economic value of different sizes of environmental damages, a contingent valuation stated preference survey was designed. This survey used five typical oil spill cases in five representative areas along the Norwegian coast. Damages from four oil spill sizes and types (from marine diesel to heavy fuel oils) were assessed by use of oil spill distribution modelling and a method for assessing impacted resources, based on environmental expert inputs. The research team had tested in focus groups which types of damages people care the most about. These included damage to sea bird populations, to sea mammals, to the coastal zones (especially areas used for recreation such as beaches) and marine life more in general (including seafood concerns). The respondents in each of the coastal oil spill regions were then presented in a websurvey a table distilling and presenting the environmental damage information in condensed form (see Figure 4.5, an example from the Oslo fjord case). This table showed the potential damages in case of an oil spill, that would happen unless the Coastal Administration implement more safety measures. This oil spill could either cause small, medium, large or very large ES loss (colours indicating seriousness from left to right). If measures were implemented and paid for by society, the present condition would instead be maintained.

(textbox continued)

The respondents were then asked in turn their willingness to pay (WTP) for preventive measures to avoid each of the four damage levels, for the oil spill in their region (assuming that people residing in the local region would care the most about avoiding an oil spill there). For each of the regions, mean WTP for avoiding each of the oil spill damages are calculated (work in progress). The aim is to calculate the aggregate WTP for the affected population in each region. The next step to use this information in CBA is to combine it with information about accident probability changes as a result of new preventive measures by the Coastal Administration. The result would then be expected net benefits from avoiding each of the damage levels for each of the five regions. This value information will then be used for CBAs of different preventive measures for the next few years, providing a better basis for good decisions that also include the values of ES and biodiversity.

	With measures	Without measures			
	Present conditions	Small loss	Medium loss	Large loss	Very large loss
Damage to birds					
	The area is an important breeding, migration and wintering ground for seabirds. The bird populations are in good condition.	The bird populations are in good condition. In total 1000 dead birds	The bird populations recover after 1 year In total 7 500 dead birds	The population of common eider is locally endangered. Other bird populations recover after 2 years In total 20 000 dead birds	The common eider and common murre populations are locally endangered. Other bird populations recover after 4 years. In total 50 000 dead birds
Damage to seals					
	Parts of the area are important to seals. The seal population is in good condition	The seal population is in good condition In total 10 dead seals	The seal population is in good condition In total 40 dead seals	The population of harbor seal recovers after 2 years In total 150 dead seals	The population of harbor seal is locally endangered In total 300 dead seals
Damage to coastal zone					
	The area is very important for recreation and outdoor life The area has a large cold-water coral reef, rich marine eelgrass meadows and a valuable natural environment	5 km of coastal zone consisting of *bare rock shores and beaches* soiled with oil Affects land and water based outdoor life Affected areas can be used as normal after 6 months	30 km of coastal zone consisting of *bare rock shores and beaches* soiled with oil Affects land and water based outdoor life Affected areas can be used as normal after 1 year	150 km of coastal zone consisting of *bare rock shores and beaches* soiled with oil Affects land and water based outdoor life Affected areas can be used as normal after 3 years	400 km of coastal zone consisting of *bare rock shores and beaches* soiled with oil Affects land and water based outdoor life Affected areas can be used as normal after 5 years
Damage to other marine life					
	Fish and shellfish in the area	Can be harvested as before. Safe to eat seafood Spawning areas for fish are unaffected	Can be harvested as before. Safe to eat seafood after 1 year Spawning areas for fish are unaffected	Fish, shellfish, mussels and seaweed should not be eaten until 3 years after the spill Spawning areas for fish are unaffected	Fish, shellfish, mussels and seaweed should not be eaten until 5 years after the spill Spawning areas for fish are unaffected

Figure 4.5 Example of damage/loss table used in the Contingent Valuation (CV) survey to describe four different loss levels for different ecosystem services (ES) from an oil spill (this case is the Oslo Fjord area).

Another case project which is testing a system with pricing of ecosystem services is under development for Jernbaneverket (Norwegian Government's Agency for Railway Services; NGARS) applying the ecosystem services approach as an alternative to the usual framework for un-priced effects for a planned railway project in the Grenland area in south-eastern Norway. This is a CBA carried out on a strategic level, and normally environmental impacts are included using a simplified version of the plusses-and-minuses methodology. In this case environmental impacts are assessed using the un-priced methodology which is normal procedure. However, NGARS further has initiated a case study which tests use of the ecosystem services approach and which aims at putting a price tag on these environmental impacts. The case study make use of information gathered as part of the normal plusses-and-minuses method and benefit transfer.

The last example we want to mention is a project for Statnett (the system operator in the Norwegian energy system). Statnett also normally uses the plusses-and-minuses method in order to assess environmental impacts of their projects. However, in this project they wanted to identify methods which can be used for pricing environmental impacts, and to implement this methodology in a case study for an on-going project which involves potential removal of high voltage overhead transmission lines in the south-western part of Norway. We have suggested that they apply an ES approach in order to do this. It turned out that the area in the case study was mainly developed areas or agricultural land, which could still be used as agricultural land or be transferred to developed area for houses and commercial buildings. The project therefore identify valuation methods appropriate to value these kind of ES.

Relevance for China

China carries out many large infrastructure projects, building roads, railways, energy operating systems, etc., like the agencies we describe above. Like Norway, China has an EIA system in place which is part of the project cycle. As far as we know, CBA is not part of the project cycle at present. Given the large number of costly infrastructure projects, and hence the need to give priority to the projects that provide the highest net benefits, the potential for increased use of CBA is expected to be huge. The ES approach may be useful in CBA as well as in combination with EIA, and it should be noted that use of the ES approach does not necessitate use of price-tags. Pricing of ES is of particular interest when CBAs or other economic methods are used for analyses, because they enable us to compare environmental impacts with other economic impacts. The use of the ES framework, even without the explicit economic valuation of ES impacts, may still provide useful information as it can highlight services that otherwise would not be considered.

4.4 Ecological Fiscal Transfers (France and Portugal)

Background and aim of policy instrument

More often than not, successful biodiversity conservation requires cooperation between local, regional and central government. Actions and policies to conserve biodiversity tend to be decided at the central or regional level and enacted at the local level. Hence the central and regional levels depend on the local level for enactment and implementation.

The central, regional and local levels of government might view advantages and disadvantages of biodiversity conservation differently. Advantages of biodiversity conservation are usually national and regional in scale. Biodiversity conservation benefits the region and the nation, and sometimes the globe. By contrast, disadvantages of biodiversity take the form of limitations on industrial activity, on infrastructure investment, on residential construction etc. Although the disadvantages do matter for the national and regional level as well, they are mostly local in scale. Hence a characteristic of biodiversity conservation is that incentives are not aligned: The national and regional level of government may emphasize the advantages, while the local level may emphasize disadvantages. The lack of alignment of incentives may give rise to difficulties in implementation and a sub-optimal solution may result.

There is also an equity issue to consider. When biodiversity conservation is implemented, and given the fact that the local level carries a disproportionate share of the disadvantage or cost, the national and regional level in effect asks local communities to take on the cost of biodiversity conservation. This would have been defendable from an equity perspective if all localities had areas to protect, but that is obviously not the case. Since biodiversity values are not present everywhere, efforts to conserve biodiversity may seem inequitable.

In their authoritative survey of Ecological Fiscal Transfers, Schröter-Schlaak et al. (2014) indicate that the problems just mentioned are prevalent in Europe, but ecological fiscal transfers may provide a solution. They point out that

> "In Europe, the Natura 2000 network of protected areas established under the Habitats Directive (EC, 2011) is the centerpiece of nature conservation and biodiversity policy. Its aim is to assure the long-term survival of Europe's most valuable and threatened species and habitats. However, decisions about where protected areas are to be sited are frequently taken at higher levels of government whereas the costs of withholding such areas from other socially and economically beneficial uses are borne by local governments and communities. While there are numerous ways to compensate private land users for such losses (e.g., payments for environmental services (PES) or agri-environment schemes) no financial incentives exist to offset the conservation costs incurred by public stakeholders (Ring, 2008). Hence there is an emerging rationale for using *ecological fiscal transfers* to give local governments the financial resources they require to maintain or enhance biodiversity conservation and ecosystem services within protected areas whose environmental benefits extend beyond municipal boundaries."

In this chapter we consider ecological fiscal transfers in some detail. We describe their properties and how they are intended to work. We discuss experiences and lessons from applying them, and we ask what China may learn from the European experience with ecological fiscal transfers.

Description of ecological fiscal transfers

Fiscal transfers from the central and regional levels to the local level is a feature of both the European and Chinese system of government. In Europe, transfers from other levels of government account for almost half of subnational expenditure (Schröter-Schlaak et al. 2014). Transfers are used to finance local level expenditure on public goods and services. In addition, many countries in Europe use transfers to redistribute from relatively richer to relatively poorer communities. This is called «fiscal equalization». Transfers are mostly unconditional. That means that transfers are as a rule not committed to any particular expenditure objective. However, some specific, earmarked transfers also exist across Europe.

Ecological fiscal transfers is a branch of fiscal transfers in which the level of transfer depends on ecological objectives, in practice often objectives for biodiversity conservation. The details of the objectives differ, as do the restrictions applied to the protected areas. The transfers are meant both to compensate local governments for their cost of biodiversity conservation (the equity aspect) and to motivate local governments to volunteer for biodiversity conservation (the incentive aspect). It is the municipality or other local administrative unit that is the recipient of the ecological fiscal transfer.

In the 1990's Brazil became the first country to introduce ecological fiscal transfers, the so-called ICMS Ecológico. The stated purpose in Brazil was to compensate municipalities for land-use restrictions imposed by protected areas (e.g., Ring 2008). In 2007 Portugal introduced an indicator tied to protected areas to the fiscal transfer system from the national to the local level (e.g., Santos et al., 2012). This became the first ecological fiscal transfer in Europe. France compensates municipalities lying within the core areas of land-based and marine national parks (e.g., Borie et al. 2014).

Schröter-Schlaak et al. (2014) contains a useful overview of how far four European countries have come in implementing ecological fiscal transfers. They distinguish four phases of the policy cycle: problem identification and agenda setting, policy formulation, decision making, implementation, and evaluation and improvement. While Portugal and France have taken ecological fiscal transfers all the way to evaluation and improvement, Germany and Portugal have hardly passed the policy formulation stage, see Table 4.1.

Table 4.1 Progress of European countries in implementing ecological fiscal transfers

Stage	Steps in designing and implementing ecological fiscal transfers	Country examples			
		PT	FR	DE	PL
Problem identification and agenda setting	Make the case for biodiversity conservation by providing evidence of losses, ecological and economic impacts. Demonstrate the fiscal needs of local authorities in relation to implementing and managing protected areas. Include consideration of ecological indicators in fiscal transfers as part of the policy agenda.	√	√	√	√
Policy formulation	Develop indicators demonstrating the quantitative and/or monetary values associated with local conservation action. Develop indicators reflecting local governments' conservation costs. Develop indicators to measure the conservation performance of local governments. Identify entry points to integrate ecological indicators in fiscal transfer schemes. Formulate alternative policy options, e.g., provide different ecological indicators and entry points for transfer calculation. Recommend the most suitable option(s) to be adopted.	√	√	(√)	(√)
Decision making	Identify potential beneficiaries and cost carriers based on scenario analysis and modelling. Find majorities for a subset of policy options. Decide on the EFT design options to be implemented.	√	√		
Implementation	Integrate the selected ecological indicators into the fiscal transfer system. Identify beneficiaries and cost carriers in practice. Take account of time lags between implementation and visibility of policy outcomes.	√	√		
Evaluation and improvement	Determine criteria for policy evaluation. Collect information through monitoring. Conduct evaluation of ecological fiscal transfers. Draw lessons and propose policy improvements.	√	√		

Note: PT = Portugal, FR = France, DE = Germany, PL = Poland.
Source Schröter-Schlaack et al. (2014).

Ecological fiscal transfers in Portugal

Being the first European country to implement ecological fiscal transfers, and arguably the country that has applied such transfers the most consistently, Portugal deserves particular attention.

Portugal is a fairly small European country of about 10 million people. The country is divided into 308 municipalities (“concelhos”) that range in size from 8 km^2 to 1720 km^2. Since 2007 Portugal has integrated ecological fiscal transfers into annual transfers from the national general budget to municipalities, in order to compensate for land-use restrictions imposed by protected areas and the Natura 2000 sites. Ecological fiscal transfers were introduced in Article 6 of the Local Finances Law. The article states that “the financial regime of municipalities shall contribute to the promotion of economic development, environmental protection and social welfare.” This objective is supported by several mechanisms including ecological fiscal transfers.

The ecological criteria in the law are “total area under protection” and “percentage of municipal land designated as protected area”. The score on these criteria contributes to the allocation of the General Municipal Fund (FGM), in the following way: 30 per cent of the FGM is allocated to municipalities depending on i) the municipalities’ total area, and ii) the amount of land designated as conservation area (Natura 2000 or any other national protected area). In further detail, the allocation rule is as follows:

- In municipalities where less than 70 per cent of the territory is protected area, 25 per cent of FGM is allocated in proportion to area weighted by elevation levels, and 5 per cent in proportion to land designated as protected area.
- In municipalities where more than 70 per cent of the territory is protected area, 20 per cent is allocated in proportion to area and elevation, and 10 per cent in proportion to land designated as protected area.

Hence, 5 or 10 per cent of FGM is allocated to municipalities that contain protected areas.

Revenue from the FGM is not earmarked and hence does not reward environmental activities. There is no incentive effect on the revenue spending side.

Ecological fiscal transfers in France

The main fiscal transfer instrument to municipalities in France is called the DGF. DGF consists of a i) an amount per inhabitant in the municipality, ii) an amount proportional to the surface area of the municipality (with a higher rate for mountain areas than for regular areas), iii) an amount aimed at compensating municipalities for the loss of other tax revenue, iv) a complementary allocation to stabilize the transfer between years, and v) an «ecological allocation» for municipalities that lie within national parks or adjacent to marine parks.

It is the ecological allocation that represents the French ecological fiscal transfer. Like in Portugal it is compensation that is the motivation for the ecological fiscal transfer. In France it is called ecological solidarity.

The ecological allocation is based on the following formula:

$$EA = \frac{MA_{Core} CO}{MA_{Total}} PV$$

Here, EA is the ecological allocation, MA_{Core} is the municipal park core area, MA_{Total} is the total municipal area, PV is the «point value», basically a factor of proportionality, and CO is a coefficient = 1 if the park area is less than 5000 km^2 and = 2 if the park area is more than 5000 km^2.

As can be seen from the formula the size of the ecological allocation depends on the point value *PV*, which is determined by the amount that the French government sets aside for the ecological allocation in total. In practice the size set aside for ecological purposes is rather small. In 2008 there were 36 800 municipalities in France. Only 150 municipalities were eligible for the ecological allocation. In 2011 just 0.02 per cent of DGF was allocated on the basis of ecological considerations.

Experiences and lessons

Environmental effectiveness of ecological fiscal transfers has not been explicitly addressed in the literature (Vatn et al., 2011). Both in Portugal and in France the transfer is designed as a compensatory measure that in itself does not include any environmental objectives. However, the size of the ecological transfer is adjusted every year in recognition of additional protected area that comes into being. This fact should give municipalities an incentive to welcome additional protected areas within their territory. Of course, in general the incentive is greater the higher is the transfer.

Despite the seemingly small size of ecological fiscal transfers in Portugal, analysis of Santos et al. (2012) suggests that the changes to the fiscal transfer system enacted in 2007 did bring about considerable revenue change for some municipalities in which the land granted conservation is a large part of overall territory. The simultaneous modification of several parameters in the system has made it difficult for municipalities to disentangle the ecological component, however. Furthermore, as Vatn et al. (2011) point out, indicators of quantity such as size of protected area must be complemented by indicators of quality to also provide incentives for the management of those areas.

Since the use of ecological transfers is not earmarked it is possible for municipalities to spend them on ecologically harmful activities as well as beneficial activities. This is another reason why it is important to consider quality-related indicators in ecological fiscal transfers.

Presently the *efficiency* of ecological fiscal transfers is high. Costs of introducing this policy instrument are low since protected area coverage is an indicator that already is measured. Implementation costs are also low since new institutions and new bureaucracy is not needed. Again the basic reason is that protected area coverage is measured and monitored in Europe independently of ecological transfers.

Should ecological fiscal transfers be extended to quality, i.e., the operation of protected areas, implementation costs may increase somewhat. But monitoring for quality is in fact required anyway in the Natura 2000 network. Therefore, to maximize efficiency quality monitoring for ecological fiscal transfers should build on regular conservation monitoring activities executed by conservation authorities.

Equity: As noted above ecological fiscal transfers in Portugal and France are intended to compensate municipalities for the economic burden of having “idle” protected areas in their jurisdiction. Since the municipalities in question often are rural and sparsely populated the ecological fiscal transfer system will on all accounts be equitable in most countries.

Since ecological fiscal transfers are not earmarked it is not clear that municipalities will use them to compensate local populations that are asked to move or give up their traditional life-style, or others who are directly affected by protection efforts. To preserve equity, it is important to compensate the affected individuals and families, especially if they are poor.

Relevance for China

China is among the 12 mega-biodiverse countries in the world (CBD 2014).[19] In 2008, an overall inventories report indicated the presence of more than 35,000 species of higher plants (of which 17,300 are endemic, ranking China third in the world after Brazil and Colombia), 6,445 species of vertebrates (667 being endemic) and 10 per cent of the world's invertebrates throughout the country. Among them are 1,371 species of birds (placing China first in the world) and 3,862 fish species (which account for 20.3per cent of the world's total). China is also one of the eight centers of origin for crops, with nearly 10,000 species of crops, including their wild relatives. China is clearly one of the most important countries globally for conservation of biodiversity and China is a signatory to the international Convention on Biological Diversity (1992).

Notable achievements have been made in regard to in situ conservation. At the end of 2011, China had established 2,640 nature reserves at different levels (not including those in Hong Kong, Taiwan and Macao), covering 149.71 million ha, representing 14.93 per cent of the total land area (the global average is 12 per cent). There are 335 national reserves, 2,747 forest parks (covering 1.83 per cent of China's total land area), including 746 national parks, 225 national scenic areas, 213 pilot national wetland parks and 219 national geological parks. In this light, the total protected area throughout the country thus covers about 17 per cent of China's total land area, to which must be added 17 national marine reserves and 113 national field sites and protected areas for the conservation of genetic resources and domesticated animals. Recently the concept of ecological red lines has been added to the repertoire, although it is not fully clear what this concept means and whether an additional system of designated areas is actually needed (Qin, 2014), see also section 4.2. In any case China has indicators to build on should it introduce ecological fiscal transfers. Given the question-marks given to the operation of some of the protected areas *it seems important to include quality indicators* in a system in China.

The case for ecological fiscal transfers in China seems to be supported by the 2015 Party document on Ecological Civilization.[20] The document states that economic policies "including pricing, fiscal, taxation and financial policies" should "motivate and guide various entities to actively take part in the development of ecological civilization". In future work the broad statements of the Party document will be elaborated on and made more concrete. Ecological fiscal transfers is an idea that deserves close consideration.

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[19] The data about biodiversity in China is taken from the Convention on Biological Diversity's (CBD 2016) country profile of China.

[20] A Chinese language text is found here: http://paper.people.com.cn/rmrb/html/2015-05/06/nw.D110000renmrb_20150506_3-01.htm. Geall (2015) gives an interpretation and commentary in English.

4.5 Other mainstreaming examples

This section provides a number of shorter case examples from Norway and Europe, in textboxes, organised in sub-sections according to the most important areas for mainstreaming biodiversity in China: payment and incentive schemes, tools for trade-off analysis and county-level performance systems and indicators.

We provide brief introductory comments to each example, and leave the reader to check the details in the textboxes.

Payment and incentive schemes

In this section we include two examples:

- Payments for management and conservation of specific species and habitat types under the Norwegian Nature Diversity Act (as described in Textbox 3.2) (Textbox 4.2)
- Biodiversity offsets and habitat banking in the EU and UK (Textbox 4.3)

The first example is a type of small PES scheme explicitly designed to conserve biodiversity.

The second example is a type of measure that is increasingly considered across Europe, where a developer can "offset" its ecosystem impacts on- or off-site (obligation to compensate under environmental liability law). If used on its own, biodiversity can be considered a direct regulation. Habitat banking is a particular case of biodiversity offsets, introduction a trading element for offset actions (credits) that are delinked both in space and time from the specific development requiring compensation (debits). This makes biodiversity offsets a marked-based instrument that create price signals of the costs of biodiversity impacts.

Textbox 4.2 Incentives for management and conservation of specific species and habitat types under the Norwegian Nature Diversity Act

The Nature Diversity Act makes specific provisions for what it terms “priority species” and “selected habitat types”. The former term means specific species that have a critical population status, have most of its distribution in Norway and/or are covered by specific international commitments. Selected habitat types have a similar interpretation as for priority species, except that the concept relates to habitats and has a fourth assessment criterion related to whether the habitat is important for any priority species. For priority species where active management is required to maintain the population, action plans are developed. A dedicated support scheme for management and other measures has been established. This is not compensation, but “positive incentives” that are meant to stimulate landowners, rights holders, organizations/institutions and municipalities to take care of these species. In some way this scheme is an “embryonic” PES scheme in the Norwegian context. The required measures will depend on the type of threat, e.g. from urbanization vs. forestry activities. There is a similar support scheme for the selected habitat types. The Norwegian Environment Agency has designed an online application system, where each support scheme has its own application form. The application is sent to the county governor’s office for assessment. It is unclear exactly how proposals are evaluated and how the size of the incentive is determined. In 2015, the scheme changed also to include rare habitat types and threatened species.

The support schemes have very recently been introduced and it is a bit early to tell how they will function. In terms of conservation effectiveness, a gap in the current conservation policy has been covered with the introduction of specific legal status and the accompanying support for management linked to the protection of specific species and habitat types. In that respect, the mechanism should give clear biodiversity benefits. However, it is not absolutely clear how (and how many) species and habitat types will eventually be chosen, how extensive the support scheme will be and how the impacts of the law will play out on other activities that may have to be abandoned or considerably revised in the face of the new law. The first list of 8 prioritized species and 5 selected habitat types were decided in 2011, with the aim to continually update the lists.

It is likely that the new measures will have a positive impact on conservation objectives, though it is too early to tell at what cost. Further, distributional impacts and legitimacy concerns may also have to be judged once impacts of the specific implementation of the schemes have been observed for a few years. The two support schemes for management of species and habitat types are promising, though they are relatively minor in size compared to for example the voluntary forest protection scheme (see section 4.2). As such, the direct regulation elements of the fairly comprehensive Nature Diversity Act, of which priority species and selected habitat types are only one of several elements, is likely to be more important for conservation benefits, than the incentives created through two small support schemes. It is also important to note that many of the species and habitat types will be outside the forestry decision making sphere, as they are not influenced by forestry activities directly. Even so, it is a first step towards the use of economic instruments in biodiversity conservation in Norway, in addition to the voluntary forest conservation program discussed in section 4.2.

Source: Barton et al. (2012).

Textbox 4.3 Biodiversity offsets and habitat banking in the EU and UK

Habitat banking can be defined as: “a market where the credits from actions with beneficial biodiversity outcomes can be purchased to offset the debit from environmental damage. Credits can be produced in advance of, and without ex-ante links to, the debits they compensate for, and stored over time”. Biodiversity credits can include both habitats and species.” (EFTEC 2010).

Actions that create credits can include the restoration or creation of habitats or measures that enhance the viability of species populations (e.g. removal of alien predators).They can also include the protection of valuable habitats that are at risk of loss or degradation (the so-called risk aversion offsets), even though the additionality that these actions may provide is a complex issue. Additionality of an action refers to the requirement that the outcomes it delivers would not have occurred without the action.

In the case of offsets, the debit and credit are quantified separately for each and every case (even though offset delivery may be undertaken in a single location to satisfy demand for more than one offset requirement). This is not the case in habitat banking: credits can be assessed once, created in different quantities and locations and stored. They need not be designed to match a specific debit at the time of creation, although they still need to fulfil equivalence requirements (i.e. be like for like or better) for the debit they are subsequently used to compensate for. The independence in the timing of credits from debits at the creation stage is the key feature distinguishing habitat banking from offsets.

Biodiversity offsets have the potential to compensate for biodiversity loss, but a number of technical, ecological, geographical and economic constraints mean that this is not possible or appropriate in all circumstances. In cases of particularly vulnerable and/or irreplaceable biodiversity, ‘like for like’ offsets should be preferred. Where the biodiversity affected is not vulnerable or irreplaceable, ‘trading up’ to conserve higher conservation priority biodiversity may be the best outcome. For habitat banking and offsetting to be successful, there is a need for a strong regulatory framework to create demand, establish basic standards, and drive the process.

The UK is currently piloting biodiversity offset schemes and the EU exploring the possibility and potential of habitat banking schemes.

Source: More information can be found here:

http://ec.europa.eu/environment/enveco/biodiversity/

Tools for trade-off analysis

This section includes two examples:

- Mapping and Assessment of Ecosystems and their Services (MAES) in the EU (Textbox 4.4)
- UK National Ecosystem Assessment (UK NEA) (Textbox 4.5)

As noted in chapter 2, the MAES work in the EU is important in its strategy to conserve biodiversity and better manage ecosystem services. The mapping tool is a means to help in policy uses such as natural resource accounting and spatially targeting policy instruments.

The UK NEA was a pioneering effort internationally to map and value key ES in a spatially explicitly manner, providing a very clear message of the welfare gain of including explicit economic values of ES.

Textbox 4.4 Mapping and Assessment of Ecosystems and their Services (MAES) in the EU

In line with the Millennium Ecosystem assessment (MA), the objective of the EU assessment is to provide a critical evaluation of the best available information for guiding decisions on complex public issues. The work being carried out is important for the advancement of biodiversity objectives, and also to inform the development and implementation of related policies, on water, climate, agriculture, forest, and regional planning. Robust, reliable and comparable data are also important for the planning and implementation of individual projects.

What is the purpose of mapping?

Maps are useful for spatially explicit prioritisation and problem identification, especially in relation to synergies and trade-offs among different ecosystem services, and between ecosystem services and biodiversity. Further, maps can be used as a communication tool to initiate discussions with stakeholders, visualizing the locations where valuable ecosystem services are produced (such as in the UK NEA, see Textbox 4.5) or used for explaining the relevance of ecosystem services to the public in their territory.

MAES Analytical Framework:

A first outcome is the development of a coherent analytical framework to be applied by the EU and its Member States in order to ensure consistent approaches are used. It is therefore framed by a broad set of key policy questions. It is structured around a conceptual framework that links human societies and their well-being with the environment (see Figure 2.1 in Chapter 2.1, which is central to this approach).

A first version of a European ecosystem map covering spatially explicit ecosystem types for land and freshwater at 1 ha spatial resolution has been developed. Ecosystems are mapped by interpreting available land cover data on the basis of the European habitat classification. For the marine part the maps have been developed using global data sets such as sea bed conditions, bathymetry, etc. This map is also available in the MAES digital atlas (see http://biodiversity.europa.eu/maes/maes-digital-atlas). The MAES digital atlas is designed to present in a systematic way maps of ecosystem types and ecosystem services. Only maps which have been published online at European, national or subnational scale are integrated there. The mapping work is then aimed to be the basis for policy use, for example in natural capital accounting and in spatially targeting and differentiating policies to take account of ES and biodiversity values.

MAES work is ongoing. The most recent report on the progress and challenges of European ecosystem services was published in March 2016. http://catalogue.biodiversity.europa.eu/uploads/document/file/1328/3rdMAESReport_Condition.pdf

Source: More information can be found here: http://biodiversity.europa.eu/maes

Textbox 4.5 UK National Ecosystem Assessment 2009-11

The UK National Ecosystem Assessment (UK NEA) was the first analysis of the UK's natural environment in terms of the benefits it provides to society. The UK NEA commenced in 2009 and reported in 2011 (a follow-on phase was implemented from 2011 that we do not report from here). It was an inclusive process involving many government, academic, NGO and private sector institutions. It was a pioneering effort internationally to map and value key ES in a spatially explicitly manner. The project started with assessing current status and trends in UK ecosystems and ES. This analysis showed decline in many ES (around 35 per cent of the services) and a need for action. Six scenarios for the future (year 2060) were then developed. The scenarios put weight on different aspects from continued economic growth and free trade to a more environmental protection focus. Substantial work was then carried out to project the development in ES flows in each of the scenarios, and value these biophysical changes in the ES flows. No new, primary valuation studies were carried out, but existing literature was used in a benefit transfer exercise to estimate the economic values (see the February issue of the journal Environmental and Resource Economics for an overview of some of the economic valuation work). The values were made spatially explicit on maps, as seen in Figure 4.6 below. In this figure the results of a comparison between welfare gains/loss for the two scenarios "World Markets" and "Nature at Work" are shown relative to the baseline. The time horizon is from 2010 to 2060, i.e. 50 years. The resources or services valued in economic terms included agricultural production (a provisioning service), greenhouse gas emissions (regulating service), recreation values (a cultural service) and urban greenspace (cultural service). In addition, biodiversity was measured by use of a non-monetary measure: a bid diversity index. The results show that compared to the status quo, the "Nature at Work" scenario contributes to a net welfare gain of £17,920 million per annum. On the other hand, the "World Markets" scenario causes a net loss of £18,990 million per annum. This shows clearly that by other priorities, and more spatially differentiated policies, large welfare gains can be achieved.

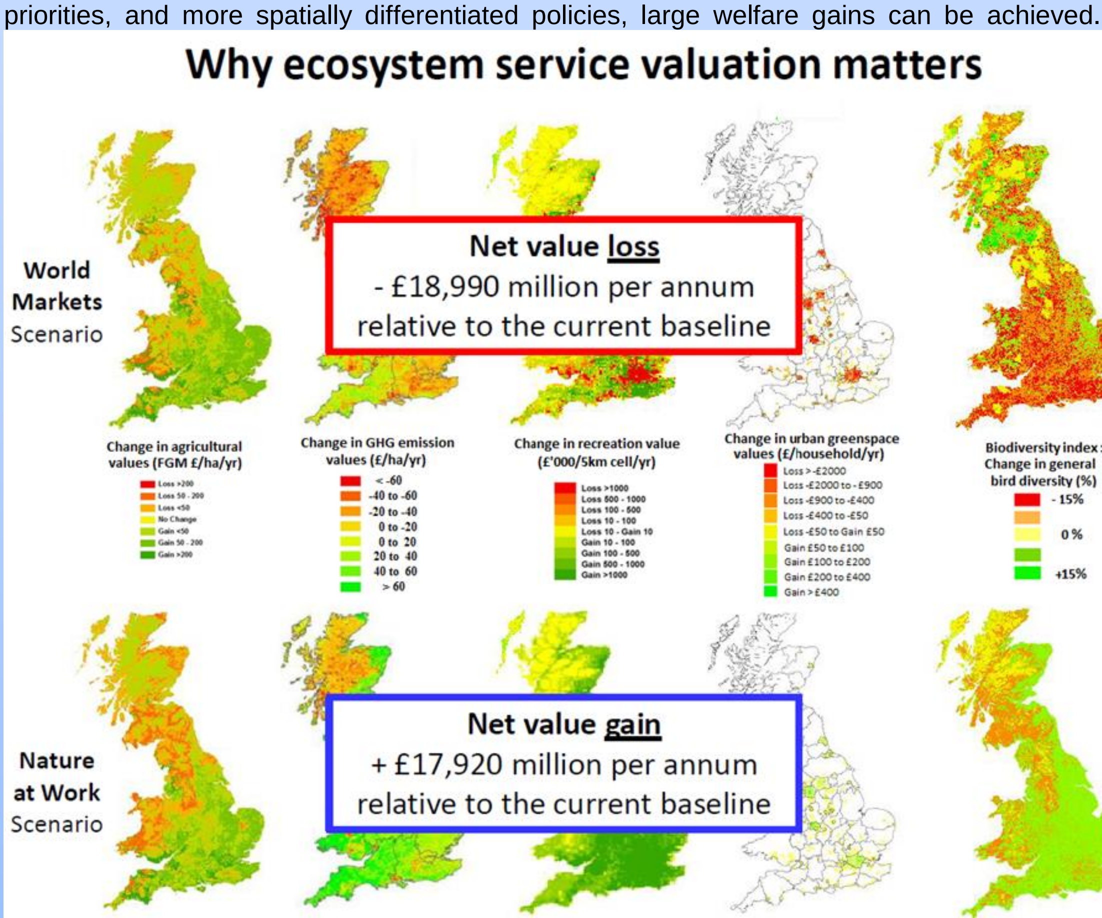

Figure 4.6 Result from the UK NEA scenario work for 2060, where net welfare implications are estimated for two scenarios "World Markets" and "Nature at Work".

Source: Further information can be found at: http://uknea.unep-wcmc.org/

County-level performance assessment and indicator systems

In this section we include more details on the Norwegian Nature Index (NI) (Textbox 4.6). We have also briefly commented on this index in chapter 3 as well. The index is primarily used as an information provisioning instrument. However, there have been methodological developments and considerations to potentially use the NI both on a more disaggregated geographical scale (e.g. municipality level), as input to consider status and trends in biodiversity, and as a basis for political targets in biodiversity conservation.

As such the NI may potentially also be used as a basis for for example ecological transfers between national government and lower administrative levels to reward environmental performance as measured by the NI. This is however a future prospect, not currently possible, due to data limitations (challenges in disaggregating the index) and for other reasons.

Textbox 4.6 The Norwegian Nature Index

The Nature Index (NI) in Norway has been developed to provide a basis to evaluate the state of biodiversity and to link the state to the management of nature. The Norwegian NI is currently based on more than 300 indicators covering all major taxonomic groups and ecosystems (Nybø 2010). The indicators can represent any aspect of biodiversity from genes to ecosystems, but in the current implementation for Norway, the indicators are mainly species (Skarpaas & Pedersen 2012), although in the case of forests, the important habitats for forests are included. It has been envisaged that the NI can be applied to assess the overall state and trends of biodiversity, particularly regarding the report of progress towards the national 2010 and 2020 targets of the Convention on Biological Diversity (Skarpaas & Pedersen 2012).

The NI has been recently incorporated into the set of indicators of sustainable development reported annually in the National Budget and several studies explore other applications that link the indicators with human activities and management plans (Skarpaas & Pedersen 2012). A fundamental concept built into the NI is that the indicators are scaled relative to a reference value, i.e. their value at a reference state (Certain et al. 2011). It is assumed that the reference state for each indicator reflects an ecologically sustainable state, and the scaled value measures the deviation from this state: a value of 1 means that the indicator is in the reference state, whereas a value of 0 means a seriously degraded state. The NI can then be calculated for a particular geographical area (e.g. municipalities), biome and particular time, as a weighted average of the scaled indicator values providing an overall metric of the state of biodiversity in each case, along a sustainability gradient. The reference state can therefore be potentially considered as a target for improved conservation measures, new instruments and sustainable management of, e.g. a particular area, biome or nature type. Figure 4.7 below shows an example of the calculated NI value for forests in Norway in 2010, Figure 4.8, the different values for different types of ecosystems in 2014.

The data basis of the NI sets the boundaries of its applicability in terms of the spatial extent, the degree of spatial detail, the comparability between geographical areas, and the time interval at which it can be calculated. At present, for a set of well-known taxa, estimates originate from monitoring programs and modelling of population dynamics, but the bulk of the information in the NI comes from expert assessments of indicators. Such information is useful for evaluation of long-term trends and goals like the 2020 target, but is less well suited for reporting of short-term changes (such as the annual sustainability indicators in the National budget) and for devising management goals and options for the future (Skarpaas & Pedersen 2012). Ongoing improvement of the knowledge base about the statistical structure of the data will contribute to more reliable assessments and widen the applicability of the NI in the future (Pedersen & Skarpaas 2012). The degree of uncertainty in the data is also reflected in the difficulties in forecasting future states based on current conditions. These projections of the NI into the future would provide a reference or benchmark of a ‘business as usual’ state. A series of methods have been evaluated to improve forecasting of future states, which appears to be a promising avenue for future applications of the NI (Skarpaas & Pedersen 2012).

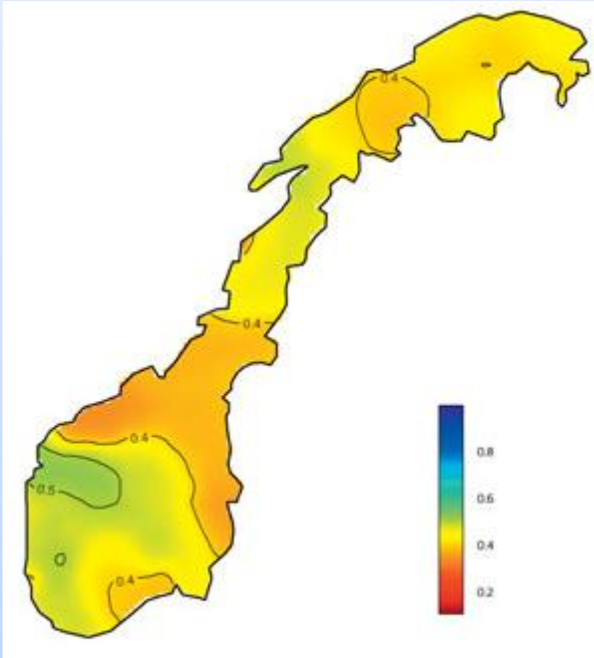

Figure 4.7 The Nature Index for forests in Norway in 2010 (1 = "undisturbed by humans"). Source: DN (2010).

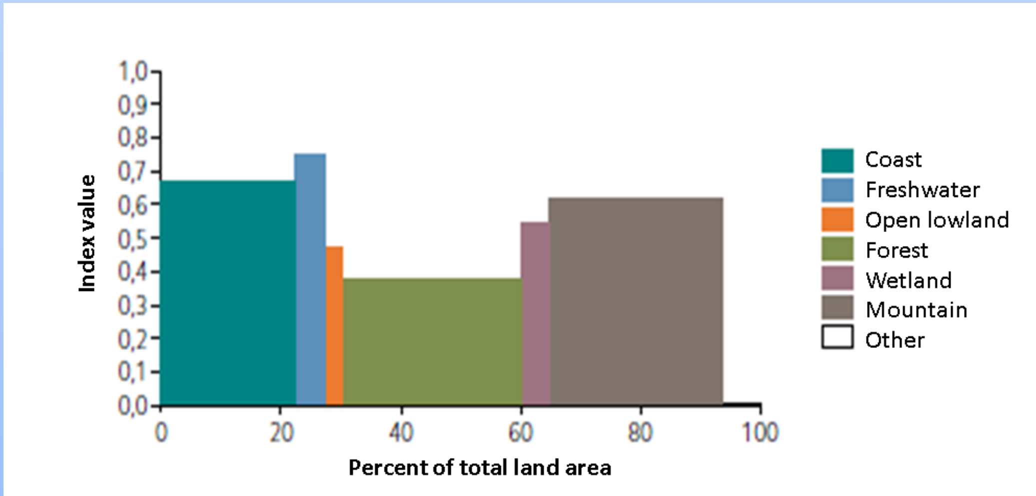

Figure 4.8 The status of Norwegian Ecosystems in 2014, in terms of NI value (second axis) and per cent of total land area (first axis). Source: Framstad (2015)

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