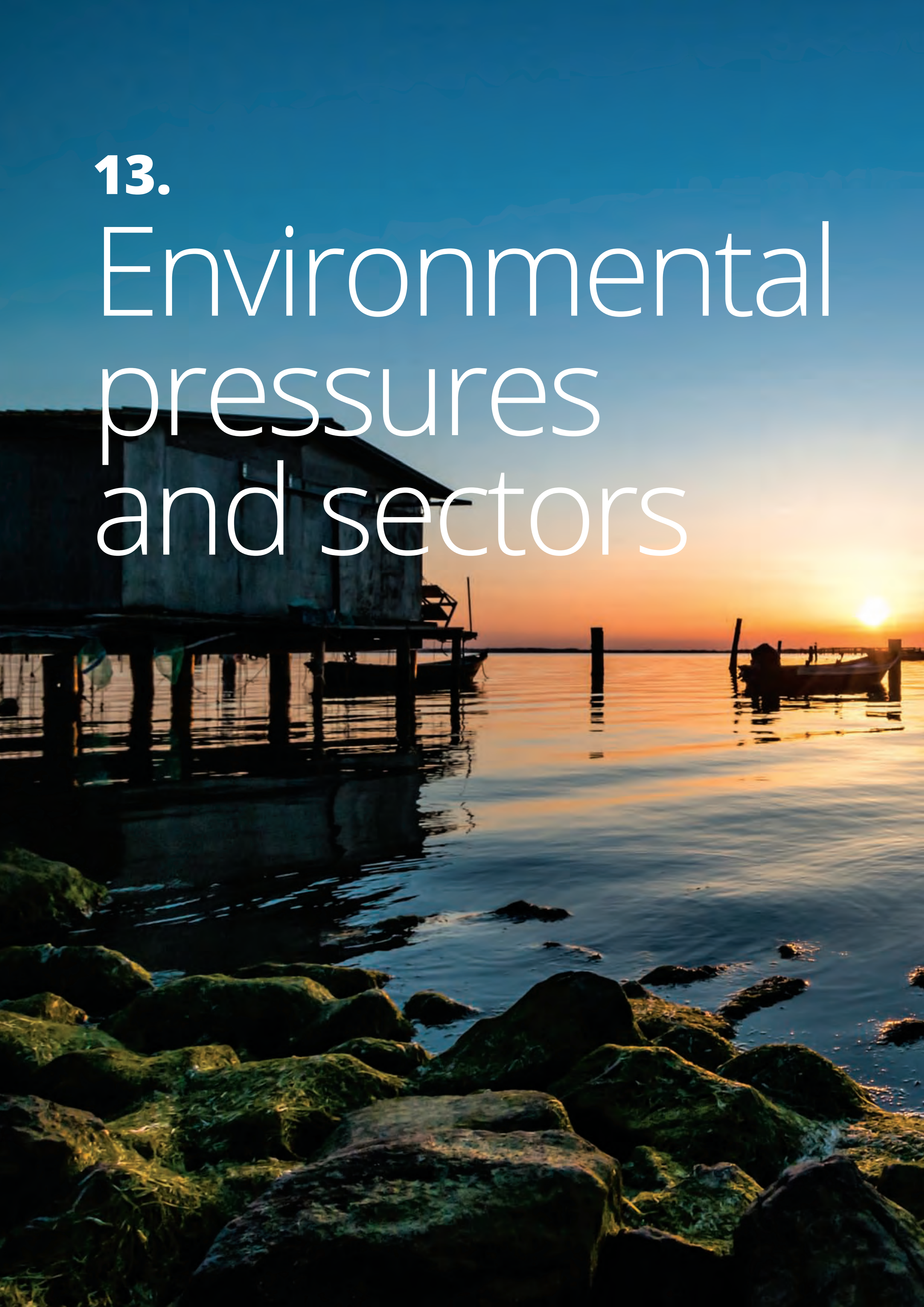
13. Environmental pressures and sectors



Summary

- The EU Seventh Environment Action Programme (7th EAP) aims to ensure that by 2020 the overall environmental impact of all major sectors of the economy is significantly reduced and that sectoral policies are developed and implemented in a way that supports environment and climate targets and objectives.

- Current developments are not in line with policy ambitions. Overall, environment and climate related concerns are not sufficiently integrated into sectoral policies and implementation requires improvement. It is unlikely that the objective of significantly reducing the overall environmental impact of all major sectors of the economy by 2020 will be met.

- Strengthening environmental integration into policy areas, such as agriculture, transport, industry and energy, and EU spending programmes is essential, but the overall approach of environmental integration has not been successful when it comes to reducing environmental pressures from economic sectors.

- Environmental policies create economic opportunities and contribute to broader social and economic objectives. However, the loss of momentum in the development of eco-industries indicates that further efforts are needed to realise the 7th EAP's ambitions of a resource-efficient, green and competitive low-carbon economy.

- There are benefits from complementing a sectoral focus and environmental integration approach with a broader systems perspective. This improves understanding of interactions and enables more coherent and effective policy interventions to reduce environmental pressures along whole value chains.

13.
Environmental pressures and sectors

13.1 Introduction

As part of efforts to turn Europe into a resource-efficient, green and competitive low-carbon economy, the EU Seventh Environment Action Programme (7th EAP) aims to ensure that by 2020 the overall environmental impact of all major sectors of the economy is significantly reduced and that sectoral policies are developed and implemented in a way that supports relevant environment and climate related targets and objectives. It also calls for an increase in the market share of green technologies and enhancing the competitiveness of European eco-industries (EC, 2013c). This dual focus reflects the fact that well-designed and implemented environmental policies also create wealth, trade and job opportunities, contributing to broader social and economic objectives.

To date, there has been over two decades of efforts to mainstream environmental and climate considerations into other policy areas. Environmental integration has been pursued in primary sectors such as agriculture, through the common agricultural policy (CAP), and fisheries, through the common fisheries policy, and in the cohesion policy. More recently, the EU's integrated maritime policy aims to take a more coherent approach to maritime issues. It focuses on issues that do not fall under a single sector and seeks to improve coordination rather than replace sector-specific policies. The EU has also committed to spending 20 % of the EU's 2014-2020 multiannual financial framework on climate-related action, a decision aiming to mainstream climate action within all policy areas.

> The EU aims to significantly reduce the environmental impacts of all major sectors of the economy by 2020.

The preceding chapters have highlighted the role of a range of sectors in driving environmental degradation as well as presenting the contribution of different sectors to emissions of pollutants. This chapter focuses on a smaller number of selected sectors, namely agriculture, marine fisheries and aquaculture, forestry and transport, given their important role generating pressures and impacts on natural capital. What follows is not a comprehensive assessment of the environmental impacts of these sectors, rather it focuses on selected key pressures and how well environmental considerations have been integrated into relevant sectoral policies. The extent to which industry is making progress towards reducing pollutant emissions and implementing clean and environmentally sound industrial technologies and processes is assessed in Chapter 12. This chapter also looks at recent developments and trends with regard to the economic sector known as the environmental goods and services sector, also known as eco-industries and the market for environmental technologies. In doing so, the chapter provides insights into the role of European environment and climate policies in addressing the environmental pressures from economic activities and the wider secondary socio-economic benefits that these measures can deliver for society.

13.2 Agriculture

13.2.1 Socio-economic relevance of the sector and policy landscape

Providing food is the primary function of European agriculture, but it also provides other essential functions such as contributing to rural development and managing landscapes. The relative importance of agriculture in the EU economy has been in decline over the last 50 years. In 2017, the sector contributed 1.2 % of EU gross domestic product (GDP) and, while its relative economic importance compared with other economic sectors is low, it contributed EUR 188.5 billion gross value added (GVA) to the economy, with EUR 57.2 billion invested in agricultural capital (Eurostat, 2018a). In 2016, about 9.7 million people worked in agriculture corresponding to a small and decreasing share (4.2 %) of the EU's total workforce, with farming remaining a predominantly family activity (Eurostat, 2018a). Agriculture remains important in rural areas as indicated by its higher share in rural employment (13.5 % in 2014) ([1]). In addition, as agriculture produces raw materials as well as food, it also supports employment and GVA creation in other sectors.

> Providing food is the primary function of agriculture, but it also provides other essential functions such as contributing to rural development and managing landscapes.

While contributing to the economy, the sector is also a large recipient of subsidies. The agricultural sector has received substantial support under the main sectoral policy framework, the CAP. The CAP was allocated around 38 % of the overall EU budget for 2014-2020 and currently has an annual budget of around EUR 59 billion (EC, 2013d). The extent of public support is indicated by the average share of EU subsidies in agricultural factor income of more than 35 % during the period 2010-2014 (European Parliament Research Service, 2017). However, this is not distributed equally across the sector. In 2017, 6.5 million out of 10.5 million farms received direct payments, and 0.5 % of all beneficiaries obtained 16.4 % of total direct payments (DG Agriculture, 2018b, 2018a; Eurostat, 2019c).

The CAP has strongly framed the development of the agricultural sector and has had a prevailing socio-economic focus. There has been a shift from a primarily sector-oriented policy to a more integrated rural development policy with structural and agri-environmental measures. The CAP 2014-2020 has the general objectives of contributing to the sustainable management of natural resources and climate action, balanced territorial development and viable food production. It comprises two main pillars: Pillar 1 provides direct payments to farmers and market interventions; and Pillar 2 supports rural development programmes. An important feature of the current CAP is the recognition that farmers should be rewarded for the provision of public goods even if they do not have a market value: however, this process has much further to go (Buckwell et al., 2017). While the CAP cannot be regarded as providing a framework for a comprehensive food policy, it includes food and food production-related objectives and measures, focusing on food security and safety and on consumer prices.

Agricultural activities and the resulting environmental outcomes are also important factors in achieving policy objectives across a range of areas. These include the objectives of the EU nature legislation and the 2020 biodiversity strategy (in particular target 3A), objectives related to air pollution (National Emission Ceilings Directive), greenhouse gas (GHG) emissions (Effort Sharing Regulation and the LULUCF Regulation — on land use, land use change and forestry) and water quality (Water Framework Directive and Nitrates Directive). Agriculture also has a key role to play in achieving the Sustainable Development Goals (SDGs), particularly SDG 2 — zero hunger — and, for Europe, SDG 12 — responsible production and consumption. The 7th EAP also contains two objectives directly relevant to agriculture, namely, to ensure by 2020 (1) that the nutrient cycle is managed in a more sustainable way, and (2) that the use of plant protection products does not harm human health or the environment and such products are used sustainably.

([1]) This refers to the EU-28 and the primary sector as a whole, including agriculture, forestry and fisheries (DG Agriculture, 2017a).

13.2.2 Selected sectoral trends in Europe, including outlooks

The development of the agricultural sector, farming patterns and the environment

Agriculture across Europe is highly diverse, reflecting different biogeographic, economic, territorial and social conditions. The main share of land in Europe is used by agriculture, and the sector depends on the sustainable use of natural resources and ecosystem services such as pollination. Farming structures vary significantly across Europe and within countries.

> The main share of land in Europe is used by agriculture and the sector depends on the sustainable use of natural resources and ecosystem services.

Agricultural production has increased since the 1950s as a result of a mix of European and national policy measures, production-related subsidies, technological innovations and market incentives (EEA, 2017c). The EU is broadly self-sufficient in most agricultural primary commodities, although this has decreased with increasing specialisation, and it is the single largest exporter of agri-food products globally (EC, 2016c). At the same time, the sector is strongly dependent on imports (notably unprocessed raw materials), such as soybeans used for livestock feed. Over the last decade energy and climate policies have driven an increase in energy crop production as a way of reducing reliance on fossil fuels (OECD/FAO, 2017).

In 2016, two thirds of the EU's farms were smaller than 5 ha and operating 6 % of the utilised agricultural area (UAA). However the general pattern of development in the agricultural sector has been towards a greater concentration of agriculture within the hands of relatively few large, often corporately owned, farms (Eurostat, 2016a), and in 2016, 3.3 % of farms were larger than 100 ha and operated 53 % of the UAA (Eurostat, 2019c).

While agricultural production has increased, the number of farms (and farmers) has been in decline (from 14.5 million farms in 2005 to 10.5 million in 2016) and is projected to decrease further with ageing farmers not being replaced (Eurostat, 2018a). Among the reasons for these developments are structural and technological changes, meaning that production takes place on fewer, larger and more capital-intensive farms (EC, 2016c). From 2007 to 2016 there has also been an increase in landless (zero-hectare) farms (Eurostat, 2018c). In the case of livestock, this type of production is less dependent on the availability of land and the environmental impacts are not always local.

There have also been changes in the extent and management of agricultural land. Grass- and cropland together make up 39 % of land cover in the EU. The proportion of total land accounted for by agricultural land is shrinking. The area of cropland, generally good quality arable land, is decreasing as a consequence of retiring farmers selling land and urbanisation but also because of afforestation and re-conversion of cropland to permanent grassland (OECD/FAO, 2017; Chapter 5). Efforts to increase production efficiency have driven increases in arable land parcel sizes across Europe, although trends vary regionally. This is frequently accompanied by a loss of landscape features (ETC ULS, 2019; Chapter 5). At the same time, agricultural land is falling fallow, because farming in marginal areas is being given up (IEEP, 2010; Terres et al., 2015).

Although the dominant trend remains towards intensification, around 9 % of agricultural land is part of Natura 2000 sites (DG Agriculture, 2017b) and around 30 % is classified as high nature value farmland (Chapter 5). The share of organic production in total agricultural production has also increased significantly in the EU and is projected to increase further. The area under organic farming increased by 18.7 % from 2012 to 2016 and now comprises 6.7 % of UAA (Eurostat, 2018d).

Agricultural production both contributes to climate change and is affected by climate change (Chapter 7; EEA, 2019a). In recent years, the sector has been increasingly affected by extreme weather events, leading to reduced yields (EEA, 2017b). Regionally, production in Europe might benefit from a longer vegetation period, leading to increasing yields of some crops. Adapting production can buffer climate-driven shocks, while affecting land use and land cover, and the traditional cultural landscape. In addition to ozone, other air pollutants also affect agricultural production.

Looking ahead, some short-term prospects for the sector can be outlined

based on current trends (based on EC, 2018a; OECD/FAO, 2017, 2018). Although there are regional and crop-related differences, productivity is projected to increase further. Steadily growing global demand for fresh dairy products and affordable feed prices should favour the livestock sector. Maize production is also expected to increase, while there will be a shift from rapeseed production to soybeans. This reflects the current trend towards an agricultural sector less oriented to producing biofuels and more to extending protein crop production.

Agriculture and environmental pressures

Agricultural activities in Europe have multiple impacts on the environment, climate and human health. Unsustainable farming practices lead to pollution of soil, water, air and food, overexploitation of natural resources and biodiversity loss and ecosystem degradation. Agricultural policy has been particularly influential in shaping European landscapes and the nature they contain. The pressures and threats for all terrestrial species, habitats and ecosystems most frequently reported by Member States are associated with agriculture (EEA, 2015). Europe is experiencing a decline in biodiversity primarily due to the loss, fragmentation and degradation of natural and semi-natural ecosystems and agricultural intensification is one of the main causes (Chapter 3).

Figure 13.1 presents selected agricultural activities and their related environmental pressures and impacts including nutrient emissions, ammonia (NH_3) and GHG emissions, pesticide and antibiotic use, soil compaction and water use. Past trends and outlooks are shown at EU level, which does not account for variation across Europe and between different types of farming practices.

> Agricultural intensification is one of the main causes of biodiversity loss and ecosystem degradation in Europe.

For some environmental pressures from agriculture no clear improving trends in absolute figures can be observed, whereas other pressures such as GHG and NH_3 emissions have increased in recent years (Figure 13.1). For instance, pesticide sales have remained relatively stable since 2011. While there are limitations to linking trends in sales with risks to human health and the environment, the use of pesticides has far-reaching impacts on food chains, soil health and biodiversity (Chapters 3, 4, 5 and 10). The share of GHG emissions from agriculture is currently around 10 % and while overall emissions have declined from 1990, in the last few years they have increased from both livestock and soils (Chapter 7).

Agriculture is the economic sector in which air pollutant emissions have been reduced the least and it is the main source of NH_3 emissions. While NH_3 emissions decreased in the EU in the period 1990-2010, they are still high and have increased since 2013, driven primarily by livestock production. This impacts aquatic and terrestrial ecosystems and also favours the formation of secondary particulate matter in the air, contributing to exceedances of air quality standards and impacting human health. In spring time these exceedances are mostly due to NH_3 coming from the use of fertilisers and nitrogen oxide (NO_x) emissions from urban traffic (Chapter 8).

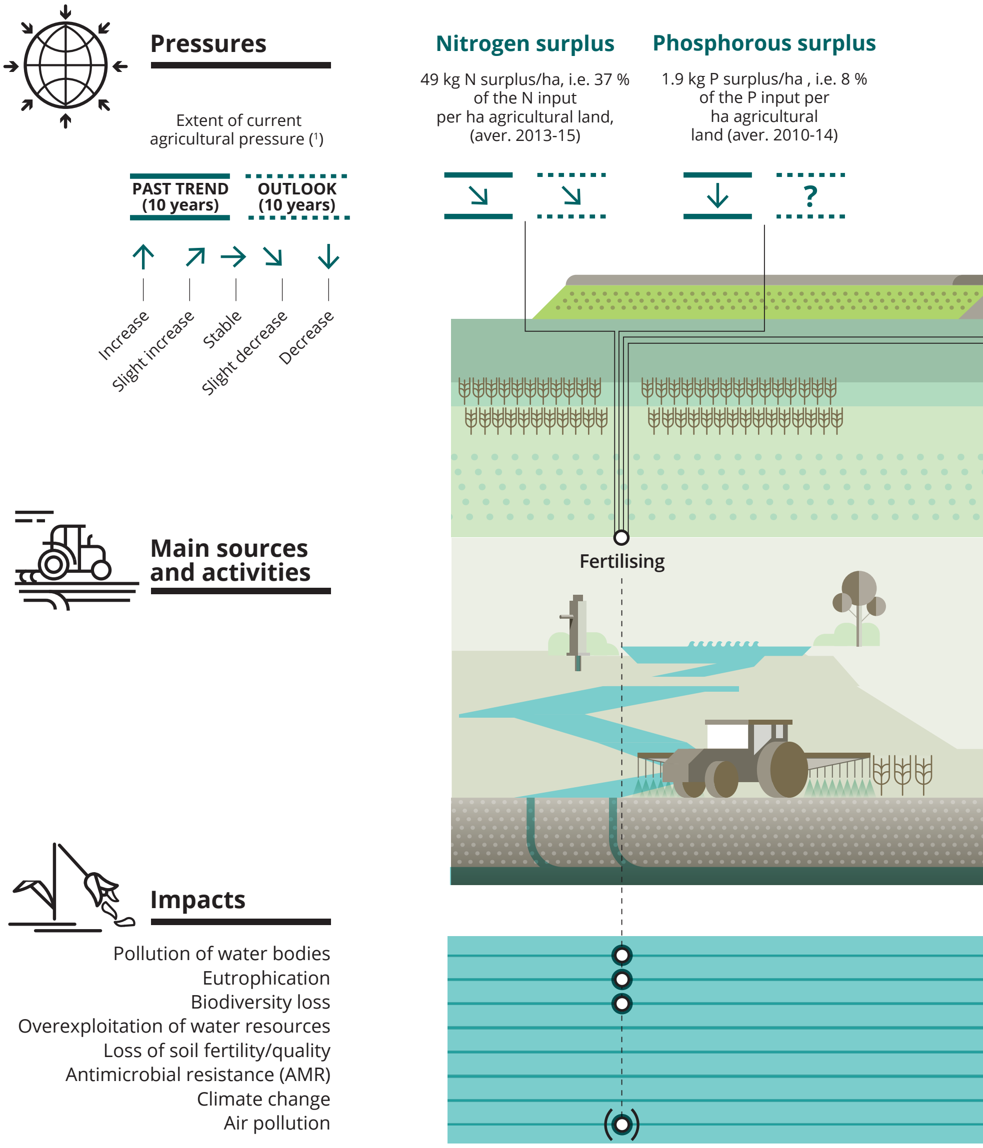
The use of nitrogen-based fertilisers in agriculture is a primary cause of diffuse pollution, one of the main environmental pressures from agriculture. Excess nitrogen discharges to the environment (soil, air and water) results in systemic environmental problems such as eutrophication. Run-off and leaching from agricultural land has been identified as the main source of nitrogen in surface and ground water bodies (Chapter 4). Nitrogen losses are captured in the nitrogen balance ([2]), which is used to assess performance regarding nutrient emissions by estimating the nitrogen surplus to the environment. Important determinants of nitrogen surplus are the amount of overall fertiliser applied to fields and the uptake by grass and harvested plants, which are influenced by farm management decisions.

The nitrogen surplus has decreased over the years from very high levels in the 1990s. From 2000 to 2015, the gross nitrogen balance improved, although this trend has levelled out since 2010 (Figure 13.2). Over the period 2000-2015, the efficiency of nitrogen use (total nitrogen outputs divided by total nitrogen inputs) also increased, contributing to the improving trend in the nitrogen balance (Figure 13.2) (Eurostat, 2018b). However, this efficiency increase did not result in significant decreases in nutrient losses. The EU as a whole and some regions in particular still have an unacceptable surplus of nitrogen

([2]) For information on the 'Agricultural land: nitrogen balance' indicator, references, and country-level information, see www.eea.europa.eu/airs/2018/natural-capital/agricultural-land-nitrogen-balance.

FIGURE 13.1 **Pressures and impacts from agriculture on the environment — past trends and outlooks, EU-28**

Agriculture has multiple impacts on the environment, climate and human health. This figure presents selected agricultural activities and their related environmental pressures and impacts. Unsustainable farming practices lead to pollution of soil, water, air and food and over-exploitation of natural resources. Past trends and outlooks show a mixed picture regarding the environmental sustainability of the agriculture sector.



Nitrogen surplus
Agriculture is the main user of nitrogen (N) globally. Over-use of N fertilisers causes eutrophication of aquatic and terrestrial ecosystems (Chapter 4, 6 and 14).

Phosphorous surplus
If more phosphorus (P) fertiliser is applied than taken up by plants, it may result in pollution of e.g. ground and freshwater and cause eutrophication (Chapter 4).

Notes:

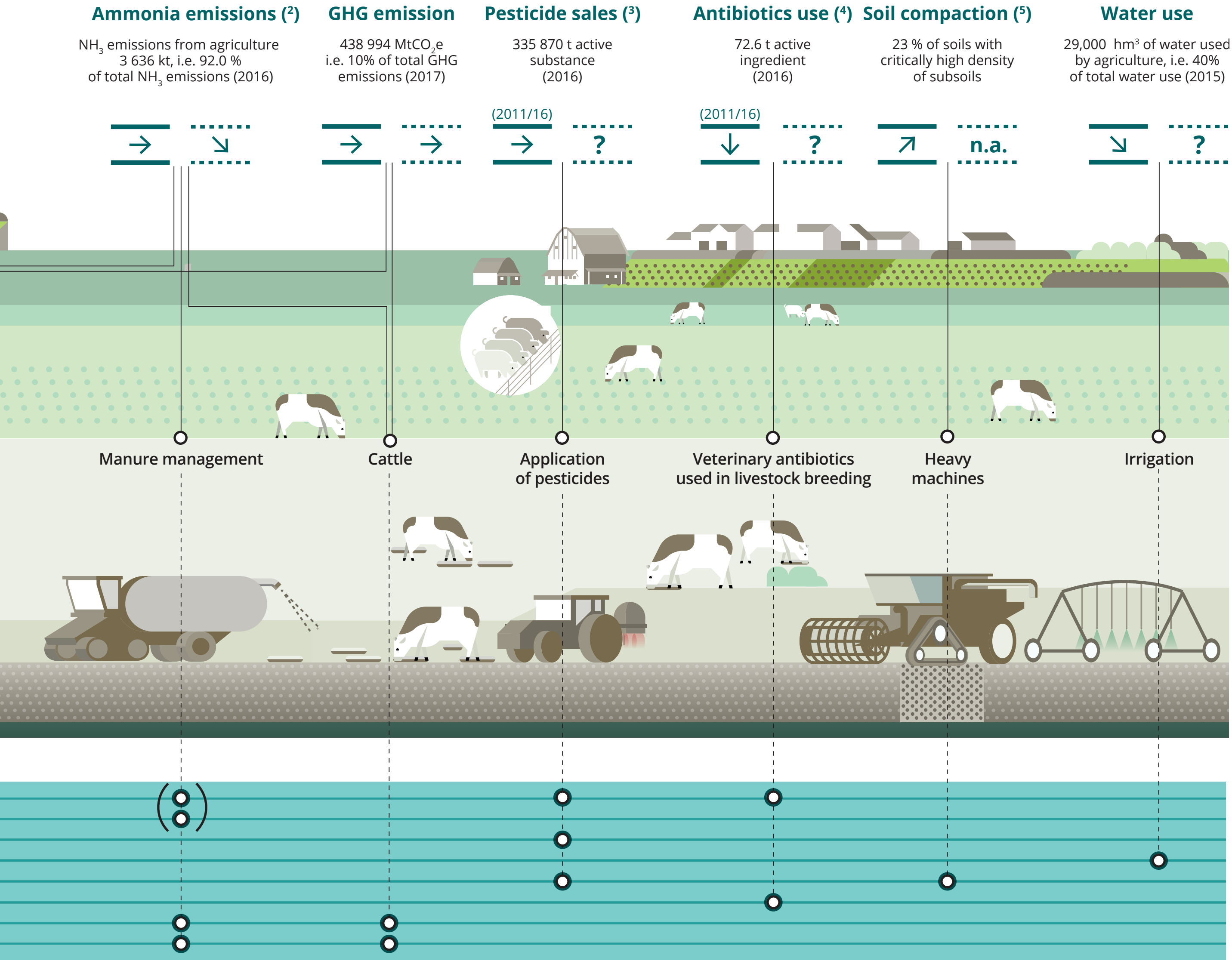
(1) If not stated otherwise, the assessment period for past trends is around 10 years, and the outlooks are provided for the year 2030. Trends are classified as 'stable' if changes are not larger than +- 1 %, as 'slightly increasing/decreasing', if changes are smaller than +/-/= 5 %, as 'increasing/ decreasing' if changes are larger than 5 %. For the outlooks projections are referring to scenarios with existing policy measures.

(2) Data for 2017 for 27 MS.

(3) Data for 16 Member States.

(4) Data for 25 Member States (past trend), data for 27 Member States (outlook).

(5) Based on expert assessment.



Ammonia emissions
Ammonia (NH_3) emissions from e.g. manure management result in air pollution and can bring harm to sensitive ecosystems (Chapter 8).

GHG emission
GHG emissions from e.g. livestock farming, agricultural land, fertilizer use and enteric fermentation contribute to climate change (Chapter 7).

Pesticide sales
Agriculture is the main user of pesticides in most countries. Pesticides have been linked to impacts on biodiversity and human health (Chapter 10).

Antibiotics use
Sold veterinary antibiotics are mainly used in animal breeding. Over use and untailored use (Chapter 10) may cause Antimicrobial resistance (AMR).

Soil compaction
Soil compaction may cause loss of soil fertility and reduce the capacity of soils to retain water and store carbon (Chapter 5).

Water use
Agriculture is a main user of freshwater resources. Overexploitation may lead to decreasing groundwater levels, salt water intrusion and loss of wetlands (Chapter 4).

FIGURE 13.2 Development of the gross nitrogen balance, nitrogen use efficiency and gross value added, EU-27

Notes: GNB, gross nitrogen balance; NUE, nitrogen use efficiency; GVA (agri), agricultural gross value added (agricultural industry). GNB and NUE are based on Eurostat data (aei_pr_gnb), Eurostat estimates for Estonia (2015), Romania and Croatia (2004-2014) Belgium, Bulgaria, Denmark, Greece, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Malta (2004-2015). GVA of the agricultural industry (values at current prices) based on Eurostat data (tag00056), economic accounts for agriculture — values at current prices.

Source: EEA calculations based on Eurostat data. 2005 = 1.

from agricultural land, and nutrient levels still exceed nutrient critical loads in most of the EU. Looking ahead, a decrease of 2.6 % in comparison to 2008 is projected for the average nitrogen surplus in the EU by 2030. The largest fall in the surplus is projected in regions where a reduction in livestock herd size is expected (EC, 2017b).

Many factors can influence the development of the nitrogen balance and trends vary regionally. These factors include ambitions to reduce production costs, policy measures, the availability and prices of different types of nitrogen fertilisers and livestock numbers (EC, 2011b; Eurostat, 2018b). Efficiency gains observed in Europe may have been achieved by adapting nitrogen management, such as changes in fertiliser application techniques or by more targeted selection of varieties (Balafoutis et al., 2017; Schrijver, 2016; Zarco-Tejada et al., 2014).

Technological developments have the potential to enable more targeted use of inputs. However, such synergies between environmental and economic interests do not occur when it comes to the structure and diversity of agricultural landscapes, and soil quality and health. Efforts to increase production efficiency and income have resulted in increasing land parcel sizes, a reduction in landscape features and drainage of land. This consolidation, increasing homogeneity and change in the use of agricultural landscapes has been linked to negative impacts on biodiversity and soil (ETC/ULS, 2019; Chapters 3 and 5).

In addition, various pressures from agriculture can have combined impacts on ecosystems and have cumulative effects. For example, in relation to soil, pesticide use can reduce soil biodiversity, irrigation can lead to salinisation, soil compaction resulting from heavy machinery use can reduce growth and resilience of crops as well as carbon formation and water retention capacity, and the risk of soil erosion is also increased through compaction as well as through increased land parcel size (Chapter 5).

> Reducing the environmental impact of agriculture would improve progress across a range of environment and climate policy objectives.

13.2.3
Responses and prospects of meeting agreed targets and objectives

Reducing the environmental impact of agricultural activities would contribute to improved progress towards a wide range of environment and climate policy objectives. Available indicators show limited progress regarding the likelihood of achieving the sector-related objectives in the 7th EAP, namely that the nutrient cycle is managed in a more sustainable way and that the use of plant protection products does not harm human health or the environment and such products are used sustainably. The Environmental Implementation Review highlighted NH_3 emissions and water pollution from nitrates caused by intensive agricultural activities as areas where efforts need to be increased (EC, 2019).

Emission-related impacts from agriculture to the environment can be reduced to a certain extent through more efficient and targeted use of inputs to agricultural production and innovation and new technologies. However, efficiency gains do not necessarily contribute to the reduction in all types of pressures, especially those related to landscapes, biodiversity and soils. The use of more environmentally sustainable farming practices such as organic agriculture and agroecology offers the potential to reduce a broader range of environmental pressures.

One of the main mechanisms to address environmental pressures from agriculture has been mainstreaming of environment and climate objectives into the CAP. There are three main mechanisms used: (1) cross-compliance; (2) greening measures; and (3) a set of voluntary measures including agri-environmental measures.

Cross-compliance was first introduced in 2003 and is a prerequisite for receiving several types of CAP funds. It currently comprises (1) statutory management requirements selected from existing directives and regulations on environment, food safety, plant and animal health, which apply to all farmers; and (2) additional standards for good agricultural and environmental conditions (GAEC), which apply only to CAP beneficiaries and deal with the protection of water, soil and carbon stocks and the maintenance of land and landscape features. Non-compliance may result in sanctions (based on EC, 2011b, 2013d; Alliance Environnement, 2007; ECA, 2017).

Greening measures were introduced in the period 2014-2020 and target the majority of farmers receiving direct payments. They comprise establishing ecological focus areas, crop diversification schemes and maintaining permanent grassland. The aim of greening measures is to make more farmers deliver environment and climate benefits, going beyond cross-compliance and acknowledging the provision of public goods (EC, 2011b).

A range of voluntary measures drives the mainstreaming of environmental and climate concerns into the CAP. Under Pillar 2, Member States have to spend at least 30 % of their budgets on measures related to environment and climate mitigation. Flexibility is given in selecting measures offered under national or regional rural development programmes. These include area-based agri-environmental-climate schemes, support for organic farming, farming in areas with natural constraints, investments in sustainable production and providing farm advisory systems covering several environment- and climate-related subjects.

The share of UAA subject to the different regimes provides an indication of their outreach and their theoretical potential but not of their effectiveness. In 2016, 83 % of UAA was subject to cross-compliance; 77 % was subject to at least one greening obligation and 10 % was under GAEC (DG Agriculture, 2019).

While environment, climate and public concerns are considered within the CAP, assessing its environmental and climate performance is challenging for several reasons. Firstly, there is a lack of target setting at the level of environmental impacts. Assessing policy performance on the basis of the extent of area under certain management regimes, or budget allocated, assumes that the measures implemented are effective and there is compliance with standards. Secondly, while the CAP is a common EU policy, implementation patterns vary among Member States and the degree of Member States' flexibility has increased. Thirdly, the environmental performance of the sector does not equal that of the CAP, as farmers' decisions are not only influenced by policies. Finally, responsibilities for mainstreaming and/or achieving environment and climate objectives related to agriculture vary. For instance, the EU 2020 biodiversity strategy explicitly requires concrete action in the field of the CAP initiated at European and national level. In contrast, the CAP contributes to climate mitigation and adaptation more generally by offering instruments to enable Member States to achieve their national targets, and Member States are responsible for achieving such targets and deciding on the means of doing so.

Nevertheless, some conclusions on the CAP's effectiveness in relation to the environment can be made. Cross-compliance has led to some reduction in pressures on the environment, for example nutrient emissions. Yet, there is still non-compliance by farmers, cases of infringement and potential for improving implementation at all levels (farmer, national, EU) (ECA, 2016). Greening is commonly considered an inefficient policy instrument that has not led to significant changes in farming practices, and the degree of flexibility decreases its potential (Alliance Environnement, 2017; ECA, 2017; Brown et al., 2019). For CAP Pillar 2, the share of 30 % of spending on measures related to the environment and climate will be achieved. However, Member States' political wills and ambitions are key determinants of the effective use of Pillar 2.

Overall, the integration of environmental objectives into the CAP does appear to have resulted in some reductions in environmental pressures such as nutrient emissions. The market reform of the CAP has also been identified as contributing to a reduction in GHG emissions from methane and nitrous oxide (Chapter 7). However, the portfolio of CAP instruments can be used and implemented more effectively for the benefit of the environment and climate mitigation (Brown et al., 2019; ENRD, 2017; Terluin et al., 2017; Zezza, 2017).

> Farmers share the aim of a sustainable and resilient food system.

In general, and in line with developments in other sectors, quantitative and enforceable targets that go beyond the assessment of budget spend could stimulate more effective and impact-oriented implementation of the CAP. Although there are some challenges in defining such targets, they could include environmental pressures directly linked to agriculture and captured in agri-environment indicators, for example NH_3 emissions, water quality, soil quality, gross nitrogen balance and impacts on biodiversity as indicated by trends in populations of farmland birds.

Looking ahead to the future of the CAP post 2020, current legislative proposals aim to make the CAP more responsive to current and future challenges. The nine objectives are economic (ensure a fair income to farmers; increase competitiveness; rebalance the power in the food chain); environmental (climate change action; environmental care; preserve landscapes and biodiversity); and social (support generational renewal; vibrant rural areas; protect food and health quality). The outcomes will largely depend on how Member States use the tools provided at European level to tailor ambitious action towards those objectives, as the level of national flexibility will further increase. Therefore, flexibility has risks around reduced levels of ambition and compliance as well as opportunities to take an integrated approach that addresses trade-offs between objectives.

Simultaneously addressing multiple ecosystem services was identified as one factor for increasing the effectiveness, efficiency and equity of the CAP (IPBES, 2018). As flexibility may also lead to lower environmental ambitions, a common set of mandatory minimum conditions and production standards is required, such as maintaining landscape features, minimum soil cover and crop diversification and rotation. Lessons learnt suggest that supplementing these with measures that are based on scientific evidence of their effectiveness and tailored to regional needs and site-specific conditions will be needed to achieve noteworthy nature conservation progress (Brown et al., 2019; Pe'er et al., 2017; EC, 2015b, 2016b; Sutherland et al., 2017).

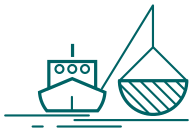
Currently, European farmers face many pressures and often run their businesses sandwiched between the immense upstream market power of input suppliers and downstream food processers and retailers (Buckwell et al., 2017). Yet, the objectives of the 7th EAP and the SDGs and the long-term interests of farmers are the same — a sustainable and resilient food system. This highlights the need to think beyond the CAP and take a food systems approach. Doing so expands the focus of attention from producers to other actors and identifies effective interventions that go beyond a sectoral approach (Chapter 16).

13.3 Marine fisheries and aquaculture

13.3.1 Socio-economic relevance of the sector and policy landscape

Fisheries and aquaculture products are an important source of protein and a crucial component of a healthy diet. They deliver important ecosystem services to society. In the EU, commercial fisheries provided about 152 720 jobs in 2017 (STECF, 2017) and aquaculture accounted for about 75 300 jobs in 2016 (STECF, 2018a). Although relatively small, the fishing sector plays an important societal role by providing economic activity and employment in many coastal communities.

The EU fishing fleet is very diverse, with the vast majority of boats less than 12 metres long, a smaller number of vessels exceeding 40 metres in length and a still poorly understood number of recreational fishery vessels (3). From an economic perspective, overall the EU fleet is profitable (STECF, 2018b). Fisheries depend on healthy seas more than any other industry, as healthy, well-managed oceans are a prerequisite for long-term investments and job creation in fisheries and the broader blue economy. Well-managed fisheries result in a cascade of positive outcomes, including increased income to fishers and reduced impacts on the wider environment.



Fisheries is an important sector providing economic activity and employment in many coastal communities.

In Europe, fish stocks and fishing fleets are managed by the common fisheries policy (CFP) (4). The CFP also includes rules on aquaculture, which are reinforced by the blue growth agenda component. The CFP applies to all vessels fishing in European waters and also to European vessels fishing in non-European waters. The scope of the CFP includes the conservation of marine biological resources and the sustainable management of fisheries targeting them. To that end, the CFP is adapting exploitation rates to ensure that, within a reasonable time frame, the exploitation of marine biological resources is restored and populations of harvested stocks are maintained above levels that can produce the maximum sustainable yield (MSY (5)). In parallel, safeguarding healthy commercial fish and shellfish populations is one of the 11 descriptors (descriptor 3 (6)) of the Marine Strategy Framework Directive (MSFD) for achieving good environmental status (GES). This objective is closely related to the objectives of the CFP, in particular the objective of ensuring MSY for all stocks by 2015 where possible, and at the latest by 2020. In addition, the MSFD also addresses sea floor integrity in descriptor 6 (7). Sea floor integrity is a key compartment for marine life, and some fishing practices such as trawling and dredging jeopardise it. Also closely related to the objectives of the CFP are commitments in the EU 2020 biodiversity strategy, in particular target 4, which requires that, by 2015, fishing is sustainable and that, by 2020, fish stocks are healthy. Fishing must have no significant adverse impacts on species and ecosystems, so that all European oceans and seas can be ecologically diverse and dynamic, as well as clean, healthy and productive by 2020.

In the context of the EU integrated maritime policy, the combination of these two key policy instruments (CFP and MSFD), along with biodiversity conservation measures under the Birds and Habitats Directives and the EU Directive on Maritime Spatial Planning (2014/89/EU) constitute the basis for the EU to deliver on its commitments to achieving healthy and productive seas as well as ensuring appropriate conservation and sustainable use of the European regional seas. Furthermore, these policy measures contribute to the overall EU vision defined in the 7th EAP of 'living well, within the limits of the planet' and more recently within the global framework on SDGs, in particular the fishing-related targets within SDG 14 on life below water.

(3) Based on data submitted by Member States under the data collection framework, there were 63 976 active vessels and 20 444 inactive vessels in 2015. Of the active vessels, 74 % were classed as small-scale coastal vessels, 25 % as large-scale vessels and the remaining 1 % as distant-water vessels (STECF, 2017).

(4) The CFP was first introduced in the 1970s and went through successive updates, the most recent of which took effect on 1 January 2014.

(5) MSY is the maximum catch (in numbers or mass) that, on average, can be removed from a population (or stock) over an indefinite period. Exploiting fish stocks at or below MSY allows them to be maintained or recovered to healthy levels, providing food for consumers while contributing to important ecosystem and marine food web functions.

(6) Descriptor 3: populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock. Three criteria for good environmental status have been identified for the commercial fish and shellfish: (1) level of exploitation; (2) reproductive capacity; and (3) healthy age and size distribution.

(7) Descriptor 6: sea floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and that benthic ecosystems, in particular, are not adversely affected.

The overall use of fish and shellfish stocks in Europe is beyond the limits for long-term sustainability.

13.3.2 Selected sectoral trends in Europe, including outlooks

Production of fish and aquaculture

In the EU, 80 % of production comes from fisheries and 20 % from aquaculture. In Europe there has been a steady decline in production since 2000 in both aquaculture (by 16 %) and capture fisheries (by 17 %; Eurostat, 2017). In 2015, total production of fishery products in Europe was an estimated 6.4 million tonnes (live weight equivalent). The EU is the fourth largest seafood producer worldwide, accounting for about 3 % of global fisheries and aquaculture production in 2015, compared with China, which produced 39 % (EUMOFA, 2018). There is a difference between the EEA member countries and cooperating countries (EEA-39), where pisces marine aquaculture (~60 %) dominates total aquaculture production, and the EU Member States (EU-28), where mollusca marine aquaculture (~50 %, comprising mussels, oysters and clams) accounts for around half of total production. The countries that contribute the most to European production (EEA-39) are Norway (approximately 46 %), followed by Spain, Turkey, the United Kingdom, France, Italy and Greece. Together these seven countries account for 90 % of all aquaculture production in Europe. Norway's production is nearly all farming of Atlantic salmon. Turkish production consists mainly of trout (inland), sea bream and sea bass (marine) (EEA, 2018c).

Overall impacts

Fish stocks are a renewable resource if exploited in an appropriate manner. Overfishing has been historically present in all EU regional seas (Jackson et al., 2001). This causes changes to marine food webs affecting species composition and abundance, and incidental catches of non-target species increase the magnitude of such change. Other impacts, for example damage to the seabed, are related to fishing methods and the type of fishing gear used.

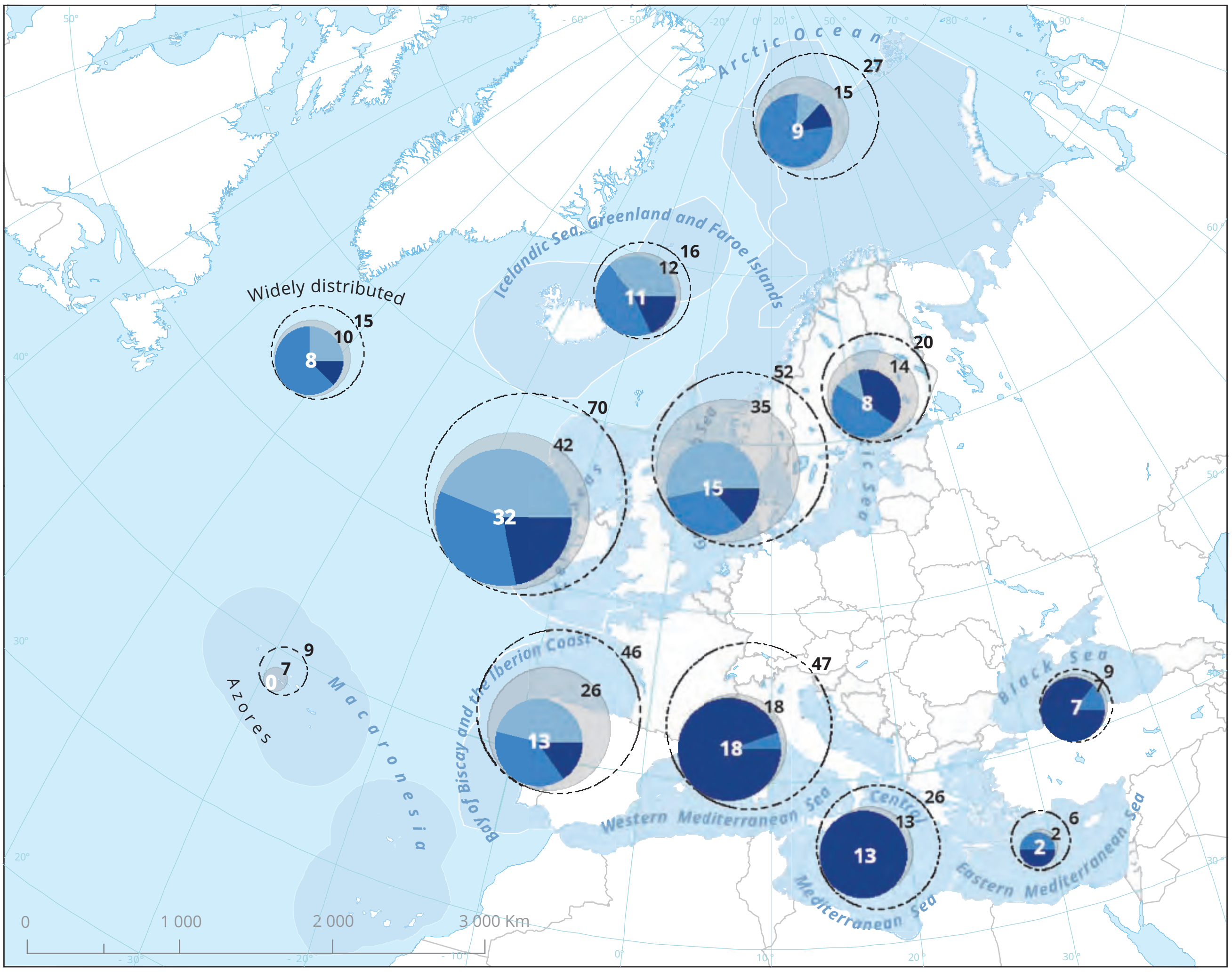
Aquaculture can include the culture of fish, shellfish and algae. Farming is carried out in land-based systems, such as recirculating systems, ponds or tanks (e.g. trout) or water-based systems in coastal (e.g. clams), onshore or offshore waters, using structures such as pens (e.g. salmon) and ropes (e.g. algae, mussels). Bivalves and algae extract food from the water column and do not require feeding in culture. Bivalves remove particulate organic matter and algae remove dissolved inorganic matter, which provides ecosystem services such as carbon sequestration and nutrient removal and has a lower environmental impact than the culture of fed species. Algae are also farmed in closed recirculating systems with almost complete water-recycling rates.

Finfish are cultured in closed systems, with minimal impact, and in open systems in the natural environment. Finfish at higher trophic levels require feeding, leading to impacts on the benthic ecosystem and surrounding environment due to the accumulation of faecal matter and uneaten feed. Integrated multi-trophic aquaculture addresses this issue by integrating the culture of species at different trophic levels (e.g. finfish, mussels, algae), with one species removing the nutrients produced by the other, in a circular loop, minimising losses to the environment. Concerns over the use of antibiotics have decreased considerably in recent years because of a drastic reduction in their use for the top cultured finfish species (e.g. salmon), but this still remains to be addressed at a wider level. A further environmental concern regarding the culture of fed species comes from fishing for feed, as fisheries are the main source of fishmeal and fish oil. Escapees of any cultured species, both native and exotic, can compete with wild stocks for habitat and food. Fisheries, fish and shellfish farming are all also a source of marine litter, and lost gear can cause additional damage to ecosystems by 'ghost fishing' and degrading to create microplastics.

Status of stocks

The overall use of fish and shellfish stocks in Europe currently remains beyond the limit for long-term environmental sustainability (Map 13.1). The latest available information shows that around 55% of the assessed fish and shellfish stocks in Europe's seas for which sufficient information is available, are in good status when assessing against the level of fishing mortality, their reproductive capacity, or both criteria. Of the assessed stocks, 27 % are in good status according to both fishing pressure and reproductive capacity (i.e. spawning stock biomass), and 28.5 % are in good status according to one of the two criteria (Map 13.1). 45 % of assessed stocks are not in good status. These percentages vary considerably between EU marine regions — from at least 62-87.5 % of the stocks meeting at least one of the GES criteria in the regions in the NE Atlantic and the Baltic Sea to only two out of 33 (6 %) and one out of 7 (14.3 %) in the

MAP 13.1 **Status of the assessed European commercial fish and shellfish stocks in relation to good environmental status per EU marine region, 2015-2017**



Status of the assessed European fish and shellfish stocks in relation to Good Environmental Status (GES) per EU Marine Region in 2015-2017

Number of assessed stocks for which adequate information is available to determine GES (X)

- Stocks in good status based on both fishing mortality and reproductive capacity
- Stocks in good status based on only one of fishing mortality or reproductive capacity
- Stocks not in good status based on both fishing mortality and reproductive capacity

X — Total number of assessed stocks: Y — Total number of stocks: Z

Note: This figure shows the status of the assessed European commercially exploited fish and shellfish stocks in relation to 'good environmental status' (GES) per EU marine region in 2017 (2016 data for the Mediterranean and Black seas). Stocks for which adequate information is available to determine GES for fishing mortality (F) and/or reproductive capacity (spawning stock biomass (SSB)) are included (where Z, total number of stocks; Y, total number of assessed stocks; and X, number of stocks for which adequate information is available to determine GES on the basis of these two criteria). A distinction is made between stocks in (1) good status based on both F and SSB; (2) in good status based on only one criteria, F or SSB (either because one of the two criteria are not in good status or there is only one available criteria and it is in good status); and (3) not in good status (based on both F and SSB or there is only one criteria available and it is not in good status). See EEA (2019b) methodology section for further information on how good status is determined. As assessments are carried out in a multiannual cycle within the Mediterranean Sea, the number of stocks included for this region depends on the period covered.

Healthy fish populations depend on healthy marine ecosystems.

Mediterranean Sea and the Black Sea respectively (EEA, 2019b).

In addition, the EU faces the dual challenge of the need to assess more stocks and the need for better information on all stocks to inform MSY-based stock assessments. Despite recent improvements in the North-East Atlantic, a major step change is required to reduce both the proportion of total allowable catches (TACs) (8) set above scientific recommendations and the number of TACs set without scientific recommendations, as this curtails opportunities for earlier recovery of stocks. Strong management decisions and transparent decision-making processes are required if TACs are to be brought into line with scientific advice by 2020 (Nimmo and Cappell, 2017).

13.3.3 Responses and prospects of meeting agreed targets and objectives

Environmental ambitions and objectives are strong policy drivers for fisheries management in Europe. Mainstreaming of environmental considerations is in place, and high-level objectives, such as the MSFD's and CFP's objectives related to achieving GES for the marine environment, have provided a basis for policy alignment. Evidence demonstrates that targeted policy actions and committed management efforts can protect and/or restore species and habitats and can help to preserve ecosystem integrity. Fisheries management efforts are clear examples of positive action and illustrate the effect of policies on trends in some long-term pressures in the North-East Atlantic Ocean and Baltic Sea (Chapter 6, Figure 6.5). Since the early 2000s, better management of fish and shellfish stocks has contributed to a clear decrease in fishing pressure in these two regional seas. Signs of recovery in the reproductive capacity of several fish and shellfish stocks have started to appear. If these efforts continue, meeting the 2020 objective for healthy fish and shellfish stocks in the North-East Atlantic Ocean and Baltic Sea could be possible, based on two of the three MSFD criteria (i.e. fishing mortality and reproductive capacity) (EEA, 2019b).

In contrast, there is no sign of improvement in the Mediterranean and Black Seas, where about 92 % of the stocks assessed are fished at biologically unsustainable levels (EEA, 2019b). These levels require urgent action, and success will depend on the availability and quality of marine information, the political will to implement scientific recommendations, and adequate uptake of management measures. In addition to improved scientific information, greater accessibility to already available information would enable more effective monitoring of progress towards CFP objectives.

European policy is also having a wider impact globally. The EU is by far the largest single market for seafood (EUMOFA, 2018; FAO, 2018) and has used this important leverage to drive a reduction in illegal, unreported and unregulated (IUU) fishing through its IUU Regulation, introduced in 2010. The EU's market leverage in combination with the IUU Regulation can drive improvement in the social and environmental performance of EU source fisheries worldwide. Although a balance would have to be achieved between fair market access and social and environmental performance, consolidation and application of international standards offers a route for the EU to facilitate improvement of source fisheries to performance levels consistent with the CFP. The upside of improving fisheries management worldwide has been quantified at up to USD 83 billion, 15 % of which would be gains resulting from applying the CFP in EU fisheries (World Bank, 2017).

Ensuring healthy fish and shellfish populations does not depend solely on fishing at environmentally sustainable levels. Healthy fish populations depend on healthy marine ecosystems. Attempts to manage Europe's seas must account for the global context, multiple interactions between society and the environment, and possible unexpected changes. This will improve system understanding and help identify novel interlinkages and drivers of change, providing insights into potential future problems. Europe's marine ecosystems continue to display symptoms of degradation and loss of resilience, which will be exacerbated by the effects of climate change (Chapter 6). Without an integrated approach to the management and protection of Europe's seas, the outlook beyond 2020 for productive seas and healthy fish and shellfish populations will continue to give cause for concern.

(8) Total allowable catches, or fishing opportunities, are catch limits (expressed in tonnes or numbers) that are set for most commercial fish stocks. The Commission prepares the proposals, based on scientific advice on the stock status from advisory bodies such as the International Council for the Exploration of the Sea and the Scientific, Technical and Economic Committee for Fisheries.

13.4 Forestry

13.4.1 Socio-economic relevance of the sector and policy landscape

According to pan-European statistics, forests cover more than 40 % of the EEA-39 region. In addition to wood supply, European forest ecosystems provide multiple functions. They host a major part of Europe's biodiversity, deliver inputs to other economic sectors, and provide forest products and ecosystem services for society and human well-being (EEA, 2016b).

Economically, Europe is one of the world's biggest roundwood producers (Forest Europe, 2015a). In 2015, about 420 000 enterprises were active in wood-based industries across the EU-28; representing 20 % of manufacturing enterprises (Eurostat, 2017). The forest-based sector contributes around 7-8 % of the EU's manufacturing GDP and employs over 3.4 million people (Eurostat, 2018a). Socially, forests have excellent recreational value and are an important part of landscape amenities and cultural heritage, and deliver improved human health and well-being, as well as employment in rural regions of Europe.

Although there is no common European forest policy in terms of a legal framework, forests are addressed across a range of environment and climate policies. The ecosystem dimension of forests is addressed in the 7th EAP, the Birds and Habitats Directives and the EU biodiversity strategy. The productive role of forests is relevant to the Renewable Energy Directive. The current EU forest strategy (EC, 2013a) embraces forest-related elements of various strategies and policies and its implementation relates to the bioeconomy strategy (EC, 2018a), circular economy package (EC, 2015a) and, following the Paris Agreement, the LULUCF Regulation. These objectives are also supported by global initiatives, such as the SDGs (15.2), the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change, where the prevention of deforestation receives primary attention through reducing emissions from deforestation and degradation. The role of forests in mitigating the risks of natural disasters is stressed in the Sendai Framework for Disaster Risk Reduction (UN, 2015).

Forests comprise 48 % of the Natura 2000 network and their use for wood production is restricted.

European forestry has a long tradition of developing and applying sustainable forest management (SFM), which has been monitored since 1998 based on an agreed set of six criteria and 52 indicators, capturing the multiple productive, social and environmental functions and services of forests (Forest Europe, 2015a). SFM aims to ensure a range of forest ecosystem services such as the protection and maintenance of biodiversity, as forests contain the greatest variety of species found in any terrestrial ecosystem, as well as protection against landslides, and water and air purification (EEA, 2016b; Thorsen et al., 2014).

13.4.2 Selected sectoral trends in Europe, including outlooks

How forest natural capital is managed is decisive for the condition of forest biodiversity and ecosystems and for the provision of products and ecosystem services. According to Corine Land Cover analyses, the forest area is overall stable in Europe (EEA, 2018d; Chapter 5). Close to 90 % of European forests are available for wood supply, and they are mostly managed in accordance with the principles of SFM. Less than 5 % of European forest areas are considered undisturbed, or natural) (Forest Europe, 2015b), while less than 1 % can be considered primary or virgin forests (Sabatini et al., 2018). Thirty million hectares of forests are protected as Natura 2000 areas, equalling 48 % of all Natura 2000 protected areas, and their use for wood production is restricted.

Supply of forest products and services

The dominant product provided by forests is wood. Reported roundwood production in the EU-28 reached 458 million m^3 in 2016 (Eurostat, 2018a). Of this, 21.6 % was used as fuelwood and the rest was industrial roundwood used for sawn wood and veneers, pulp and paper production. While EU industrial roundwood production has remained on average 45 million m^3 lower than in 2007, the production and trade of wood for fuel has grown substantially since 2010, and increasing demand has been driven by policy objectives to increase the use of energy from renewable sources.

Wood products such as pellets and briquettes account for 45 % of the EU-28's gross inland energy consumption of renewables, reaching more than 70 % in some countries. Imports of wood pellets from outside Europe have doubled reaching 6 billion tonnes in 2015 (Eurostat, 2018a). Timber production is projected to double over the next two decades (Bais-Moleman et al., 2018), which may result in challenges for the forest-based sector's ability to mobilise wood. Less than two thirds of Europe's forest growing stock was mobilised in

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the period from 1990 to 2016 (Forest Europe, 2015a). This is likely to be due to the fragmented ownership of forests, which creates difficulty in accessing and mobilising wood resources. About 60 % of the European forests are privately owned, of which more than 60 % have an area of less than 1 ha; the average size of holdings is below 5 ha (Schmithüsen and Hirsch, 2010). However, recent studies indicate that reported removals might be underestimated (Camia et al., 2018; Schelhaas et al., 2018; Chapter 5).

The forest-based sector also supplies non-wood products, such as cork, mushrooms, berries, game, many of which are not marketed, although their value has been estimated at EUR 723 million, indicating their economic importance (Forest Europe, 2015a). Furthermore, in line with the new bioeconomy strategy, the forest sector is increasingly exploring novel products, such as bioplastics, biocomposites, wood-based textiles for clothing, and the use of forests for climate-smart construction materials. These new products are expected to require low volumes of forest biomass while providing high value (de Jong et al., 2012).

The increased awareness of the multifunctionality of forests and the many benefits of forest ecosystem services for society has promoted developments in the forest sector that respond to these broader environmental and societal needs. The benefits provided by forest ecosystem services comprise the above-mentioned provisioning services (e.g. wood and fibres) and important regulating services (e.g. clean air and water, flood and erosion control, forest water regulation and resource management). Forests are also important in climate change mitigation and adaptation as they sequester and store carbon in the forest ecosystem and in harvested wood products. Cultural services include accessible and attractive forest areas, rich in biodiversity, that support education and nature-based sustainable tourism, and recreational and health related activities. However, realising these ecosystem benefits for society requires careful integration of biodiversity considerations into the forestry sector. There are little available data on the economic value of marketed forest ecosystem services, although the income from forest ecosystem services exceeds that from timber production in many European countries (Forest Europe, 2015a; Marchetti et al., 2018).

Environmental pressures

Only one third of the forest habitats listed under the EU Habitats Directive are in favourable conservation status (Chapter 3). For bird populations, nearly two thirds of the assessments of woodland and forest species are secured (i.e. they show no foreseeable risk of extinction and have not declined or depleted). This is better than for other ecosystem types such as agricultural areas (EEA, 2015). Regarding common birds, forest birds show less decline than farmland birds (EEA, 2018a).

Natural (storms, pests) and human-induced disturbances (forest fires, infrastructure and tourism) are threats to Europe's forests (Chapter 7). Climate change is expected to trigger increased frequencies and intensities of natural disturbances (Seidl et al., 2017). Storm damage is projected to increase by 15 % by 2100, potentially resulting in a 5 % annual reduction in carbon sequestration by forests (Gardiner et al., 2013). Boreal regions experiencing increased air temperatures have reported large-scale insect outbreaks (Pureswaran et al., 2018). Some species of fungi and pests benefit from milder winters in temperate forests, facilitating their spread, such as ash dieback. Despite many uncertainties, it is generally accepted that there has been an increase in the incidence of pests and diseases in European forests (FAO, 2006; Desprez-Loustau et al., 2007) and a shift in the spatial and temporal ranges of insects, as a result of climate change.

> Only a third of forest habitats protected under the EU Habitats Directive show a favourable conservation status.

Fires cause damage by altering the ecosystem structure, composition and condition. Severe wildfires may remove soil organic matter and result in erosion and the loss of nutrients and biodiversity (Certini, 2005; Santín and Doerr, 2016). This may turn forest soils into carbon sources (Ludwig et al., 2018). Several studies suggest that climate change would lead to a marked increase in the potential for forest fires in south-eastern, south-western and, in relative terms, western-central Europe (Khabarov et al., 2016; Bedia et al., 2014). The burnt area in southern Europe could more than double during the 21st century for a reference climate scenario and increase by nearly 50 % for a 2 °C scenario (Ciscar et al., 2014). Additional adaptation measures would substantially reduce the risk of forest fires, such as prescribed burning, firebreaks and behavioural changes (Khabarov et al., 2016; Chapter 7).

Forest ecosystems also have to cope with multiple pressures generated from human-related activities (EEA, 2016b). These include activities that directly affect ecosystems and habitats such as certain forest management practices. In particular, intensively managed even-aged forests and biomass production plantations may have a severe impact on whole habitats through clear-cutting and deadwood removal. Long-term loss of biodiversity in temperate and boreal forests has been observed under management systems that favour

60 %

of forests in the EU-28 are certified compared with 12 % globally.

even-aged forests and plantations (Sing et al., 2018). Nevertheless, only 10 % of Europe's forests have been classified as intensively managed (EEA, 2016b). Forest fragmentation is another factor contributing to biodiversity loss, illustrating the interlinkages between forestry and other sectors such as transport (Chapter 5).

Other human-induced pressures have an indirect impact on the forest ecosystem, for example air pollution, climate change and invasive alien species. Deposition of sulphate (SO_4^{2-}) causes the acidification of forest soils and is reported to be high in central and southern Europe. Likewise, nitrate (NO_3^-) deposition causes eutrophication and acidification in western Europe (Sardans et al., 2016; Petrash et al., 2019). Although Europe's forests show no tendency towards defoliation or forest decline, several studies show signs of nutrient imbalances in European forests, such as increasing limitation of phosphorus in trees and forest stands (Michel and Seidling, 2017; Goswami et al., 2017). Invasive alien species are also negatively impacting forest ecosystem processes leading to reduced forest condition, biodiversity and productivity. For example, the non-native black cherry (*Prunus serotina*) is widespread, challenging foresters to regenerate their forests with native forest trees (EEA, 2016b). Further global change is likely to increase the presence and spread of invasive alien species and the damage they cause to forest resources.

13.4.3
Responses and prospects of meeting agreed targets and objectives

The implementation of EU biodiversity policy still remains a major challenge, and there has been little improvement in the conservation status of forest habitats and species since 2013 despite the implementation of the EU forest strategy (EC, 2018d). Although there are no concrete targets for the sustainable management of European forests, a common management objective is the need to balance production and biodiversity and minimise the impacts described above. SFM provides criteria and indicators that foster governance, institutional frameworks and indicators to measure success in balancing the production function with ecological concerns, for example the amounts of deadwood and biological and genetic diversity. Although SFM does not give specific recommendations for management regimes, increasing evidence shows that the ecological aspects of SFM would need to embrace management approaches that promote more uneven-aged forests with, for example, long-term irregular or small-scale shelter wood systems or even single-tree selective systems, as in 'close-to-nature silviculture', as far as this is economically feasible and suitable for the forest type (Banaś et al., 2018; Hessenmöller et al., 2018). Systems that ensure structural diversity and small-scale variability in ecosystems and habitats have less impact on biodiversity (Chaudhary et al., 2016; Puettmann et al., 2015).

Under the LULUCF Regulation, forest management practices are expected to try to optimise forest functions as carbon sinks and as a natural asset for the bioeconomy. The different objectives of climate policies and bioeconomy and biodiversity policies can result in trade-offs if high-disturbance management systems, such as intensively managed plantations and short-rotation forests for biofuels, are promoted, as these are not in line with long-term biodiversity considerations. Recent scenario analysis (Kändler and Riemer, 2017) shows that a 'nature conservation preference scenario' gives the best results for both climate change and biodiversity conservation, in line with other nature-based solutions (Chapter 17).

Certification is a tool to enhance SFM. The two most widely applied schemes are the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC). More than 60 % of forests in the EU-28 are certified, mostly under the FSC or PEFC or both, compared with 12 % globally. The area under certification has been increasing in recent years, which could reflect an increase in the area for which evidence of SFM is available. To date, this is probably the best way to evaluate the sustainability of forest management (EEA, 2016b).

Good governance, science-informed content and holistic policies are crucial to provide the right incentives for sustainable forest management to build a synergistic relationship between biodiversity and bioeconomy-related goals. Although some progress has been made, the Environmental Implementation Review states explicitly that some Member States should improve their protection of forests through incentives for foresters following the EU forest strategy and SFM principles (EC, 2019).

13.5
Transport

13.5.1
Socio-economic relevance of the sector and policy landscape

Economic competitiveness and social welfare depend on an efficient and accessible transport system. Roughly 11.5 million people, corresponding to 5.2 % of the EU's total workforce, were employed in the transport sector in

2016, contributing EUR 652 billion in GVA to the economy (Eurostat, 2019f, 2019g). The sector is a source of government revenue through vehicle and fuel taxes, and infrastructure charges, but it is also a large recipient of subsidies. Transport is a key source of environmental pressures in Europe, especially of GHGs, air pollutants and noise. It also takes up large swathes of land and contributes to urban sprawl, the fragmentation of habitats and the sealing of surfaces.

Transport is one of the main sectors responsible for climate change, air pollution and noise in the EU.

The sector and its environmental impacts are subject to regulatory, planning and investment decisions at various levels. National, regional and local governments typically play an important role in transport planning and infrastructure development. The European level provides the regulatory framework for many aspects of transport, establishes common objectives and is also an important source of infrastructure funding for many Member States. Because of the cross-border nature of many transport activities, there are also numerous international agreements and treaties, in particular in the frameworks of the United Nations Economic Commission for Europe (UNECE), the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO).

Although the transport sector is crucial for achieving the EU's decarbonisation ambition, there is no specific and binding target for reducing GHGs in EU legislation or international commitments for the sector as a whole. There is, however, a close link between transport GHG emissions and the EU's pledge under the Paris Agreement to reduce its total GHG emissions by at least 40 % by 2030 compared with 1990 levels. The EU is planning to deliver on this pledge by reducing emissions under the EU Emissions Trading System (ETS) by 43 % and emissions in the sectors not covered by the ETS by 30 % below 2005 levels by 2030. Transport is a key sector outside the ETS, but the electricity consumed by transport (e.g. by electric rail transport or electric cars) is included in the ETS, along with domestic aviation (within the European Economic Area). International aviation is currently excluded, as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), developed within the ICAO framework, will be introduced in 2021. Under CORSIA, the process of monitoring, reporting and verification of GHG emissions from international aviation started in 2019. International shipping is mainly covered by the IMO. A European process for monitoring, reporting and verification of carbon dioxide (CO_2) emissions from international shipping started in 2018.

To implement the required reduction in the non-ETS sectors, the newly adopted Effort Sharing Regulation established individual national 2030 targets. Each Member State is, in principle, free to decide where and how to make reductions, but transport is the dominant source and needs to be tackled in order to reach the overall target.

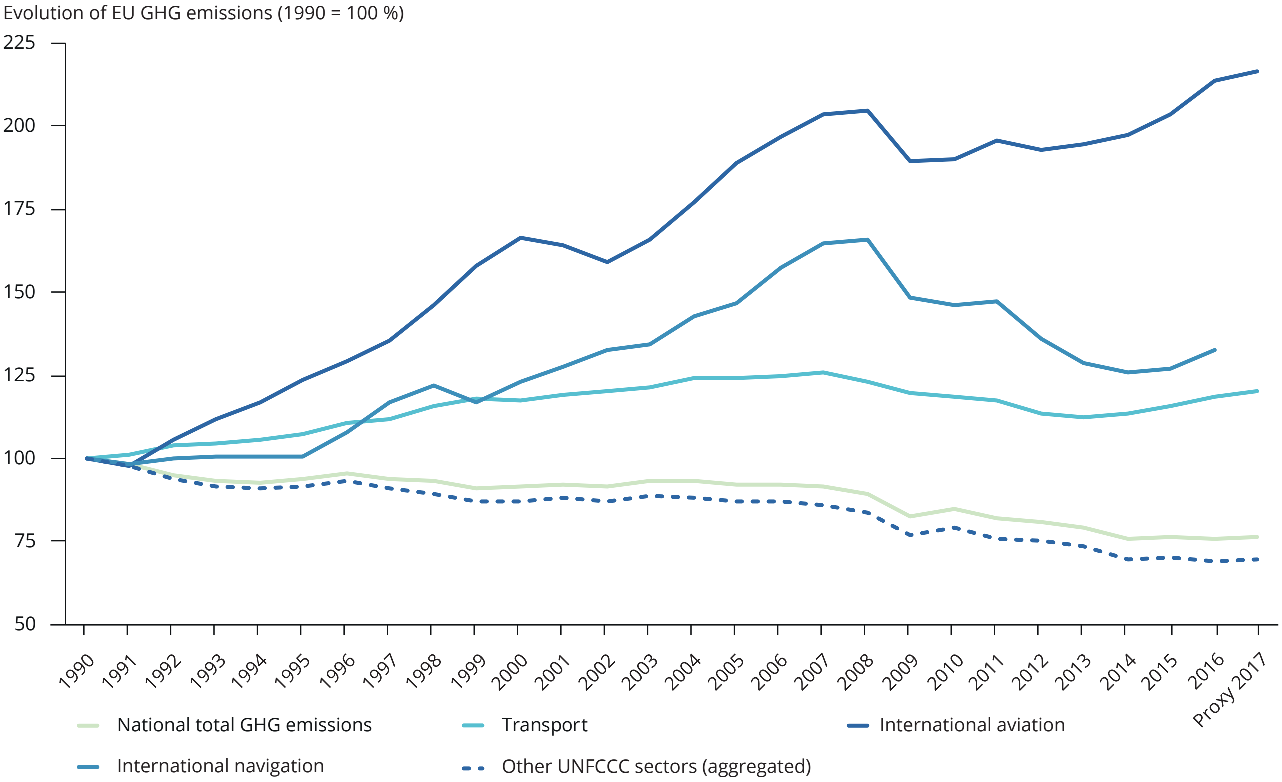
To this end, increasingly stringent requirements to reduce CO_2 emissions from cars and vans have been introduced and recently extended until 2030 (see the EU Regulation on post-2020 CO_2 emission targets for cars and vans (EU, 2019). In early 2019, agreement was also reached on similar requirements for lorries. In addition, the Clean Vehicles Directive has been reviewed and now includes binding minimum targets for clean and zero-emission vehicles in public procurement. The revised Renewable Energy Directive (EU, 2018) requires a minimum of 14 % renewable energy in final transport sector energy consumption by 2030.

European legislation also sets progressively stricter emission limits for air pollutants from cars and vans and for lorries, buses and coaches. Known as 'Euro standards', these apply to important air pollutants including NO_x and particulate matter (PM) from the tailpipe and also to evaporative emissions from the fuelling system. However, the exploitation of weaknesses in the laboratory-based tests has resulted in widespread exceedance of the NO_x limits for diesel cars and vans in real-world driving conditions. This is one of the reasons why European air quality requirements are breached in many urban areas. To address this situation, a new on-road test now complements laboratory-based testing. This new test is mandatory for all new cars and vans as from September 2019. Shipping and aviation also have a significant impact on air quality (EEA, 2017a).

13.5.2
Selected sectoral trends in Europe, including outlooks

Transport activity in Europe is still strongly correlated with environmental pressures. Although efficiency improvements have had a mitigating effect, the growing demand for transport still translates into increasing environmental pressures. GHG emissions increased by roughly one quarter between 1990 and 2016 (including international aviation but excluding international shipping) (Figure 13.3). Transport's share of the EU's total GHG emissions increased

FIGURE 13.3 EU GHG emissions in the transport sector, 1990-2017



Notes: Preliminary data for 2017 (EEA, 2018e). Preliminary data for 2017 are not available for international navigation.

UNFCCC, United Nations Framework Convention on Climate Change.

Source: EEA.

from 15 % to 24 % during the same period. This is mainly a result of the continued reliance of the EU transport system on fossil fuels and of growing transport demand. Important new EU legislation has recently been agreed on to reverse this trend, but it remains to be seen to what extent this can offset the expected increase in transport demand.

The road sector is key within the transport sector, and in 2016 it accounted for 72 % of all GHG emissions from transport (including international aviation and international shipping). Passenger cars and vans account for 72.5 % of road transport emissions, followed by trucks and buses at 26.3 %.

A 24 % increase in total EU GHG emissions was noted from the transport sector in 2016, compared to 1990.

Shipping and aviation are the second and third biggest sources of transport GHG emissions after road transport, and international aviation has seen rapid growth in GHG emissions over the last two decades.

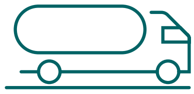
Regarding air pollutant emissions from transport (e.g. NO_x, PM, SO_2, sulphur dioxide), there has been a strong decline in the overall volume since 1990, but important problems with local air quality due to transport emissions persist. Road transport alone was responsible for 39 % of the EU's total NO_x emissions in 2016 and non-road transport (aviation, railways, inland waterways etc.) for another 9 %. In the same year, transport in its entirety also accounted for 13 % of $PM_{2.5}$ (particulate matter ≤ 2.5 μm diameter) and 12 % of PM_{10} (particulate matter ≤ 10 μm diameter) emissions (EEA, 2018b). Non-exhaust emissions (e.g. particles from brake and tyre wear) have increased in importance over time. It is estimated that they can account for more than half of the total PM_{10} emissions from road transport (EEA, 2016a). The sources and effects of air pollution are described in greater detail in Chapter 8.

Transport is also the dominant source of environmental noise in the EU, with over 113 million people exposed to high levels of road traffic noise. Road traffic noise makes the largest contribution to the burden of disease due to noise (80 %) (Chapter 11). Transport infrastructures such as roads and railway tracks are also a main cause of landscape fragmentation and they alter ecological conditions by cutting through natural habitats (Chapters 3, 4 and 5). Looking ahead, there are a number of promising technological developments and also some signs of changes in behaviour that could put the transport sector on a more sustainable trajectory (Chapter 16). However, so far these have not resulted in reduced environmental pressures.

13.5.3 Responses and prospects of meeting agreed targets and objectives

The focus of EU transport policy is on increasing the efficiency of the transport system and also on internalising the economic costs of environmental and health impacts where feasible. It is not a policy objective to curb mobility. Transport impacts are not just determined by economic activity and technology, however. They are also linked to land use planning, culture and lifestyles, which makes a very broad set of policies relevant to transport impacts.

There is no EU-level transport strategy setting out specific transport policy measures to achieve the 40 % reduction in GHG emissions by 2030 that the EU is committed to. The 2011 White Paper on transport, *Roadmap to a single European transport area — towards a competitive and resource efficient transport system*, is the only EU policy document that contains a numerical target for the transport sector (EC, 2011c) beyond 2030. It sets out the ambition to reduce GHG emissions from transport by at least 60 % by 2050 compared with 1990 levels. The EU strategy for low-emission mobility reiterates this target and identifies priority areas for action (EC, 2016a). However, the analysis behind the long-term strategy (EC, 2018c) shows that a reduction of more than 60 % will be required to achieve the goals of the Paris Agreement. A transport-related target also exists in the Renewable Energy Directive which requires that at least 10 % of transport fuels must come from renewable sources by 2020. In addition, the Fuel Quality Directive mandates a reduction in the GHG intensity of transport fuels by a minimum of 6 % by 2020. The proportion of renewable energy used in transport stood at 7.6 % in 2017 and the EU trend in the share of renewables in transport remains well below the target path required to reach the 2020 goal (Eurostat, 2019i).



Strengthening environmental integration into transport policy is vital.

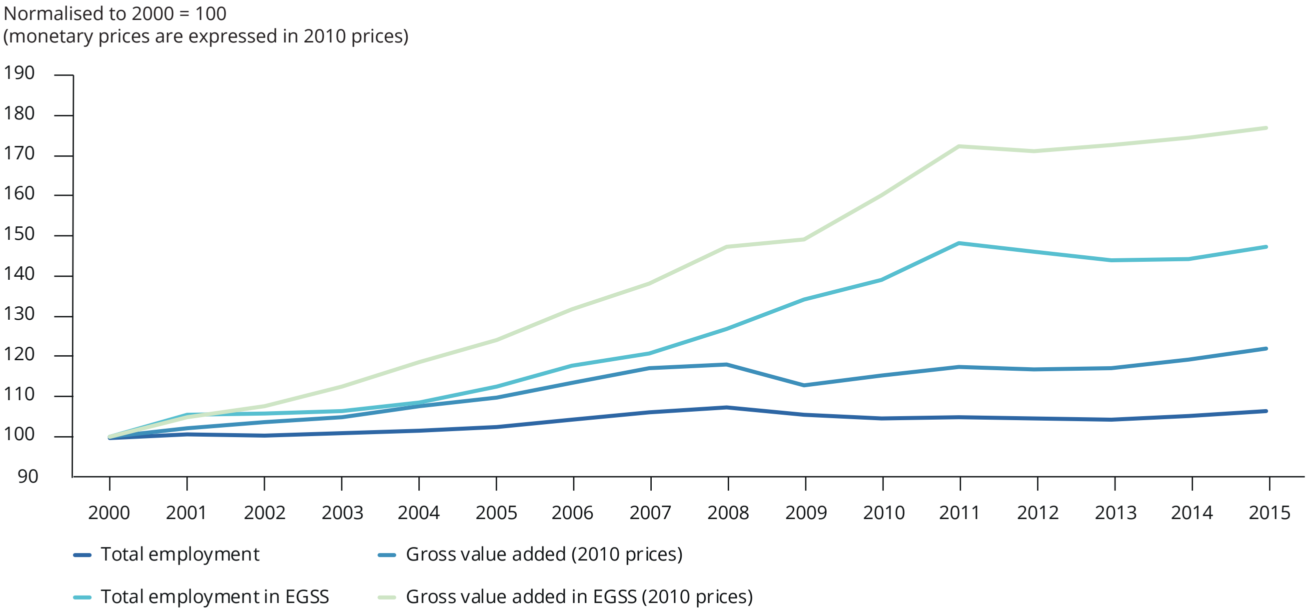
European air quality targets are not transport specific, but transport plays a central role as a source of emissions under the Ambient Air Quality and National Emissions Ceilings Directives. It is the main source of NO_x and an important source of particulate matter (PM_{10} and $PM_{2.5}$). In particular, the annual nitrogen dioxide (NO_2) limit values are exceeded in many European cities, which is directly linked to road transport and diesel cars in particular. As to landscape fragmentation, target 2 of the EU biodiversity strategy (EC, 2011a) includes the objective to restore at least 15 % of degraded ecosystems by 2020, inter alia, by establishing green infrastructure. The green infrastructure strategy (EC, 2013b) describes practical ways of reducing fragmentation. Regarding transport noise, the Environmental Noise Directive requires noise maps and action plans for major roads, railways and airports but does not include targets. The 7th EAP sets out the broad objective of reducing the overall environmental impact of production and consumption in the mobility sector by 2020.

The available data on GHG emissions from transport and local air pollution do not indicate that the transport sector is already on a trajectory that is compatible with long-term targets and improved air quality. However, European Commission projections that take into account the expected future effect of agreed policy measures conclude that the target to reduce GHG emissions will be achieved. An assessment against noise and landscape fragmentation objectives is more difficult because of the absence of EU-wide targets.

Overall, achieving environmental targets is complicated by the fact that transport policy is subject to conflicting objectives, including those for economic development, territorial cohesion and environmental sustainability. Furthermore, the governance of the transport sector is complex, located at multiple levels, and policy integration is challenging. International negotiations are required to effectively address the environmental effects of the aviation and maritime shipping sectors, which are responsible for a growing share of NO_x and GHG emissions (EEA, 2017a).

Although environmental objectives inform most transport policy decisions, this does not always translate into optimal outcomes from an environmental perspective (especially in the domains of

FIGURE 13.4 Value added and employment in the EU-28: total economy versus the EGSS



Source: EEA, based on Eurostat (2019a, 2019e, 2019h, 2019b, 2019d).

taxation and infrastructure development). There appears to be consensus on the importance of integrating environmental objectives into all European policies relevant to transport. This means anticipating the impacts on transport of policies in other sectors of the economy, in particular of decisions on urban planning, land management and taxation. However, there is limited evidence that this is happening in a consistent and effective manner.

13.6 Developments in eco-industries

The wider societal benefits of well-designed and implemented environmental policies are substantial in Europe. Environmental regulations often create incentives for new economic activities that develop less polluting goods and services. The 7th EAP aims to boost the competitiveness of eco-industries and strengthen the market share of green technologies by 2020. This may contribute to reducing environmental pressures as well as delivering important socio-economic benefits in terms of wealth, job creation and trade. The environmental goods and services sector (EGSS) ([9]), also called eco-industries or environmental industries, produces products and services aimed at protecting the environment and managing natural resources.

13.6.1 Environmental goods and services sector

Since 2000, the EGSS has outperformed the total economy of the EU-28 in terms of creating economic prosperity and employment. From 2000 until 2011, there was a steep increase in GVA, but since then the EGSS has displayed similar growth rates to the total economy (Figure 13.4). Employment in the EGSS increased by about 47 % during the period between 2000 and 2015 compared with 6 % in the total economy of the EU-28.

While the EGSS represents a small share of total economic performance in terms

([9]) The EGSS follows a globally agreed statistical standard covering environmental protection and resource management activities (for more information, see Eurostat (2016b)).

of GVA, its economic significance grew from 2000 to 2015, with an increased share of both GVA (from 1.6 % to 2.3 %) and employment (from 1.3 % to 1.8 %). Labour productivity in the EGSS is higher than in the overall economy, and the EGSS is on average 25 % more productive than the overall economy. One reason for this may relate to the fact that industries belonging to the EGSS are more technologically and capital intensive.

13.6.2 Market share of green technologies

Since 2012, the growth of the market for environmental technologies in Europe has lost some momentum, as illustrated by the trends in the development of the EGSS (Figure 13.4). However environmental policies, in particular those encompassing mandatory targets, can also stimulate international trade by creating demand for environmental and energy technologies. International trade in green technologies can bring economic benefits for Europe while also providing global benefits through the circulation and transfer of green technological knowledge across borders (EEA, 2014). The global market for environmental technologies and resource efficiency is considered to have high growth potential, with a projected average annual growth rate of 6.9 % up to 2025 (BMU, 2018).

From 2000 to 2015, industries producing environmental protection goods performed better, in terms of the export growth rate of the companies producing them, than total manufactured goods (Gehrke and Schasse, 2017). During the period between 2002 and 2015, the share of global exports of environmental protection goods of the four largest EU economies (Germany, France, United Kingdom and Italy) decreased from 33 % to 25 %, a situation comparable to that of the United States and Japan.

The EU environmental economy grew faster than the overall economy in terms of employment and value added since 2000.

The combined share of the eastern European countries (Poland, Czechia, Slovakia, Slovenia, Hungary, Latvia and Estonia) increased from 3.2 % to 5.9 %. At the same time China increased its export share from 4.6 % to 16.2 %.

Europe is improving its role as a provider of wind technologies to the world market, with total exports growing rapidly from very low levels at the beginning of the current decade up to about EUR 6.5 billion in 2016. This decreased in 2017, which can be partly attributed to a slowdown in the creation of new capacity globally. Of the top 10 producers of wind technologies, five are located in Europe (Germany, Denmark and Spain), and together they accounted for about 49 % of the world market in 2017 (REN21, 2018). Chinese producers (4 out of the top 10) have an increasing role in the world market, and trade data indicate a decline in EU exports to China; however, trade volumes with China are still small.

Developments in green technologies are not limited to eco-industries, as companies belonging to traditional industries have also diversified into green technology and now account for 43 % of the world market for environmental technology and resource efficiency. Mechanical engineering has the highest share of 18 %, followed by electrical engineering (13 %), the chemical industry (9 %) and automotive engineering (3 %) (BMU, 2018). Therefore, traditional industries are playing a crucial role in progressing towards a resource-efficient, green and competitive low-carbon economy. At the same time, it is essential that these industries adopt environmentally sustainable, resource-efficient and low carbon production technologies. This involves aiming for more widespread application of innovation with environmental benefits by enterprises in all sectors of the economy. The EU undertakes community innovation surveys assessing the uptake of these innovations in the EU. The results of the last such survey from 2014 reveal that reducing energy use and CO_2 emissions, recycling waste or water for own use or sale, and reducing pollution and material or water use are the main purposes of investments in environmentally sound innovation. The main driver of uptake is benefits for the company's reputation and the fact that the benefits of these investments apply within the company and do not negatively affect end-users (Alquézar and Kwiatkowski, 2019).

The importance of traditional industries is illustrated by recent research on how economies can be transformed so that long-term climate protection objectives are met while reducing consumption of natural resources (UBA, 2017). Steel production is of great importance when considering the trade-offs between climate and natural resource policies and also illustrates well the potential trade-offs between different SGDs (Chapter 15). The iron and steel sector is one of the largest energy-consuming sectors and is responsible for 7 % of total global CO_2 emissions from fossil fuels (IEA, 2018). Fossil fuel combustion in this and other industrial sectors also contributes significantly to air pollution in Europe (Chapter 12). At the same time, the steel intensity of electricity-generating technologies differ widely, with some renewable electricity-generating technologies

Strengthening environmental integration into sectoral policies is essential to improve policy implementation.

having the highest steel requirements. Therefore, the iron and steel sector, a traditional industrial sector, is crucial to any economic transformation, as it could be technically feasible that GHG emissions from this sector can be almost completely avoided (UBA, 2017). In addition, increasing the circular use of materials could lead to steel production being based on scrap steel with a corresponding decrease in resource extraction.

There is considerable technical potential for decarbonising energy- and material-heavy economic sectors, such as aluminium, plastics, cement and steel, by managing demand through material efficiency and circularity. It is projected that the CO_2 emissions of these sectors could be reduced by up to 56 % in European economies by 2050, primarily by increasing material efficiency and enhancing circularity through improved product design and new business models (Energy Transition Commission, 2018).

Decarbonisation and reduced consumption of natural resources can be achieved in parallel, and the global costs of decarbonising four industrial sectors — cement, steel, ethylene and NH_3 — have been estimated to be about USD 21 trillion between now and 2050. However, the costs could be considerably lower, in the range of about USD 11 trillion if zero-carbon electricity prices fall further compared with fossil fuel electricity prices (McKinsey & Company, 2018).

Traditional industries are the producers and suppliers of intermediate inputs for the production of green technologies. Therefore, the projected growth in markets for green technologies is heavily dependent on the economic output of and jobs in traditional industries (BMU, 2014). This illustrates the need to assess the whole value chain of environmental technologies and consider the role of traditional industries, as well as those defined as eco-industries, in progressing towards a resource-efficient, green and competitive low-carbon economy.

Advancements in technology and an increase in the deployment of eco-innovations is crucial for the transition towards a low-carbon, resource-efficient and circular economy, but at the same time rebound effects may limit the reduction in environmental pollution. The efficiency gains of technological improvements may be partially offset by a reduction in costs, which leads to an increase in demand (EEA, 2013; Sorrell, 2007; Greening et al., 2000). Assessing rebound effects is also critical for the sharing economy, as savings from sharing initiatives can result in increased use of other goods and services (Skjelvik et al., 2017). The setting of absolute and quantifiable reduction targets at sectoral or economy-wide level can reduce such rebound effects.

13.7 Conclusions

The sectors assessed here are major contributors to significant environmental pressures including climate change, biodiversity loss, air pollution and water pollution. There is a mixed picture in terms of past trends and an outlook in which current developments are not in line with policy ambitions. Agriculture in particular has been identified as a key source of environmental pressures, demonstrating the need for greater ambitions in terms of reducing impacts of agricultural activities on biodiversity, freshwater, marine pollution, GHG and NH_3 emissions and soils.

The pace of change also differs across sectors. For example, while there have been reductions in GHG emissions from industry, GHG emissions from transport and NH_3 emissions from agriculture continue to increase. The current status of many fish stocks requires urgent action. For both fisheries and forestry, increased political will is needed to implement scientific recommendations. It is unlikely that the objective of significantly reducing the overall environmental impact of all major sectors of the economy by 2020 will be met.

The importance of policy coherence and environmental integration has been highlighted in the preceding chapters, for example the need for improved coherence between the CAP, CFP and biodiversity objectives (Chapter 3) and between rural development plans under the CAP and the Water Framework Directive (Chapter 4). Analysis of the relationships at the nexus between agriculture and water shows that a more integrated approach is possible (EC, 2019). Environmental objectives have clearly been integrated into a range of sectoral policies. However, there are some challenges in assessing how successful this has been in reducing environmental pressures because of the limited availability of evidence and the fact that environmental outcomes are influenced by factors other than policy.

The integration of environmental objectives into the CAP does appear to have resulted in a reduction in some environmental pressures such as nutrient emissions. The market reform of the CAP has also been identified as contributing to a reduction in GHGs from methane and nitrous oxide (Chapter 7). However, structural changes in the economy have also contributed to a reduction in environmental pressures linked to economic activities.

Looking ahead, it is clear that the policy approach of environmental integration has not been successful when it comes to reducing environmental pressures from sectors. In many cases, sectoral policies encompass a range of objectives, governance is complex and policy integration is challenging, and the environment is a lower priority than other objectives. For example, the EU industrial policy strategy brings together a wide range of policies relating to industry (EC, 2017a). However environmental aspects do not feature prominently, with the exception of references to achieving a low-carbon and circular economy, while industrial pollution is not mentioned. This highlights the scope for further environmental integration across industrial policy, especially in the context of the policy objective of industry having a share of 20 % of GDP by 2020. Strengthening environmental integration into key policy areas such as agriculture, industry and transport, at both the framing and execution stages, is essential to improve policy implementation (EC, 2019).

> Policy needs to consider environmental, economic, social and governance dimensions and their synergies and trade-offs.

Environmental policies create economic opportunities and contribute to broader social and economic objectives. Ambitious and fully implemented policies create conditions that stimulate the development of environmental technologies, creating new job opportunities as well as offsetting potential job losses in other sectors of the economy. However, the loss of momentum in the development of the environmental goods and services sector indicates that further efforts are needed to realise the 7th EAP ambitions of a resource-efficient, green and competitive low-carbon economy.

In addition, the sectors featured here have to deliver multiple societal functions, supporting livelihoods as well as having a vital role in stewardship of the environmental resources they ultimately depend on. This means that policy interventions need to consider environmental, economic, social and governance dimensions and their inherent synergies and trade-offs. There are benefits from complementing a sectoral focus and environmental integration approach with a broader systems perspective (Chapter 15). This places sectoral activities within wider production and consumption systems, improving our understanding of interactions and enabling more coherent and effective policy interventions to reduce environmental pressures along whole value chains, thereby realising potential co-benefits for human health and well-being.