Food and Agriculture Organization of the United Nations

COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

REGIONAL SYNTHESIS REPORTS

EUROPE AND CENTRAL ASIA REGIONAL SYNTHESIS FOR

THE STATE OF THE WORLD'S BIODIVERSITY FOR FOOD AND AGRICULTURE

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ROME, 2019

Required citation:
FAO. 2019. *Europe and Central Asia Regional Synthesis for The State of the World's Biodiversity for Food and Agriculture*. Rome.
https://doi.org/10.4060/ca6995en.

ISBN 978-92-5-131963-5

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Foreword

The State of the World's Biodiversity for Food and Agriculture, published earlier this year, highlights many grounds for concern about the loss of biodiversity in and around food production systems, particularly in the case of the homogenized, high external input "industrial" production systems that have become increasingly dominant in many parts of the world over the last half century. Europe is one of the parts of the world where the transition towards this kind of production, and away from an agriculture based largely on local resources – including on genetic resources adapted to local environments – has gone the furthest and Central Asia is about to follow the same pathway. While the region's production systems remain diverse – ranging from highly intensive and technology-dependent to traditional pastureland – impacts on biodiversity have often been severe, frequently leading to a decline in the supply of important ecosystem services, both to the food and agriculture sector itself and to society more generally. The resilience and sustainability of the region's food systems are at risk.

Fortunately, the news is not all bleak. As described in this synthesis report, many European countries reported that they have put in place a range of initiatives aimed at promoting the sustainable use and conservation of biodiversity for food and agriculture, although it is important to note here that information from Central Asian countries is limited. Innovative biodiversity-based or biodiversity-friendly practices are increasingly widely being implemented in European countries and attempts are being made to establish more-integrated approaches to the management of landscapes and ecosystems, accommodating multiple goals and the interests of multiple groups of stakeholders. For some components of biodiversity for food and agriculture, cross-border collaboration in efforts to promote sustainable management is also relatively well developed in parts of the region. Having said all this, however, it is clear from the available data on the current status and trends of region's biodiversity that an enormous amount remains to be done. This will need to include promoting stronger cooperation across the region as a whole.

This synthesis report and those prepared for other regions are among the outcomes of a major global exercise in data collection and analysis. Many needs and priorities have been identified and have been discussed, formally and informally, among countries at regional and world levels. The process of developing a potential international policy response to the findings of *The State of the World's Biodiversity for Food and Agriculture* is currently ongoing. Clearly, I do not wish to pre-empt the outcomes of this process. However, I would like to conclude by re-emphasizing the significance of the challenges we face and the need for urgent action.

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Financial and logistical support to the organization of an informal regional consultation on the state of Europe and Central Asia's biodiversity for food and agriculture, held in Bonn, Germany, 18 to 20 April 2016, was provided by the Government of Germany. Financial support for the preparation of the regional synthesis report was provided by the Governments of Germany, Spain and Switzerland.

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About this report

BACKGROUND

This report summarizes the state of biodiversity for food and agriculture in the Europe and Central Asia region based on the information provided in country reports submitted to FAO as part of the reporting process for the report on *The State of the World's Biodiversity for Food and Agriculture*. A first draft, based on 17 country reports, was prepared as supporting documentation for an informal regional consultation on the state of Europe and Central Asia's biodiversity for food and agriculture, held in Bonn, Germany, 18 to 20 April 2016. The document was later revised based on feedback received from the participants of the informal consultation and on additional country reports (two) and country-report updates received by FAO before September 2016. During the informal consultation, participants also discussed regional needs, priorities and possible actions for the conservation and sustainable use of biodiversity for food and agriculture.[1] It should be noted that no country reports were received from Central Asia and that only one Central Asia country (Tajikistan) was represented at the informal regional consultation.

SCOPE

The report addresses the biodiversity for food and agriculture (see working definition below) found in plant, animal, aquatic and forest production systems and the ecosystem services associated with them. It focuses particularly on associated biodiversity (see working definition below) and on species that are sources of wild foods.

WORKING DEFINITIONS

The working definitions of biodiversity for food and agriculture and associated biodiversity used for the purposes of this report (and in the country-reporting process for *The State of the World's Biodiversity for Food and Agriculture*) are described, along with other key concepts, in FAO (2019).

Biodiversity for food and agriculture

Biodiversity for food and agriculture includes the variety and variability of animals, plants and micro-organisms at the genetic, species and ecosystem levels that sustain the ecosystem structures, functions and processes in and around production systems, and that provide food and non-food agricultural products and services. Production systems, as defined for the purposes of this report, include the livestock, crop, fisheries and aquaculture and forest sectors. The diversity found in and around production systems has been managed or influenced by farmers, pastoralists, forest dwellers and fisherfolk over many hundreds of generations and reflects the diversity of both human activities and natural processes. Biodiversity for food and agriculture also encompasses wild foods of plant, animal and other origin.

Associated biodiversity

Associated biodiversity comprises species of importance to ecosystem function, for example through pollination, control of plant, animal and aquatic pests, soil formation and health, water provision and quality, etc., including *inter alia*:

a) micro-organisms (including bacteria, viruses and protists) and fungi in and around production systems of importance to use and production, such as mycorrhizal fungi, soil microbes, planktonic microbes, and rumen microbes;

[1] See Annex 2 of *Report of the Informal Regional Consultation on the State of Europe and Central Asia's Biodiversity for Food and Agriculture* (CGRFA-16/17/Inf.11.1) (FAO, 2016).

b) invertebrates, including insects, spiders, worms, and all other invertebrates, that are of importance to crop, animal, fish and forest production in different ways, including as decomposers, pests, pollinators, and predators, in and around production systems;
c) vertebrates, including amphibians, reptiles, and wild (non-domesticated) birds and mammals, including wild relatives, of importance to crop, animal, fish and forest production as pests, predators, pollinators or in other ways, in and around production systems;
d) wild and cultivated terrestrial and aquatic plants other than crops and crop wild relatives in and around production areas, such as hedge plants, weeds and species present in riparian corridors, rivers, lakes and coastal marine waters that contribute indirectly to production.

Domesticated species may also provide ecosystem services other than provisioning ones and affect crop, animal, fish and forest production in different ways.

Executive summary

WHAT IS BIODIVERSITY FOR FOOD AND AGRICULTURE?

"Biodiversity is the variety of life at genetic, species and ecosystem levels. Biodiversity for food and agriculture (BFA) is, in turn, the subset of biodiversity that contributes in one way or another to agriculture and food production. It includes the domesticated plants and animals raised in crop, livestock, forest and aquaculture systems, harvested forest and aquatic species, the wild relatives of domesticated species, other wild species harvested for food and other products, and what is known as 'associated biodiversity', the vast range of organisms that live in and around food and agricultural production systems, sustaining them and contributing to their output [such as natural enemies of pests, pollinators, soil micro-organisms]. Agriculture is taken here to include crop and livestock production, forestry, fisheries and aquaculture" (FAO, 2019).

ABOUT THIS REPORT

This report summarizes the state of biodiversity for food and agriculture in the Europe and Central Asia region based on the information provided in country reports submitted to FAO as part of the reporting process for *The State of the World's Biodiversity for Food and Agriculture*. The document was prepared as supporting documentation for an informal regional consultation on the state of Europe and Central Asia's biodiversity for food and agriculture held in Bonn, Germany, 18 to 20 April 2016. It should be noted that no country reports were received from Central Asia and that only one Central Asia country was represented at the informal regional consultation.

SUMMARY

As of September 2016, 19 out of 54 countries from Europe and Central Asia had officially submitted a country report to contribute to the preparation of *The State of the World's Biodiversity for Food and Agriculture*. This regional synthesis report provides an overview of their inputs, organized into four main areas: (i) assessment and monitoring; (ii) conservation and sustainable use; (iii) policies, institutions and capacity; and (iv) regional and international cooperation.

Europe and Central Asia is a vast region characterized by a great variety of climates, topographies, aquatic environments and soil types, and hence also biodiversity. With respect to biodiversity for food and agriculture in particular, the region experienced substantial losses in the twentieth century. Changing land-use patterns have been identified as one of the main causes of these losses. To intensify production, agricultural activities were increasingly segregated by sector. The use of chemical inputs and heavy machinery increased and traditional practices such as extensive livestock farming were abandoned in many places. These changes led, *inter alia*, to widespread eutrophication of water bodies as a result of runoff from agricultural lands, and concentration on an ever-smaller number of economically profitable higher-yielding species, varieties and breeds. Today, climate change and the proliferation of invasive alien species are considered to be the main threats to biodiversity for food and agriculture.

The trend towards an ever-greater concentration on limited numbers of livestock breeds, crop varieties and tree species seems to have levelled off in recent years, at least in the western part of the region. For example, countries reported that efforts to protect native livestock breeds at risk have multiplied and that forests have become more diverse and natural in structure as a result of revised forest policies.

Compared with other regions, Europe and Central Asia (or more specifically Europe) has a particularly high level of knowledge on the status and trends of associated biodiversity and wild food resources. The population trends of many species are well documented and monitored and there are a significant number of ongoing research projects on, *inter alia*, functional biodiversity in food production systems, biodiversity and climate change and invasive alien species. However, the vast majority of reporting countries indicated that data gathered on associated biodiversity

often represent only a snapshot of the status of a given component of associated biodiversity within a given production system. Countries tended to agree that more needs to be done to establish baseline data and to ensure that monitoring activities are repeated systematically. Where wild food resources are concerned, fish and game species seem to be quite systematically monitored in most of the reporting countries. Monitoring levels for fungi, wild berries, medicinal plants and herbs vary from country to country.

Most reporting countries deploy a range of management and diversity-based practices to support the maintenance and use of biodiversity for food and agriculture. Integrated plant nutrient management, integrated pest management, organic farming, landscape management and pollination management were among the most frequently reported practices in both livestock and crop production systems. In the case of forest production systems, reduced-impact logging and sustainable soil and landscape management practices were widely reported. Most countries mentioned that they had adopted the ecosystem approach applied to capture fisheries. In aquaculture, integrated pest management, organic fish farming and conservation hatcheries were the most frequently reported practices.

Limited information was provided on the potential use of biodiversity for food and agriculture to adapt to and mitigate climate change. A number of countries highlighted the need to improve diversification within food-production systems to enhance the sustainability and resilience of these systems and strengthen rural livelihoods. Some countries also referred to their respective national strategies for adaptation to climate change. These strategies, however, tend to focus on how to protect biodiversity from climate change rather than on how biodiversity can be used in climate change adaptation. Quite a few countries presented examples of how components of biodiversity for food and agriculture have been used to slow the spread of invasive alien species. However, none of the country reports stated that the contribution of these components was considered sufficient to keep the proliferation of invasive species and their negative impacts on native flora and fauna under control. No reports provided examples related to the potential use of biodiversity for food and agriculture to prevent or reduce damage caused by natural disasters.

Ecosystem, landscape and seascape approaches seem to be fundamental to most national, subregional and regional policies related to the diversity of food and agriculture. As noted above, most of the reporting countries have adopted the ecosystem approach applied to fisheries. Most also support the implementation of sustainable forest management practices. Organic farming and integrated pest management were widely reported as examples of the application of the ecosystem approach in crop production. With respect to landscape and seascape initiatives, countries indicated that they had, inter alia, designated aquatic protected areas to conserve biodiversity. A few countries indicated that they had only recently adopted ecosystem approaches and were finding it difficult to develop adequate policies and strategies to ensure these approaches are applied in practice.

The conservation of many components of biodiversity for food and agriculture remains challenging. With respect to associated biodiversity in particular, even though some targeted *in situ* conservation programmes exist, most species are conserved through general biodiversity conservation efforts. Programmes may target habitats and species in and around production systems, but they are typically not targeted specifically because of their beneficial roles in food and agricultural production. *Ex situ* conservation initiatives for components of associated biodiversity and wild food species appear to be more common in the region. Most countries indicated that they have microbial culture collections containing taxonomically diverse groups of micro-organisms that can be utilized in agriculture and horticulture or in the pharmaceutical or agrifood industries. With regard to invertebrates, honey-bee and bumble-bee species are bred and sold for pollination of field and horticultural crops in quite a few countries. Very few examples of measures specifically targeting the conservation of wild food species were reported, which could be because none of the reporting countries considered wild food species to be of great importance to food security and nutrition.

Most reporting countries indicated that they had revised, or were in the process of revising, national laws to facilitate the implementation of the Nagoya Protocol on Access to Genetic

Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity; others acknowledged their obligation to comply with the Protocol. Approaches to the regulation of access to genetic resources for food and agriculture seem to vary from country to country. In the Netherlands, for example, no specific access rules will apply to genetic resources occurring in *in situ* conditions, whereas Spain's Natural Heritage and Biodiversity Law regulates access to and use of genetic resources from wild taxa.

Countries in the region have put in place a range of national policies and programmes of relevance to the conservation and sustainable use of biodiversity for food and agriculture, many of which are linked to regional policies and programmes. In European Union (EU) Member States, measures at national level are aligned with relevant EU regulations, directives and payment schemes. Most EU Member States mentioned the importance of direct support schemes under the Common Agricultural Policy, for example payments for agricultural practices that are climate friendly and beneficial to the environment and payments in support of sustainable forest management practices. Non-EU members in the region are not covered by these measures and may therefore have very different needs and priorities in terms of policy and programme development for the conservation and use of biodiversity for food and agriculture.

With respect to the conservation and (to a far lesser extent) use of associated biodiversity and wild food species, many reporting countries noted the importance of National Biodiversity Strategy and Action Plans. Country-level initiatives specifically targeting this field include Germany's Draft National Programme for the Conservation and Sustainable Use of Genetic Resources of Micro-organisms and Invertebrates and France's Agricultural Observatory of Biodiversity. The latter involves farmers in monitoring various components of associated biodiversity in agricultural environments and identifying how their status relates to farming practices. At the regional level, the European and Mediterranean Plant Protection Organisation is developing strategies to combat the introduction and spread of invasive alien species. A list of such species is currently being drawn up at EU level. However, there are still significant knowledge gaps with regard to the effects of invasive alien species on production systems and ecosystem services, which constrain the development and implementation of national and regional programmes in this field.

In many higher education institutions in the region, issues related to the conservation of biodiversity (including associated biodiversity) are addressed separately from those related to sustainable use. As a result of this "decoupling", trained experts tend to lack skills in interdisciplinary work.

Reporting countries are aware of the need to strengthen research on associated biodiversity (particularly in soils) and ecosystem functioning. Advancing research in this area requires effective prioritization of the species to be targeted, a continuous and sufficient flow of funding and adequate human resources. With respect to the latter, the region is short of species specialists and taxonomists to conduct survey and identification work.

Reporting countries seem to agree that regional collaboration in the field of associated biodiversity could be strengthened, particularly with respect to work on micro-organisms, invertebrates, invasive alien species and ecosystem approaches.

I. Assessment and monitoring of biodiversity for food and agriculture

1.1 REGIONAL CONTEXT

As of September 2016, the following European and Central Asian countries had submitted country reports as contributions to the preparation of *The State of the World's Biodiversity for Food and Agriculture*: Belgium, Bulgaria, Croatia, Estonia, Finland, France,[1] Germany, Hungary, Ireland, the Netherlands, Norway, Poland, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom. This amounts to slightly over one-third of the 54 countries in Europe and Central Asia.[2] Sixteen of the 19 reporting countries are Member States of the European Union (EU).[3] The 19 countries combined cover an area of approximately 4 481 816 km^2, including land and water, which is about 16 percent of the total territory of the region.

Table 1. Percentage of land, water, agricultural and forest areas in Europe and Central Asia located in countries that provided country reports[1]

	Total area	Land area	Water area	Agricultural area	Forest area
% covered by country reports	16.1	16	18	21.3	14.3

[1] Country, land, water, agricultural and forest areas can be found on http://faostat3.fao.org/home/E
Source: Calculated from FAOSTAT data for 2014.

Together, the reporting countries cover all the agro-ecological zones that are present in the region.[4] Most of the countries are located in temperate and boreal climatic zones. Parts of three countries are situated in subtropical zones. However, given the absence of reports from some large countries that are known to be rich in biodiversity for food and agriculture, the reporting countries may not provide a representative sample of the region's ecosystems, production systems and biodiversity hotspots.[5] In particular, it should be noted that no country reports were received from Central Asia.

The region includes four officially identified biodiversity hotspots, namely the Caucasus, Irano-Anatolian, Mediterranean Basin and Mountains of Central Asia hotspots. These locations are known to be particularly rich in endemic plant species and are home to a range of unique bird, mammal, amphibian and reptile species.[6] Twenty-five of the region's countries (in addition to a number of countries from East Asia, the Near East and North Africa) have territories that fall within these biodiversity hotspots.[7] However, only six of these countries (Bulgaria, Croatia, France, Slovenia, Spain and Turkey)[8] submitted country reports.

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[1] Draft report.

[2] The following web pages give an overview of FAO Member States grouped according to their regional distribution: Africa: http://www.fao.org/africa/countries/en/; Asia and the Pacific: http://www.fao.org/asiapacific/countries/en/; Europe and Central Asia: http://www.fao.org/europe/countries/en/; Near East and North Africa: http://www.fao.org/neareast/countries/en/; Latin America and the Caribbean: http://www.fao.org/americas/paises/en/; North America: http://www.fao.org/north-america/fao-in-north-america/about-us/en/

[3] The 28 Member States of the European Union are: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

[4] See FAO's global Agro-Ecological Zoning system (AEZ) at http://www.fao.org/nr/gaez/en/#

[5] Biodiversity hotspots are the richest and most threatened reservoirs of plant and animal life on Earth.

[6] See Critical Ecosystem Partnership Fund (CEPF) at http://www.cepf.net/resources/hotspots/Europe-and-Central-Asia/Pages/default.aspx

[7] Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Croatia, France, Georgia, Greece, Israel, Italy, Kazakhstan, Kyrgyzstan, Montenegro, North Macedonia, Portugal, Romania, Russian Federation, Serbia, Slovenia, Spain, Tajikistan, Turkey, Turkmenistan, Uzbekistan.

[8] Bulgaria, Croatia, France, Slovenia, Spain and Turkey have territories lying within the Mediterranean Basin biodiversity hotspot. Northeastern Turkey forms part of the Caucasus hotspot, while large parts of the country's central and eastern zones fall within the Irano-Anatolian hotspot.

Table 2. Production systems reported in Europe and Central Asia

Production system	Countries reporting
Livestock grassland-based systems	Belgium, Bulgaria, Croatia, Estonia, Finland, France, Germany, Hungary, Ireland, Netherlands, Norway, Poland, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom
Livestock landless systems	Belgium, Bulgaria, Croatia, Estonia, Finland, France, Germany, Hungary, Ireland, Netherlands, Poland, Slovakia, Spain, Sweden, Switzerland, Turkey, United Kingdom
Naturally regenerated forests	Belgium, Bulgaria, Croatia, Estonia, Finland, France, Germany, Hungary, Poland, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom
Planted forests	Belgium, Bulgaria, Croatia, Estonia, Finland, France, Hungary, Ireland, Netherlands, Poland, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom
Self-recruiting capture fisheries	Belgium, Croatia, Finland, Germany, Hungary, Ireland, Netherlands, Norway, Poland, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom
Culture-based fisheries	Bulgaria, Estonia, Finland, Hungary, Netherlands, Poland, Spain, Sweden, Switzerland, Turkey
Fed aquaculture	Belgium, Bulgaria, Croatia, Estonia, Finland, Germany, Hungary, Ireland, Netherlands, Norway, Poland, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom
Non-fed aquaculture	Bulgaria, Croatia, Estonia, Germany, Hungary, Ireland, Netherlands, Slovenia, Spain, Sweden, Turkey, United Kingdom
Irrigated crops (rice)	Bulgaria, France, Hungary, Spain, Turkey
Irrigated crops (other)	Bulgaria, Croatia, Finland, France, Hungary, Poland, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom
Rainfed crops	Belgium, Bulgaria, Croatia, Estonia, Finland, France, Germany, Hungary, Ireland, Netherlands, Norway, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom
Mixed systems (livestock, crop, forest and /or aquatic and fisheries)	Belgium, Bulgaria, Croatia, Estonia, Finland, France, Ireland, Norway, Poland, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom
Other production systems	
Beekeeping	Finland
Semi-natural forests	Norway
Horticulture[1]	Netherlands, Sweden, Turkey

[1] Most countries in the region cultivate horticultural crops. These are usually reported on under the various crop production system categories proposed by FAO in the country report guidelines. Three countries in the region chose to add horticulture (under glass) as a separate category.
Note: For a description of the production-system classification used in the reporting process, see Table 1.1 in FAO (2019).
Source: Country reports prepared for *The State of the World's Biodiversity for Food and Agriculture* (FAO, 2019).

The country-reporting guidelines provided by FAO invited countries to list their production systems in accordance with the categories shown in Table 2. Some constraints were encountered in this regard; for example:

1. Countries interpreted the various production system categories differently.
2. Countries faced difficulties in providing information according to the proposed classification (e.g. the areas covered by each production system).

1.2 STATUS, TRENDS AND DRIVERS OF CHANGE OF BIODIVERSITY FOR FOOD AND AGRICULTURE

1.2.1 Main drivers of change affecting genetic resources for food and agriculture

Land-use change: Most countries considered land-use change and land fragmentation to be among the main threats to biodiversity for food and agriculture. For example, over the past decades the conversion of farmland and forests into urban land and increases in monoculture farming have led to a reduction in the amount of land available for food and timber production and a decline in the diversity of crop and forest-tree species and the species associated with them.[9]

[9] Detailed information on the main drivers of change affecting associated biodiversity species in the region is provided in Section 1.2.6) of this report.

Invasive alien species (IAS)[10] were referred to in most country reports as a serious and growing threat to biodiversity for food and agriculture in water and on land. IAS tend to reproduce rapidly and out-compete native species for food, water and space (CBD, 2012). They are sometimes introduced into a country deliberately, for example for fish farming, the pet trade, horticulture or biological control, and sometimes unintentionally, through means such as land and water transportation and travel (ibid.). A number of countries are monitoring invasive alien species and "doorknockers",[11] with some listing species known for their significant ecological impact on so-called Black Lists. Other countries indicated that they do not yet have a system in place to assess the introduction of IAS.

Several countries mentioned that the rapid dispersion of invasive alien species into sea and freshwater environments (e.g. introduction of non-native brown trout into rivers with native brown trout) is causing the spread of new pests and diseases among native wild populations and is increasing competition for food and space.

Countries also referred to the increasing prevalence of pests in forests, which is believed to be suppressing the growth and affecting the diversity of native forest-tree species. Several IAS are known to have taken an enormous toll on European forests. In the 1970s, for example, the introduction of Dutch elm disease, caused by a fungus from Asia, devastated elm populations in much of central Europe and the United Kingdom (Genovesi and Shine, 2004). More recently, *Hymenoscyphus fraxineus*, the fungus that causes ash dieback disease, has been rapidly spreading across much of Europe, severely affecting ash populations (Forestry Commission, 2016). The emerald ash borer (*Agrilus planipennis*), a beetle that was recorded in Moscow in 2003 and is now moving west into Europe (Baranchikov *et al.*, 2008; Orlova-Bienkowskaja, 2014) and is suspected to be present in Sweden, is also posing a major threat to ash populations (Thomas, 2016). Loss of the ash would have a significant impact on biodiversity. For example, 44 species in the United Kingdom (4 lichens, 11 fungi and 29 invertebrates) are considered to be "obligate" ash-associated species and a further 62 (19 fungi, 13 lichens, 6 bryophytes and 24 invertebrates) to be highly associated with the ash (Mitchell *et al.*, 2014).

A few countries highlighted the growing presence of non-native plant species, including noxious weeds, in cultivated fields. They indicated that this could lead to an increased use of herbicides in order to protect crops, which would have negative consequences for native weeds and their associated biodiversity, including functional groups such as mycorrhizal fungi.

Quite a number of IAS with harmful effects on biodiversity for food and agriculture were mentioned in more than one country report, including the harlequin ladybird (*Harmonia axyridis*), which preys on native ladybirds, crayfish plague (*Aphanomyces astaci*), a water mould that infects crayfish, the Pacific oyster (*Crassostrea gigas*), which harms other marine resources such as scallops, destroys habitat and causes eutrophication, American waterweed (*Elodea canadensis*), Nuttall's pondweed (*E. nuttallii*) and floating pennywort (*Hydrocotyle ranunculoides*), which compete with native weeds for nutrients and space, American mink (*Neovison vison*), which preys on native vertebrates, and Japanese knotweed (*Fallopia japonica*), which invades riparian ecosystems and roadsides by forming dense colonies that wipe out other herbaceous species.

Overall, research on the impact of invasive species on production systems and ecosystem services in Europe and Central Asia is still at a very early stage and mainly focused on developing methods for monitoring and assessment.

The **increased availability of nutrients** (particularly of nitrogen and phosphorus) in terrestrial and aquatic ecosystems as a result of excessive fertilizer use in agriculture is considered to be an important threat to biodiversity for food and agriculture. High nutrient deposition endangers

[10] The Convention on Biological Diversity defines an invasive alien species as a species whose introduction and/or spread outside its natural past or present distribution threatens biological diversity (see definitions from COP VI/23, http://www.cbd.int/decision/cop/default.shtml?id=7197).

[11] "Doorknockers" are potentially invasive alien species.

biodiversity in crop fields, but is also believed to be one of the main drivers behind the loss of plant biodiversity in grasslands; leached nutrients from neighbouring crop fields allow faster growing plants in grasslands to become invasive, blocking sunlight from reaching smaller, slower-growing plants. This eventually causes rare and sensitive plant species to disappear and weeds to spread (Hautier, Niklaus and Hector, 2009; Gál-Bélteki and Marticsek, 2010).

Even if nutrient inputs in agriculture and the discharge of noxious substances into water bodies have significantly fallen since the 1980s, the Baltic Sea continues to be regarded as severely eutrophicated. Several countries mentioned that this sea continues to suffer from excessive algal, phytoplankton and cyanobacteria[12] growth and that its fish populations are severely damaged.

Acid rain: Large areas in the region are still suffering from damage caused by acid rain. In the 1980s, acid rain resulted in widespread damage to forests in the border areas between Poland, Germany and Czechia. Since then, much has been done to reduce noxious sulphur dioxide emissions, which has contributed, among other factors, to the restoration of forest trees in Germany, even if it has not yet led to the improvement of tree crown condition. Over the years, acidification has also reduced water quality in lakes and rivers, depleting and even wiping out fish stocks, and affecting other aquatic animals and plants. In Norway, for example, more than 9 000 fish stocks had been lost and over 5 000 were severely depleted due to acidification in 1990 (Norwegian Environment Agency, 2015). However, it is estimated that the area with damaged fish stocks had been reduced by nearly 40 percent by 2006 (ibid.).

Climate change is recognized as another significant driver of change. Some countries mentioned that meadows with more biodiversity will be able to handle drought better than those with low species diversity.

1.2.2 Main features of the status and trends of plant, animal, forest and aquatic genetic resources

Intensive use of land and waterways is considered to be one of the main threats to the region's biodiversity for food and agriculture. The region experienced major losses of biodiversity for food and agriculture in the twentieth century, mainly as a result of the widespread commercialization of agriculture, forestry and fisheries. Production intensification required significant changes in land- and water-management practices, which led, inter alia, to concentration on an ever-smaller number of economically profitable higher-yielding species, varieties and breeds. Narrowing of the genetic resource base continues to affect the conservation and the use of genetic resources for food and agriculture, even if the trend towards the use of only a limited number of livestock breeds and crop varieties seems to have levelled off in recent years.

Animal genetic resources for food and agriculture

Several countries, including Germany, mentioned that high-performance livestock breeds have been introduced at the expense of traditional breeds and their often-extensive production systems to provide an expanding consumer industry with uniform products of strictly defined quality at falling prices. Stringent selection and widespread use of ever fewer sires have led to an increase in inbreeding among high-output livestock populations, while many native breeds have become endangered. In the 2000s, with the introduction of special legislation and subsidies to protect native breeds at risk of extinction and increasing support from breed-specific breeding associations and societies, the downward trend in the population sizes of native livestock breeds seems to have levelled off in some countries. Native livestock breeds are more likely to survive if they remain competitive and economically active. Countries acknowledged that effective conservation will require better understanding of how at-risk breeds can be utilized.

[12] Toxic cyanobacteria affect the biodiversity in standing waters and contaminate drinking water.

Plant genetic resources for food and agriculture

Grasslands constitute a large part of the region's agricultural land (e.g. they cover approximately 30 percent of central Europe's[13] and 90 percent of Ireland's farmed area – Zimkova *et al.*, 2007; country report of Ireland). Over recent decades, agricultural intensification and the abandonment of traditional land uses such as mowing on extensive meadows and extensive livestock grazing have contributed to declines in biodiversity. Large areas of species-rich grasslands have been replaced by high-yielding grassland (often sown with imported grass seeds), converted into cropland or overgrown by shrubs. These changes have led to significant habitat alterations, resulting in the disappearance of many plant and animal species associated with open landscapes. Loss of indigenous grass species is further intensified by genetic erosion (crossing with widely used, often imported, cultivars).

Choices of crops grown in Europe are essentially economically driven (shaped by the demand behaviour of commerce and consumers). In quite a number of countries, including France, Germany, Poland, the Russian Federation, Ukraine and the United Kingdom, wheat has become the most important crop species (FAO, 2014). Barley and rye continue to be important food crops in central, eastern and northern Europe, while losing cultivation shares in some western European countries. Some countries also referred to increasing silage maize cultivation for biogas production. Most countries reported that over the last ten years there has been an increase in the proportion of land cultivated organically.

Generally speaking, quite a large number of varieties of different crops were reported to be available to farmers, with several countries pointing out that they have no indication that crop diversity is decreasing. Most countries mentioned that the diversity of plant genetic resources for food and agriculture tends to be higher in small-scale production systems.

Across Europe, horticulture provides a significant contribution to the economy, employment and food security. Fruit and vegetables account for 18 percent of the total value of agricultural production in the EU, and take up only 3 percent of its cultivated land. Production by commercial horticulture growers seems to be dominated by high-yielding, mostly imported, crop varieties, with few or no landraces or farmer varieties grown. While countries found that it was difficult to ascertain the exact state of diversity in horticulture crops, most agreed that the greatest diversity is to be found in private gardens and in the form of home-saved seeds rather than in the commercial sector.

Forest genetic resources

With respect to forest genetic resources, most countries described the condition of forests as good, reportedly as a result both of sound forest management by forest owners and foresters and of forest policies geared towards multifunctional and sustainable forests. Over the past 25 years (since heavy industrial production declined), the health, age and species composition of forest stands have improved across the region, with most countries, even those that were left with hardly any forest cover after centuries of overexploitation and clearances for agriculture, reporting a steady increase in total forest area since the beginning of the twentieth century.[14] Many countries indicated that the percentage of deciduous trees, and of native broadleaves in particular, in their forests has risen as a result of policies aimed at bringing back natural forest cover.

Aquatic genetic resources for food and agriculture

With increasing seafood prices, aquaculture has steadily been growing in the region to meet fish consumption needs. This trend is likely to continue in the coming decade, even if, as noted in some country reports, the need to comply with licensing laws is an obstacle to the further expansion of

[13] Taken by Zimkova *et al.* (2007) to encompass Austria, Czechia, Germany, Hungary, Italy, Poland, Slovakia, Slovenia and Ukraine.

[14] Growing stock in forests and other wooded land is considered an important and well-accepted proxy for biodiversity by the European Environment Agency (EEA, 2007).

the sector. In some countries, more than 95 percent of commercialized fish production now comes from aquaculture. The most important fish species used in fish farming in the region include carp, catfish, salmon and trout. Aquaculture of molluscs, such as the common mussel and the Pacific oyster, was also reported.

Water-management practices, such as fragmentation of water courses and construction of flood-protection barriers, have led to a decline in aquatic biodiversity. Dams, as well as hydro-electric power schemes, have frequently been found to be responsible for declining fish stocks in rivers. Some countries also indicated that commercial fishing in lakes and rivers increasingly needs to compete with other water uses (e.g. navigation, recreational activities/tourism,[15] energy generation through hydro-electric power and abstraction of water for cooling purposes).

Some countries, especially in northern and eastern Europe, reported that the reproduction areas of wild salmonids have been so badly affected by human activities that depleted native stocks have had to be restocked with farm-grown smolt to maintain fisheries. Interventions of this kind could lead to genetic pollution and homogenization of remaining wild populations.

Offshore wind parks, sand and gravel extraction, and gas and petroleum pipelines are considered to be particularly damaging to marine flora and fauna, depriving fisheries of key fishing grounds and aquatic genetic resources of their habitats.

Although several stocks of fish in the region's coastal and high-sea waters are still not within safe biological limits, several countries reported that fishing pressure on marine aquatic resources has declined over the last decade. Stocks of many commercial fish species have stabilized or recovered as a result of consistently implemented management plans.

1.2.3 National information systems on associated biodiversity

The vast majority of reporting countries indicated that they have information systems in place to monitor one or several associated biodiversity species. However, in most countries these information systems have been developed in the context of environmental monitoring programmes and not because the monitored species are considered of importance to food or forest production systems.

Box 1. The Agricultural Observatory of Biodiversity – an example of monitoring of biodiversity associated with farmland

In 2009, as part of the country's national biodiversity strategy, France's Ministry of Agriculture established the Agricultural Observatory of Biodiversity project. The project, which is coordinated by the National Museum of Natural History, was developed to improve the monitoring of the state of various components of associated biodiversity in agricultural environments and to identify how these components relate to farming practices. Most of the information is provided by farmers, who participate in the project on a voluntary basis. At present, the project focuses on solitary bees and butterflies in relation to pollination and as agro-environmental indicators, earthworms in relation to soil fertility, and terrestrial invertebrates, such as slugs and beetles, in the context of pest control.

More information on this project is available (in French) at http://observatoire-agricole-biodiversite.fr/presentation.

Source: Adapted from the country report of France.

[15] Several countries specifically mentioned that angling is becoming an increasingly important economic activity.

The most frequently monitored components of associated biodiversity in the region include amphibians and reptiles, bats, bees,[16] birds,[17] butterflies, crop pests and their natural enemies,[18] freshwater and marine fish, fungi, lichen, mosses, terrestrial mammals,[19] and wild and cultivated terrestrial and aquatic plants other than crops and crop wild relatives, including hedge plants, weeds and species present in riparian corridors, rivers, lakes and coastal marine waters.

Most countries have established Red Lists that summarize the status and trends of native flora and fauna species and the threats affecting them. These lists are based on The International Union for Conservation of Nature Red List of Threatened Species and are reviewed at regular intervals. At present, while the monitored species are linked to the ecosystems in which they occur (including agricultural, forest and marine ecosystems), no information is gathered on the functions the species have (or are thought to have) in these ecosystems.

Some countries, including Finland, indicated that up to 70 percent of all biodiversity-related monitoring work is conducted voluntarily by experts and enthusiasts. Monitoring of butterflies is volunteer-based in most countries in the region.

With respect to the monitoring of habitat and bird diversity, European Union Member States are obliged to report in detail on the habitats and species listed in the European Habitat and Birds Directives. Within the framework of the Birds Directive, countries have to report every three years, while the Habitats Directive calls for reports every six years.

Several countries mentioned monitoring micro-organisms (including bacteria, viruses and protists) and fungi, including those that are of importance to food production, such as mycorrhizal fungi, soil microbes, planktonic microbes and rumen microbes.

Very few countries specifically mentioned monitoring soil organisms in and around production systems, even if soil biodiversity is recognized as important to the sustainability of these systems. The United Kingdom mentioned that a pilot project (involving government and research institutions) is underway to develop and apply genetic barcoding and metabarcoding approaches for use in identifying and characterizing communities of soil organisms. The outcome of this work may enable trends in soil micro-organisms to be monitored in the future.

To conclude, numerous monitoring programmes are being implemented in the region, covering a broad range of taxonomic groups. Linking data from existing surveys on associated biodiversity species with spatially explicit information on production systems could help in understanding trends in associated biodiversity.

1.2.4 Associated biodiversity species actively managed for the provision of ecosystem services

Table 3. Associated biodiversity species most frequently reported to be actively managed for the provision of ecosystem services in Europe and Central Asia

Ecosystem service	Species/other taxonomic group	Countries where species are reported
Pollination	Honey bees European honey bee (*Apis mellifera*) Carnolian honey bee (*Apis mellifera carnica*) Spanish honey bee (*Apis melifera iberica*) Bumble bees Buff-tailed bumblebee (*Bombus terrestris*) Wild bees Red mason bee (Osmia bicornis) Hornfaced bee (Osmia cornuta) Flies Marmalade hoverfly (*Episyrphus balteatus*)	Belgium, Finland, France, Germany, Hungary, Ireland, Netherlands, Norway, Poland, Slovakia, Spain, Sweden, Switzerland, United Kingdom

[16] Mostly honey bees and to some extent bumble bees.
[17] Monitored bird species include arable-land and grassland birds and waterfowl.
[18] Monitoring crop pest and their natural enemies is usually part of integrated pest management programmes in agriculture and horticulture.
[19] Rodents, small and large game species, etc.

Table 3 *Cont'd*

Ecosystem service	Species/other taxonomic group	Countries where species are reported
	Dronefly (*Eristalis tenax*) Toadfly (*Lucilia caesar*) Blowfly (*Lucilia sericata*) Long hoverfly (*Sphaerophoria scripta/rueppelii*) <u>Plants</u> Goatgrasses (*Aegilops* spp.) *Allium* spp. Mustard (*Brassica* spp.) Common knapweed (*Centaurea nigra*) Field scabious (*Knautia arvensis*) Lucerne (*Medicago sativa*) Sainfoin (*Onobrychis viciifolia*) Lacy phacelia (*Phacelia tanacetifolia*) Red clover (*Trifolium pretense*) Vetch (*Vicia* spp.)	
Pest and disease regulation	<u>Biological control organisms:</u> - Parasitoid insects (*Aphidius rhopalosiphi* and *Psyllaephagus pilosus*) - Nematodes - Mites (*Typhlodromus pyri*) - Micro-organisms - Centipedes - Insectary plants (onion, carrots, lacy phacelia [*Phacelia tanacetifolia*] and tagetes), i.e. plants that assist the growth of crop by attracting beneficial insects or repelling pests. - Vertebrates: a. Fish such as wrasse (Labridae) that reduce the burden of sea lice parasites in aquaculture; b. Birds that eat caterpillars and other insects are attracted by placing nesting boxes in orchards.	Belgium, Bulgaria, Croatia, Estonia, Finland, France, Germany, Ireland, Netherlands, Norway, Sweden, Switzerland, United Kingdom
Water purification and waste treatment	<u>Riparian planting</u> Alder (*Alnus glutinosa*) Silver birch (*Betula pendula*) Downy birch (*Betula pubescens*) Hazel (*Corylus* spp.) Hawthorn (*Crataegus* spp.) Spindle-tree (*Euonymus europaeus*) Ash (*Fraxinus* spp.) Holly (*Ilex aquifolium*) Crab apple (*Malus sylvestris*) Pedunculate oak (*Quercus robur*) Common reed (*Phragmites australis*) Sitka spruce (*Picea sitchensis*) Lodgepole pine (*Pinus contorta*) Scots pine (*Pinus sylvestris*) Aspen (*Populus tremula*) Wild cherry (*Prunus avium*) Blackthorn/sloe (*Prunus spinosa*) Sessile oak (*Quercus petraea*) Eared willow (*Salix aurita*) Goat willow (*Salix caprea*) Rusty willow (*Salix cinerea*) Elder (*Sambucus nigra*) Rowan (*Sorbus Aucuparia*) Yew (*Taxus baccata*) Guelder rose (*Viburnum opulus*) <u>Remediation of waste water</u> European pike-perch (*Sander lucioperca*) White clover (*Trifolium repens*)	Bulgaria, Estonia, Finland, France, Ireland, Netherlands, Norway, United Kingdom

Table 3 *Cont'd*

Ecosystem service	Species/other taxonomic group	Countries where species are reported
Natural hazard regulation	Riparian planting Beech (*Fagus* spp.) Pine (*Pinus* spp.) Norway spruce (*Picea abies*)	Norway, Slovakia, Switzerland
Nutrient cycling	Riparian planting Alder (*Alnus glutinosa*) Silver birch (*Betula pendula*) Downy birch (*Betula pubescens*) Hazel (*Corylus* spp.) Hawthorn (*Crataegus* spp.) Spindle-tree (*Euonymus europaeus*) Ash (*Fraxinus* spp.) Holly (*Ilex aquifolium*) Crab apple (*Malus sylvestris*) Pedunculate oak (*Pedunculate oak*) Sitka spruce (*Picea sitchensis*) Lodgepole pine (*Pinus contorta*) Scots pine (*Pinus sylvestris*) Aspen (*Populus tremula*) Wild cherry (*Prunus avium*) Blackthorn/sloe (*Prunus spinosa*) Sessile oak (*Quercus petraea*) Eared willow (*Salix aurita*) Goat willow (*Salix caprea*) Rusty willow (*Salix cinerea*) Elder (*Sambucus nigra*) Rowan (*Sorbus aucuparia*) Yew (*Taxus baccata*) Guelder rose (*Viburnum opulus*) Cover crops Mustard (*Brassica* spp.) Barley (*Hordeum vulgare*) Perennial rye grass (*Lolium perenne*) Lacy phacelia (*Phacelia tanacetifolia*) Timothy (*Phleum pretense*) Rye (*Secale cereale*) Red clover (*Trifolium pretense*) White clover (*Trifolium repens*) Winter wheat (*Triticum aestivum*) Vetch (*Vicia* spp.) Cyprinid fishes Bream (*Abramis brama*) Ide (*Leuciscus idus*) Roach (*Rutilus rutilus*)	Belgium, Bulgaria, Finland, France, Ireland, Norway, Sweden, Switzerland, United Kingdom
Soil formation and protection	Planting of crops and trees Alder (*Alnus glutinosa*) Oats (*Avena* spp.), including black oats (*Avena strigosa*) Mustard (*Brassica* spp.) Buckwheat (*Fagopyrum esculentum*) Barley (*Hordeum vulgare*) Phacelia Willow (*Salix* spp.) Rye (*Secale cereale*) Vetch (*Vicia* spp.) Forage crops (unspecified)	Bulgaria, Germany, France, Ireland, Norway, Switzerland, United Kingdom

Table 3 *Cont'd*

Ecosystem service	Species/other taxonomic group	Countries where species are reported
Water cycling	Planting of riparian broadleaf woodlands and maintenance of healthy forests Fish species management Sturgeon (*Acipenseridae*) European whitefish (*Coregonus lavaretus*) Rainbow trout (*Oncorhynchus mykiss*) European pike-perch (*Sander lucioperca*)	Belgium, Finland, Norway, United Kingdom
Habitat provisioning	Managing buffer zones (e.g. hedgerows along the edges of agricultural lands, areas between cultivated land and forests, riparian vegetation, etc.) and expansion of broadleaved woodland Planting of (mostly native) tree (including fruit-tree) and shrub species: Alder (*Alnus glutinosa*) Silver birch (*Betula pendula*) Downy birch (*Betula pubescens*) Hazel (*Corylus* spp.) Whitethorn/hawthorn (*Crataegus* spp.) Spindle/pegwood (*Euonymus europaeus*) Ash (*Fraxinus* spp.) Ivy (*Hedera* spp.) Holly (*Ilex aquifolium*) Woodbine/honeysuckle (*Lonicera* spp.) Crab apple (*Malus sylvestris*) Pedunculate oak (*Quercus robur*) Common reed (*Phragmites australis*) Sitka spruce (*Picea sitchensis*) Lodgepole pine (*Pinus contorta*) Wild cherry (*Prunus avium*) Blackthorn/sloe (*Prunus spinosa*) Scots pine (*Pinus sylvestris*) Aspen (*Populus tremula*) Sessile oak (*Quercus petraea*) Dog rose (*Rosa canina*) Blackberry (*Rubus villosus*) Eared willow (*Salix aurita*) Goat willow (*Salix caprea*) Rusty willow (*Salix cinerea*) Elder (*Sambucus nigra*) Rowan (*Sorbus aucuparia*) Yew (*Taxus baccata*) Gorse, furze or whin (*Ulex* spp.) Elm (*Ulmus* spp.) Guelder rose (*Viburnum opulus*) Planting of crops, including for bird cover Oats (*Avena sativa*) Kale (*Brassica oleracea*) Quinoa (*Chenopodium quinoa* Willd.) Linseed (*Linum usitatissimum*) Phacelia Triticale (hybrid of wheat and rye) Management of salmonids (Salmonidae) to improve their habitat.	Belgium, Estonia, Finland, France, Germany, Hungary, Ireland, Norway, Sweden, Switzerland, United Kingdom
Production of oxygen, gas regulation	Forest planting in new areas Beech (*Fagus* spp.) Spruce (*Picea* spp.) Pine (*Pinus* spp.)	Norway, Slovakia

Source: Country reports prepared for *The State of the World's Biodiversity for Food and Agriculture* (FAO, 2019).

1.2.5 Wild food species

With some exceptions, wild food resources, including species of wild plants, game, wild fruit and fungi, are primarily harvested and consumed on a recreational basis. Their contribution to food security is generally minor and they make up only a very small proportion of the European diet. According to Schulp, Thuiller and Verburg (2014), wild food resources receive little attention in quantifying, valuating and mapping studies because of a perceived low importance or a lack of data. Their study showed that a wide variety of game (38 species), mushrooms (27 species) and vascular plants (81 species) are collected and consumed in the EU. While the economic and nutritional values of wild food are of very little importance in terms of GDP or total consumption, it is estimated that over 100 million EU citizens consume terrestrial wild food (Schulp, Thuiller and Verburg, 2014). Overall, collecting wild food is a valued recreational activity and both the collection and consumption of wild food provide important cultural ecosystem services. Because of these benefits, Schulp, Thuiller and Verburg (2014) argue that wild foods should be included in EU ecosystem service assessments. They concluded that data collection on wild-food abundance and production, as well as systematic inventories of wild-food harvesting need to be strengthened (ibid.).

In a number of countries, the economic contribution of recreational activities that have developed around wild-food harvesting (e.g. hunting and fishing licences, renting of cabins and hunting and fishing gear, etc.) is becoming increasingly important.

Table 4. Wild food species reported by two or more countries in Europe and Central Asia

Wild food species	Countries where species is reported
Fish[1]	
Asp (*Aspius aspius*)	Croatia, Finland, Poland
Burbot (*Lota lota*)	Finland, Poland
Cod (*Gadus morhua*)	Belgium, Norway, Sweden
Crayfish (*Nephrops norvegicus*)	Croatia, Sweden
Cyprinids: barbel (*Barbus barbus*), bream (*Abramis brama*), chub (*Leuciscus cephalus*), crucian carp (*Carassius carassius*), dace (*Leuciscus leucitincascus*), European carp (*Cyprinus carpio*), ide (*Leuciscus idus*), nase carp (*Chondrostoma nasus*), roach (*Rutilus rutilus*), tench (*Tinca tinca*)	Belgium, Croatia, Poland, Spain, Switzerland
Eel (*Anguilla anguilla*)	Belgium, Finland, Poland
Grayling (*Thymallus thymallus*)	Finland, Poland, Switzerland
European hake (*Merluccius merluccius*)	Croatia, Norway
Atlantic herring (*Clupea harengus*)	Norway, Sweden
Perch (*Perca fluviatilis*)	Belgium, Finland, Poland, Switzerland
Pike (*Esox lucius*)	Belgium, , Finland, Poland, Switzerland
Pike-perch (*Sander lucioperca*)	Belgium, Croatia, Finland, Poland, Sweden
Salmonids: Adriatic brown trout (*Salmo cenerinus*), Arctic charr (*Salvelinus alpinus*), Atlantic Salmon (*Salmo salar*), brown trout (*Salmo trutta*), lake charr (*Salvelinus umbla*) marble trout (*Salmo marmoratus*), rainbow trout (*Oncorhynchus mykiss*), Rhône trout (*Salmo rhodanensis*)	Belgium, Croatia, Finland, Poland, Spain, Switzerland
Sole: grey sole (*Glyptocephalus cynoglossus*), lemon sole (*Microstomus kitt*), Dover sole (*Solea solea*)	Belgium, Croatia, Norway
Whitefish (*Coregonus* spp.), including the European whitefish (*C. lavaretus*) and vendace (*C. albula*)	Finland, Poland, Switzerland
Game	
Elk/moose (*Alces alces*)	Finland, Norway, Sweden
Fallow deer (*Dama dama*)	Belgium, Germany, Spain
Red deer (*Cervus elaphus*)	Belgium, Germany, Norway, Spain, Switzerland
Roe deer (*Capreolus capreolus*)	Belgium, Finland, Germany, Norway, Spain, Sweden, Switzerland

Table 4 *Cont'd*

Wild food species	Countries where species is reported
Wild reindeer (*Rangifer tarandus*)	Finland, Norway
Chamois (*Rupicapra rupicapra*)	Germany, Spain, Switzerland
Mouflon (*Ovis musimon* and *O. orientalis*)	Belgium, Germany, Spain
Wild boar (*Sus scrofa*)	Belgium, Finland, Germany, Norway, Spain, Sweden, Switzerland
Hare (*Lepus* spp., *L. europaeus*, *L. timidus*[2])	Belgium, Finland, Germany, Norway, Spain, Switzerland
Common rabbit (*Oryctolagus cuniculus*)	Belgium, Finland, Germany, Spain, Switzerland
Birds	
Wild geese: greylag goose (*Anser anser*), bean goose (*A. fabalis*)	Belgium, Germany, Finland, Norway
Grouse: black grouse (*Tetrao tetrix*) , capercaillie (*T. urogallus*), hazel grouse (*Tetrastes bonsia*), rock ptarmigan (*Lagopus muta*), willow ptarmigan (*L. Lagopus*)	Croatia, Finland, Norway, Switzerland
Eurasian woodcock (Scolopax rusticola)	Belgium, Germany, Spain, Switzerland
Partridge (*Alectoris graeca*, *A. rufa* and *Perdix perdix*)	Germany, Spain, Switzerland
Pheasant (*Phasianus colchicus*)	Belgium, Finland, Germany
Duck species: common teal (*Anas crecca*), gadwall (*Anas strepera*), wild duck (*A. platyrhynchos*), diving ducks (*Aythya* spp.) such as the common pochard (*A. ferina*) and the tufted duck (*A. fuligula*)	Belgium, Finland, Germany, Switzerland
Berries[3]	
European black elderberry (*Sambucus nigra*)	Croatia, Germany, Norway, Switzerland, United Kingdom
Juniperus spp.: common juniper (*J. communis*), prickly juniper (*J. oxycedrus*)	Croatia, Germany, Norway
Prunus spp.: almond (*P. dulcis*), blackthorn/sloe (*P. spinosa*), Chinese bush cherry (*P. tomentosa*), hackberry (*P. padus*) and wild cherry (*P. avium*)	Bulgaria, Croatia, Germany, Norway, Spain, United Kingdom
Ribes spp.: black currant (*R. nigrum*), gooseberry (*R. uva crispa*) and red currant (*R. rubrum*)	Bulgaria, Germany, Norway, Sweden
Rubus spp.: Arctic raspberry (*R. arcticus*), dewberry (*R. caesius*), backberry (*R. fructicosus*), cloudberry (*R. chamaemorus*), raspberry (*R. idaeus*), stone bramble (*R. saxatilis*) and thornless blackberry (*R. ulmifolius*)	Croatia, Germany, Norway, Poland, Spain, Sweden, Switzerland, United Kingdom
Wild strawberry (*Fragaria vesca*)	Bulgaria, Croatia, Norway, Sweden, Switzerland
Vaccinium spp.: bilberry (*V. myrtillus*), northern bilberry (*V. uliginosum*), lingonberry (*V. vitis-idaea*)	Bulgaria, Croatia, France, Germany, Norway, Poland, Sweden, Switzerland
Fungi[4]	
Chanterelle species: common chanterelle (*Cantharellus cibarius*), black trompet mushroom (*Craterellus cornucopioides*) and funnel chanterelle (*C. tubaeformis*)	Croatia, Germany, Norway, Switzerland, United Kingdom
Cep (*Boletus aestivalis* and *B. edulis*)	Croatia, Germany, Norway, Switzerland, United Kingdom
Hedgehog mushroom (*Hydnum repandum*)	Croatia, Norway, United Kingdom
Lactarius spp., including saffron milk cap mushroom (*L. deliciosus*) and false saffron milk cap mushroom (*L. deterrimus*)	Croatia, Norway
Wild plants/herbs[5]	
Allium spp.: broadleef wild leek (*A. ampeloprasum*), ramsons/wild garlic (*A. ursinum*) and sand leek (*A. scorodoprasum*)	Bulgaria, Croatia, Spain, Sweden, Switzerland, United Kingdom
Artemisia spp.: e.g. manzanilla de Sierra Nevada	Bulgaria, Spain
Asparagus spp.: wild asparagus (*A. acutifolius*), garden asparagus (*A. officinalis*) and *A. tenuifolius*	Croatia, Spain
Common nettle (*Urtica dioica*)	Bulgaria, Croatia, United Kingdom
Common sorrel (*Rumex acetosa*)	Bulgaria, Spain, Sweden, United Kingdom
Fennel (*Foeniculum vulgare*)	Bulgaria, Croatia, Spain
Thymus spp.: common thyme (*T. vulgaris*), Spanish thyme (*T. mastichina*), wild thyme (*T. polytrichus*) and *T. zygis*	Spain, United Kingdom

Table 4 *Cont'd*

Wild food species	Countries where species is reported
Shrubs/trees	
Carob tree (*Cerationia siliqua*)	Bulgaria, Croatia
Hazel (*Corylus avellana*)	Croatia, Switzerland
Pinus spp.: Stone pine (*P. pinea*)	Bulgaria, Croatia, Spain
Rowan (*Sorbus aucuparia*)	Croatia, Germany, Norway
Strawberry tree (*Arbutus unedo*)	Croatia, Spain
Sweet chestnuts (*Castanea sativa*)	Croatia, Germany, Spain, Switzerland, United Kingdom
Others	
Edible snails: Burgundy snail (*Helix pomatia*); Roman snail (*H. cincta cincta*), Turkish snail (*H. lucorum*) and *H. secernenda*	Croatia, Poland

[1] Several wild fish species were reported by only one country; some countries chose to report on capture-based and self-recruiting fish species, while others did not (e.g. Norway, Spain and the United Kingdom).
[2] In Germany, the mountain hare (*Lepus timidus*) is protected year round.
[3] Thirty-seven unnamed edible wild berry species were reported by Finland.
[4] Spain reported that its forests contain a large number of edible fungi species. These were not listed in detail in the country report.
[5] Spain has an important collection of wild edible plant species, none of which were included in the wild food species list (see Table 3.7, page 139 of Spain's country report).
Source: Country reports prepared for *The State of the World's Biodiversity for Food and Agriculture* (FAO, 2019).

1.2.6 Status, trends and drivers of change of associated biodiversity, ecosystem services and wild food resources

Generally speaking, the status and trends of associated biodiversity of relevance to food and agriculture are less systematically monitored than those of animal, aquatic, forest and plant genetic resources. More often than not, the levels and period of funding for research on associated biodiversity impose restrictions on what is achievable, and the data and research outputs are best described as snapshots in space and time. Moreover, research focus tends not to be on associated biodiversity in production systems per se. For example, the rarity and decline of bumble bees (linked to pollination) is widely recognized across the region, but this is not reported on a production-system basis.

With EU Member States being obliged to report on the status and trends of bird populations to comply with the EU Birds Directive,[20] and thanks to active ornithological societies, birds are among the few categories of associated biodiversity that are monitored on a regular basis.

Since the 1960s, terrestrial invasive alien species have become more prevalent across the region, except in forest and woodland ecosystems. Over the past decade, improved forest management seems to have contributed to a reduction in the presence of invasive alien species in these ecosystems.

Climate change was highlighted by several countries as a major threat to biodiversity in terrestrial, inland-water and coastal ecosystems. In the region's temperate zones, rising temperature and changing rainfall patterns are expected to lead, *inter alia*, to altered crop growth cycles and to increases in the prevalence of weed species, plant and animal diseases and insect pests. In southern Europe, the projected changes in temperature and rainfall are expected particularly to threaten biodiversity in and around rainfed crop systems in arid and semi-arid zones. Among other potential threats, the report from Ireland mentions that degraded upland habitats and their associated species are predicted to become less resilient to the effects of climate change in the immediate future. These predictions relate mainly to drier summers and higher levels of more intense rainfall that are likely to result in bog bursts and landslides, which may in turn have an impact on other habitats such as lakes.

Regarding wild food species, most countries across the region mentioned that terrestrial and aquatic wild edible animal species are exposed to illegal hunting and poaching. Various wild-food harvesting activities can have major impacts on biodiversity and its management, leading, for example, on the one hand to overexploitation and permanent loss of species and on the other

[20] The Birds Directive aims to protect all of the 500 wild bird species naturally occurring in the European Union (http://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm); trends in specialist farmland birds are monitored through the Farmland Bird Indicator.

to the conservation of woodlands as hunting grounds (Emanuelsson, 2009; Schulp, Thuiller and Verburg, 2014).

Agricultural landscapes

In the EU, bird species linked to agricultural landscapes, for example the black-headed gull (*Chroicocephalus ridibundus*), black-tailed godwit (*Limosa limosa*), linnet (*Carduelis cannabina*), hortulan bunting (*Emberiza hortulana*), oystercatcher (*Haematopus ostralegus*), lapwing (*Vanellus vanellus*), great bustard (*Otis tarda*), curlew (*Numenius arquata*), European roller (*Coracias garrulus*) and woodchat shrike (*Lanius senator*) have declined or become locally extinct. Agricultural intensification is mentioned as the main factor behind their dwindling numbers. Intensive farming has, for example, contributed to landscape homogenization, causing the loss of important microhabitats for nesting and feeding. It has also been a driving force behind the loss of mixed-farming systems and land abandonment and subsequent vegetation regrowth, which have adversely affected farmland birds such as the skylark (*Alauda arvensis*) and grey partridge (*Perdix perdix*), although other species such as the woodpigeon (*Columba palumbus*) and red-backed shrike (*Lanius collurio*) have benefitted. It is still unclear whether the agri-environmental and nature conservation measures taken in some countries to reverse the negative trends of farmland bird populations are having a positive effect.

Quite a few countries indicated that the abandonment of extensive livestock farming has been the main driver behind the loss of open landscape-dependent grasses, other wild plants and other associated biodiversity species. Studies in various European countries have found that the use of pesticides, especially insecticides, herbicides and fungicides, has also had negative effects on wild-plant diversity, including on weed species known to provide habitats for other components of associated biodiversity. Overall, countries that monitor the occurrence of plant species indicated that plant diversity on arable and horticultural land has been improving since the 1990s. It was noted that agri-environment schemes and organic farming have positively affected the species diversity of plants and carabids in agricultural fields, but not of birds (country reports cited the study undertaken by Geiger *et al.*, 2010).

Some of the Nordic countries mentioned that intensified reindeer herding and subsequent overgrazing had led to a reduction in the quality and amount of lichen on winter pastures, resulting in increased use of winter hay and helminthicides. Other changes in agricultural practices, such as the increased use of heavy agricultural machinery, monocultures of shallow-rooted crops (e.g. maize), inappropriate crop rotation (no legumes or intercropping) and high levels of pesticide use, are mentioned in the country reports as having particularly affected the stability and structure of soils and altered soil biodiversity in terms of species richness and community composition (e.g. of carabids). Several countries mentioned that unsustainable farming practices such as these were mainly introduced and spread as the result of policy reforms and changing agricultural markets.

Climate change, invasive species, parasites and pathogens, pesticides, inadequate water management and monocultures of mostly non-traditional crops (mainly rapeseed), in combination with the exclusion of river buffer zones and green margins as refuges, were mentioned as being among the main causes of a decline in the diversity and abundance of invertebrates such as pollinating insects, worms, slugs and snails. Some countries mentioned that the state of their insect colonies in general, and of bees in particular, is currently below the optimal threshold for pollination of flowering plants in arable land and grassland. According to a recent assessment by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) on pollinators, pollination and food production, 9 percent of Europe's bee and butterfly species are threatened with extinction and the populations of 37 percent of the bee species and 31 percent of the butterfly species for which sufficient data are available are declining.

France noted the negative effect of inappropriate use of artificial light – so-called light pollution – on the biological functions of certain insect species.

Forest and woodlands

The status and trends of forest-related species are relatively well monitored in the western part of the region. For example, the PanEuropean Common Bird Monitoring scheme, which has an indicator for common forest birds, draws on data from most of European countries west of the former Soviet Union, plus the Baltic states, (Iceland, Turkey and some Balkan countries are not included) (EBBC, 2019). The period between 1980 and 2016 saw an overall decline in the indicator, although with geographical variations (steeper declines in southern and northern Europe and a slight increase in western Europe) (ibid.). In the Netherlands, the occurrence of forest and woodland birds seems to have been generally stable or increasing since the 1980s. The steady increase in total forest area and changes in forest management (from an exclusive focus on wood production towards multipurpose forest management) are believed to be behind the rising numbers of forest-related bird, bat, invertebrate and fungi species (Noordijk *et al.*, 2010).

Some countries reported a loss of fungi diversity in production forests as a result of acid rain, eutrophication, land-use change and the removal of dead wood. In contrast to plant diversity on arable and horticultural land, plant diversity in woodland, grassland and boundary habitats has also continued to decline since the 1990s.

Changing agricultural practices were reported to have enhanced the spread of invasive alien species, such as the flowering plant *Amorpha fruticosa* and the tree *Robinia pseudoacacia*, that are known to suppress the development of native forest species. At the same time, however, honey bees have benefitted from the presence of nectar- and pollen-rich species such as these.

Overall, the resilience of forests and their biodiversity potential in the region is increasing thanks to the expansion of forest area in favour of deciduous tree species, increasing dead wood volumes and the ongoing reduction in household waste, sewage discharge and pollution arising from agricultural and forestry practices.

Marine, freshwater and wetland ecosystems

Human activities are causing significant damage to marine and freshwater habitats and species, both through the discharge and runoff of nutrients and other chemicals and through direct physical contact or disturbance.

Most countries mentioned fisheries as being the activity with the most widespread negative effects on marine flora and fauna. By selectively removing certain species and size classes of fish, fishery activities have affected the structure and functioning of ecosystems (Daan *et al.*, 2005). Bottom-trawl fishing has been a major factor in damaging seabed communities, particularly in biogenic habitats (e.g. coral reefs) and relatively stable habitats in deeper waters (Reiss *et al.*, 2009; Lambert *et al.*, 2014; Van Denderen *et al.*, 2014). In shallow waters that are frequently exposed to natural perturbations by tidal currents or storms, bottom trawling has less impact (Diesing, Stephens and Aldridge, 2013).

The Netherlands noted that the populations of mammals and fish in the North Sea increased by 25 percent on average between 1990 and 2001, with stabilization after 2003 (Oerlemans *et al.,* 2015). The observed increase in sea temperatures in the southern North Sea has resulted in changes in the fish community. Species that prefer warmer temperatures, such as sea bass, have increased, while species that prefer cooler waters, such as plaice and cod, have decreased or moved to deeper waters (Dulvy *et al.*, 2008; Ter Hofstede and Rijnsdorp, 2011). In general, species richness is increasing, probably in response to the increase in temperature and the appearance of invasive species (Ter Hofstede, Hiddink and Rijnsdorp, 2010; Oerlemans *et al.*, 2015).

The voluntary introduction of the Pacific oyster (*Crassostrea gigas*) into the Netherlands in the 1960s and the red king crab (*Paralithodes camtschaticushas*) into the Barents Sea during the 1930s resulted in their uncontrolled proliferation into adjacent water bodies. While both are considered a serious threat to the existing functions of coastal waters, oyster reefs can also provide an important habitat for certain species (Smaal, Kater and Wijsman, 2009) and the red king crab is one of the crabs most preferred for consumption.

Box 2. Countermeasures taken to reduce adverse effects of drivers of change on associated biodiversity, ecosystem services and/or wild foods: examples from Bulgaria, Germany and Hungary

Like many other countries in the region, Bulgaria officially prohibits the burning of stubble and other plant waste on agricultural land (Article 6 of the Law on Protection of Agricultural Land). As knowledge of the long-term detrimental effects stubble burning on soil quality and overall cropland/grassland production increases, so does the number of countries banning the practice.

The country report from Germany mentions the use of innovative techniques to prevent the harmful effects of spreading nitrogen-containing residues from animal husbandry on the land. It also mentions the use of innovations in fisheries technology to help reduce by-catches and disruption of the benthos.

Hungary combines *ex situ* and *in situ* conservation measures to counter declines in the numbers of sterlet (*Acipenser ruthenus*) and wild common carp (*Cyprinus carpio*). Wild and cultured strains of sturgeon species and common carp are stored in live and deep-frozen gene banks to preserve the species' genetic diversity and facilitate their reintroduction for conservation purposes. At the same time, the species' migration routes are being rehabilitated and their wintering, spawning and fattening grounds restored. The success of this initiative relies on thorough knowledge of the processes that affect the species' population dynamics and the environment.

Source: Adapted from the country reports of Bulgaria, Germany and Hungary.

In some freshwater ecosystems, improvements in water quality, the construction of fish passages and the restoration of waterway banks to create spawning habitats have led to improved habitat provisioning and increasing fish population sizes. In the Netherlands, for example, the population sizes of animal species in freshwater habitats and marshes increased by 40 percent between 1990 and 2003, after which they stabilized (Oerlemans *et al*., 2015). Acid rain (sulphur and nitrogen deposition) is still a serious threat to freshwater biodiversity in the region. Many years of liming, combined with reductions in acid deposition, have improved water quality to the extent that ecosystems are recovering, even if this positive trend has become less marked since 2000. Countries reported that invasive alien species also continue to exert major pressure in freshwater habitats.

Intensive fish culture in ponds is believed to be among the causes of the declining numbers of some water and wetland bird species such as ducks and grebes.[21] For example, a study in South Bohemia found that high fish-stock density had a negative effect on the density of diving ducks in fishponds (Pykal and Janda, 1994).

1.3 NEEDS AND PRIORITIES

With respect to sectoral genetic resources for food and agriculture, Germany indicated that not all information about plant genetic resources is sufficiently accessible, in particular with respect to characterization and evaluation data relevant to breeding research. It expressed the need to establish modern information systems linking data on plant genetic resources in gene banks to information on value-enhancing and phenotypic traits. International efforts in this regard, for example through the DivSeek initiative,[22] have recently got under way.

In general, there is relatively good understanding and knowledge of overall trends in biodiversity in the reporting countries. It is, however, more difficult to discern changes in components of associated biodiversity within the production systems designated by FAO for the purposes of *The*

[21] *The Fifth National Report of the Czech Republic to the Convention on Biological Diversity* (submitted to the CBD on 11 June 2014).

[22] The DivSeek initiative aims to characterize crop diversity and develop a unified, coordinated and cohesive information management platform to provide easy access to genotypic and phenotypic data associated with genebank germplasm (see http://www.divseek.org/).

State of the World's Biodiversity for Food and Agriculture. In order to do this in any meaningful or comprehensive way, baseline data on associated biodiversity in each of these production systems would be required and these data would then need to be regularly updated so that any changes could be detected. At present, there are few or no data of this kind.

Research related to associated biodiversity within production systems is undertaken by a number of institutions, universities and colleges, and non-governmental organizations (NGOs) in the region. However, the ecological data they gather often represent a snapshot of a given component of associated biodiversity within a given production system. This is, of course, valuable and serves to answer specific research questions. Such data, however, do not serve to monitor trends unless the research is repeated systematically.

Several countries expressed the need for comprehensive research programmes on extensive grazing to facilitate the design of agri-environmental schemes that help to maintain and restore biodiversity in grasslands. They mentioned that research in this area should combine expertise from ecology, botany, agronomy, animal production and rural economics, and include both field experiments and analytical modelling.

In quite a number of countries, there are major gaps in knowledge of soil biodiversity. Only very few soil-associated species seem to be monitored on a regular basis. Countries mentioned finding it difficult to determine which species should be prioritized for monitoring, surveying and mapping. They also indicated that the limited availability of financial and human resources is a significant constraint to advancing work in this area.

Most countries stressed the need to strengthen the monitoring of pollinators. The United Kingdom reported that it was developing a bee-monitoring framework to be implemented as part of England's National Pollinator Strategy and that this would enable trends to be determined in the future.

Slovenia specifically mentioned the need to improve monitoring activities related to edible fungi, which it considers crucial to the control of overharvesting.

With respect to invasive alien species and to their possible ecological impact, there are still (too) many unknowns in all the reporting countries. Risk assessments associated with "new" alien species (i.e. so-called door knockers) and knowledge of their colonization and damage potential are also lacking.

Information and knowledge gaps also exist with respect to the effect on biodiversity for food and agriculture of unsustainable practices such as bottom trawling and the use of neonicotinoid chemical crop protection products.

II. Sustainable use and conservation of biodiversity for food and agriculture

2.1 SUSTAINABLE USE

2.1.1 Management practices supporting the maintenance and use of biodiversity for food and agriculture

Most reporting countries apply a range of management and diversity-based practices to support the maintenance and use of biodiversity for food and agriculture. Integrated plant nutrient management, integrated pest management, organic farming, landscape management and pollination management were among the most frequently reported practices in both livestock and crop production systems. In forest production systems, reduced-impact logging and sustainable soil and landscape management practices were reported to be commonly applied. Most countries mentioned that they had adopted the ecosystem approach applied to capture fisheries. In aquaculture, integrated pest management, organic fish farming and conservation hatcheries were the most frequently reported practices.

Organic farming and integrated pest management were described in the country reports as important forms of ecosystem approaches in crop production systems. In 2015, 6.2 percent of utilized agricultural area in the EU was under organic management (EC, 2016). Quite a few countries are aiming to increase the number of organic farmers and the area under organic cultivation over the next decade.

In several countries in the region, livestock are used for conservation grazing. This practice aims to restore, maintain and increase the biodiversity of natural or semi-natural grasslands, heath-lands, wood pastures, wetlands and other habitats. It has proven to be particularly beneficial in restoring and maintaining grassland and heath-land ecosystems. Conservation grazing is often practised alongside other conservation measures.

Switzerland mentioned having undertaken a large-scale study entitled "Biodiversity in Switzerland from 1900 to the present – has decline bottomed out?" which, *inter alia*, aimed to identify management practices that are applied in agriculture, forestry and waterways and have an effect on associated biodiversity. The findings of the study, including estimates of the impact these practices will have in the future, are summarized in Switzerland's country report.[23]

Most reporting countries seem to agree that there is a need to thoroughly evaluate the effectiveness of management and diversity-based practices intended to favour associated biodiversity and the provision of regulating and supporting ecosystem services. Several countries indicated that the voluntary participation of farmers, foresters and other actors (e.g. members of the public) in the provision of data for this purpose is becoming increasingly important.

Table 5 summarizes reported trends in the adoption of selected management practices that countries were invited to report on. Table 6 lists additional measures reported to be taken to support the sustainable use of associated biodiversity and/or wild foods and where available indicates reported trends.

Table 5. Reported trends in the adoption of selected management practices and approaches in Europe and Central Asia

Practice or approach	Production systems	Countries reporting	Reported trends in adoption
Agroforestry	Livestock grassland-based, Livestock landless, Naturally generated forests, Planted forests, Irrigated crops (non-rice), Rainfed crops	Belgium, Croatia, Finland, Germany, Poland, Slovakia	Generally stable to positive

[23] See table on page 40 of Switzerland's country report.

Table 5 *Cont'd*

Practice or approach	Production systems	Countries reporting	Reported trends in adoption
Base broadening	Livestock grassland-based, Livestock landless, Planted forests, Culture-based fisheries, Fed aquaculture, Irrigated crops (non-rice), Rainfed crops, Mixed, Horticulture (under glass), Semi-natural forests[1]	Belgium, Croatia, Estonia, Finland, Netherlands, Norway, Poland, Slovakia, Slovenia, Sweden, Switzerland	Stable to positive
Conservation agriculture	Livestock grassland-based, Livestock landless, Planted forests, Irrigated crops (non-rice), Rainfed crops, Mixed	Belgium, Croatia, Estonia, Finland, Germany, Norway, Poland, Slovakia, Spain	Stable to strongly positive
Diversification	Livestock grassland-based, Livestock landless, Naturally regenerated forests, Planted forests, Self-recruiting capture fisheries, Culture-based fisheries, Fed aquaculture, Irrigated crops (non-rice), Rainfed crops, Mixed, Horticulture (under glass), Semi-natural forests[1]	Belgium, Croatia, Finland, Hungary, Netherlands, Norway, Poland, Slovakia, Slovenia, Sweden, Switzerland	Stable to strongly positive
Domestication	Livestock grassland-based, Livestock landless, Planted forests, Self-recruiting capture fisheries, Fed aquaculture, Non-fed aquaculture, Irrigated crops (non-rice), Rainfed crops, Mixed, Semi-natural forests[1]	Belgium, Croatia, Finland, Hungary, Norway, Poland, Slovenia, Slovakia, Switzerland	Stable to strongly positive, with two countries reporting negative in capture fisheries
Ecosystem approach to fisheries	Self-recruiting capture fisheries, Culture-based fisheries, Fed aquaculture, Non-fed aquaculture	Croatia, Estonia, Finland, Norway, Poland	Stable to strongly positive
Enrichment planting	Naturally regenerated forests, Planted forests, Semi-natural forests[1]	Croatia, Estonia, Netherlands, Norway, Slovakia	Positive to strongly positive
Home gardens	Livestock grassland-based, Livestock landless, Culture-based fisheries, Irrigated crops (non-rice), Rainfed crops	Croatia, Germany, Hungary, Poland, Slovakia, Slovenia, Switzerland	Positive, with five countries reporting negative trends in rainfed crop production systems
Integrated pest management	Livestock grassland-based, Livestock landless, Naturally generated forests, Planted forests, Fed aquaculture, Irrigated crops (non-rice), Rainfed crops, Mixed, Horticulture (under glass), Semi-natural forests[1]	Belgium, Croatia, Estonia, Finland, Germany, Hungary, Netherlands, Norway, Poland, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom	Stable to strongly positive
Integrated plant nutrient management	Livestock grassland-based, Livestock landless, Naturally generated forests, Planted forests, Irrigated crops (rice), Irrigated crops (non-rice), Rainfed crops, Mixed, Horticulture (under glass), Semi-natural forests[1]	Belgium, Croatia, Estonia, Finland, Germany, Hungary, Ireland, Netherlands, Norway, Poland, Slovakia, Slovenia, Spain[2], Sweden, Switzerland, United Kingdom	Stable to strongly positive
Landscape management	Livestock grassland-based, Livestock landless, Naturally generated forests, Planted forests, Fed aquaculture, Non-fed aquaculture, Self-recruiting capture fisheries, Culture-based fisheries, Irrigated crops (non-rice), Rainfed crops, Mixed, Horticulture (under glass), Semi-natural forests[1]	Belgium, Croatia, Estonia, Finland, Germany, Hungary, Netherlands, Norway[3], Poland, Slovenia, Slovakia, Sweden, Switzerland, United Kingdom	Stable to positive
Low external input agriculture	Livestock grassland-based, Livestock landless, Naturally generated forests, Fed aquaculture, Non-fed aquaculture, Irrigated crops (rice), Irrigated crops (non-rice), Rainfed crops, Mixed	Belgium, Croatia, Estonia, Germany, Hungary, Norway, Poland, Slovenia, Spain[2], United Kingdom	Stable to positive, negative in one country in livestock landless systems
Management of micro-organisms	Livestock grassland-based, Livestock landless, Naturally regenerated forests, Self-recruiting capture fisheries, Fed aquaculture, Rainfed crops, Mixed, Semi-natural forests[1]	Croatia, Finland, Norway, Slovenia	Stable to positive
Organic agriculture	Livestock grassland-based, Livestock landless, Naturally generated forests, Planted forests, Culture-based fisheries, Fed aquaculture, Non-fed aquaculture, Irrigated crops (rice), Irrigated crops (non-rice), Rainfed crops, Mixed, Horticulture (under glass), Apiculture	Belgium, Croatia, Estonia, Finland, Germany, Ireland, Hungary, Netherlands, Norway, Poland, Slovakia, Slovenia, Spain, Sweden, United Kingdom	Stable to strongly positive

Table 5 *Cont'd*

Practice or approach	Production systems	Countries reporting	Reported trends in adoption
Pollination management	Livestock grassland-based, Livestock landless, Naturally generated forests, Planted forests, Irrigated crops (non-rice), Rainfed crops, Mixed, Horticulture (under glass), Semi-natural forests[1]	Belgium, Croatia, Estonia, Hungary, Netherlands, Norway, Poland, Slovakia, Slovenia, Sweden, United Kingdom	Generally positive
Polyculture/aquaponics	Culture-based fisheries, Fed aquaculture, Non-fed aquaculture	Estonia, Hungary, Poland, Slovakia, Slovenia	Differs by country
Reduced-impact logging	Naturally generated forests, Planted forests, Mixed, Semi-natural forests[1]	Belgium, Croatia, Estonia, Finland, Germany, Norway, Poland, Slovenia, Sweden, Switzerland, United Kingdom	Stable to strongly positive
Restoration practices	Livestock grassland-based, Livestock landless, Naturally regenerated forests, Planted forests, Self-recruiting capture fisheries, Fed aquaculture, Non-fed aquaculture, Irrigated crops (non-rice), Rainfed crops, Mixed, Semi-natural forests[1]	Belgium, Croatia, Estonia, Finland, Netherlands, Norway, Poland, Slovakia, Slovenia, Switzerland, Sweden	Positive to strongly positive
Sustainable soil management practices	Livestock grassland-based, Livestock landless, Naturally generated forests, Planted forests, Irrigated crops (non-rice), Rainfed crops, Mixed, Semi-natural forests[1]	Belgium, Croatia, Estonia, Finland, Germany, Hungary, Norway, Poland, Slovenia, Slovakia, United Kingdom	Stable to strongly positive

[1] "Semi-natural forests" is a production-system category used in the country report from Norway. Sustainable forest management is Norway's general forestry management regime. It promotes sustainable practices, including elements of integrated plant nutrient management, integrated pest management, pollination management, sustainable soil management practices, water management practices and water harvesting. Trends in the application of these practices have as yet not been monitored.
[2] In Spain, IPNM and low external input agriculture are both encompassed in what is referred to as "integrated production".
[3] The Programme for the Endorsement of Forest Certification (PEFC) Norway Forest Management Standard applies to practically all productive forests.
Source: Country reports prepared for *The State of the World's Biodiversity for Food and Agriculture* (FAO, 2019).

Table 6. Additional measures taken to support sustainable use of associated biodiversity and/or wild foods in production systems

Sector	Measure	Country	Reported trends in adoption
Aquaculture and fisheries	Application of "polluter pays" principle.	Hungary	Not known
	Long-term lease of natural water bodies to strengthen fisheries management.	Hungary	Not known
	Fisheries management and fishery inspections to sustainably exploit aquatic living resources.	Netherlands	Not known
	Technical innovations are being explored to reduce collateral damage to the ecosystem (e.g. catch of undersized fish and reduction of adverse effects on seabed habitats).	Netherlands	Positive
Crop systems	Base broadening may be beneficial for associated biodiversity, as one of many efforts to restrict the use of plant-protection products.	Switzerland	Not known
Mixed systems	Promotion and wide application of mixed farming, where agricultural and animal production coexist in a single production system.	Poland	Not known
Across different production systems	National and common European policies promoting sustainable farming, forestry and fisheries. Examples of such policies include: agri-environment and climate measures; fertilizer directives; pollinator strategies; payment schemes; felling licences; measures to limit the unsustainable use of associated biodiversity and wild food species in state-owned forests; common fishery policy catch quotas; marine conservation zones.	All reporting countries	Positive

Source: Country reports prepared for *The State of the World's Biodiversity for Food and Agriculture* (FAO, 2019).

Box 3. Programmes supporting biodiversity-based and biodiversity-friendly management practices: examples from Belgium, France and Spain

Belgium: Conservation of landscape complexity is stimulated by agri-environmental schemes under the rural development programme and regulated through legislation. The rural development programme promotes the creation and maintenance of hedges, tree lines, species-rich field margins, etc. Permit requirements for the alteration or removal of landscape elements are regulated by law. The effects of these measures on biodiversity for food and agriculture are not known.

France: In 2013, as part of its national agroecological project, the country's Minister of Agriculture launched the "Ambition Bio 2017" programme to boost the development of organic farming in various branches of agriculture. In 2015, as a result of this programme, the number of organic farms increased by 9 percent to a total of 28 884 farms, and at the end of 2015 the total agricultural area used for organic production surpassed 5 percent. During the same period, the production of and demand for organic food products, respectively, increased by 23 percent and 15 percent. These trends appeared to be continuing into 2016.

Spain: Since the 1990s, the country has promoted practices that support conservation agriculture. Among other actions, measures were introduced to stimulate extensive agriculture and support conservation tillage systems as a means of reducing soil erosion. The government also imposed a ban on stubble burning. More recently, measures promoting shifting cultivation, terraces, flowerbeds and vegetative hedges to enable the establishment of plant cover and direct seeding were introduced through agri-environment schemes.

Source: Adapted from the country reports of Belgium, France and Spain.

2.1.2 Effect of diversity per se on productivity, food security and nutrition, and rural livelihoods

Like a number of other countries, Croatia reported on the importance of crop diversification to efforts to strengthen rural livelihoods and enhance the sustainability and resilience of crop production systems in the context of climate change. By growing and rotating different crops varieties, farmers are better protected against harmful insects, weeds and diseases. Crop diversification also contributes to reducing the risk of total crop failure in the event of unforeseen weather events, such as sudden frost or drought, which may negatively affect one crop variety but not the other(s). Several EU Member States, including Croatia, briefly described how farmers are advised to manage crop diversification in practice. On crop fields covering an area between 10 and 30 hectares, farmers should cultivate at least two different crop varieties, with the main crop covering 75 percent or less of the total area. On crop fields covering more than 30 hectares, at least three different crop varieties should be grown, whereby the main crop should cover no more than 75 percent and the two main crops no more than 95 percent of the total area. These crop diversification requirements are part of the EU's prerequisites for receipt of green direct payments through its "greening" programme.[24]

Very few countries provided examples of cases in which a lack of biodiversity for food and agriculture is known to have affected productivity, food security and nutrition, rural livelihoods, ecosystem services, sustainability, resilience or sustainable intensification. Norway mentioned that its poultry sector lacks diversity and depends entirely on international poultry breeding companies for its breeding material. Like other countries in the region, Norway has no local commercial poultry breeds/lines to fall back on in the event of a critical situation (e.g. an unforeseen disease outbreak). Belgium reported that with the disappearance of migrating fish species, such as salmon,

[24] See http://ec.europa.eu/agriculture/direct-support/greening/index_en.htm

sea trout, sturgeon, flounder and shad, healthy food resources that used to be available for consumption have been lost.

2.1.3 Use of biodiversity for food and agriculture for coping with climate change, invasive alien species and natural or human-made disasters

Countries provided a number of examples of the use of biodiversity for food and agriculture as part of their efforts to address climate change, invasive alien species or disasters of various kinds. This information is summarized in Table 7.

Table 7. Reported examples of the use of biodiversity for food and agriculture to cope with climate change, invasive alien species or natural or human-made disasters in Europe and Central Asia

Countries	Description
Use of biodiversity for food and agriculture to adapt to and mitigate climate change	
Bulgaria, Finland, Germany, Ireland, Netherlands, Norway, Poland, Spain, Switzerland, United Kingdom	The majority of countries in Europe indicated that they have a national strategy in place for adaptation to climate change. Most of these strategies embed the conservation and the efficient utilization of biodiversity for food and agriculture. Some of the described strategies tend to focus more on how to protect biodiversity from climate change than on how it could be used in climate change adaptation. Most countries also reported on other policies, strategies and programmes that address issues related to biodiversity for food and agriculture in a climate change context. In this regard, national biodiversity strategies, forest strategies, sustainable development and environmental policies, as well as national sectoral programmes for the conservation and sustainable use of animal, plant, forest and aquatic genetic resources, were frequently mentioned.
Use of biodiversity for food and agriculture to manage the spread of/control invasive alien species	
Croatia, Hungary, Ireland, Norway, Poland, United Kingdom	Quite a few examples were given of cases in which components of biodiversity for food and agriculture have been used to slow the spread of invasive alien species. However, countries indicated that the contribution of these components was often limited and insufficient to keep the proliferation of the invasive species and their negative impacts on native flora and fauna under control. Examples: - Commercially important predatory-fish species such as the wels catfish (*Silurus glanis*) and the pike-perch (*Sander lucioperca*) could contribute to the control of invasive alien fish species such as the Amur sleeper (*Perccottus glenii*) (Hungary). - Some native forest tree types are genetically more resistant than others to ash dieback, a disease caused by the alien ash dieback fungus (*Chalara raxinea*). Identifying and breeding such trees could contribute to keeping the spread of the disease under control (Norway). - Attempts have been made to control the spread of the flowering plant *Amorpha fruticosa* through the reintroduction of grazing cattle (Croatia). - Bulgaria mentioned that cover crops such as perennial rye-grass (*Lolium perenne*) and alfalfa (*Medicago sativa*) could contribute to the control of the spread of invasive ragweed (*Ambrosia artemisiifolia L.*) by competing for light, moisture and soil nutrients. Ragweed has, *inter alia*, led to reduced crop yields in the country's sunflower, maize and wheat production systems. - Native tree species are being introduced to control invasive species in forests via resource limitation. This practice, which is also referred to as ecological restoration, is for example applied in France, where various willow species are introduced into riparian zones to limit the spread of Japanese knotweed (*Fallopia japonica*) by competing for light. - Where pine martens are present it has been found that numbers of the invasive grey squirrel are low and that this favours the native red squirrel. It is suggested that the reason for this is that pine martens prefer to eat greys than reds (Ireland). - Natural ecosystems (e.g. mire, natural forests) and well-maintained semi-natural ecosystems (e.g. meadows and pastures) are more resistant to invasion by alien plant species (Poland). Current research is investigating whether: 1. non-native Japanese knotweed psyllid (*Aphalara itadori*) could be used to control the spread of Japanese knotweed (*Fallopia japonica*); 2. a rust fungus could be used to control Himalayan balsam (*Impatiens glandulifera*) (United Kingdom). - Mixed-farming systems (crops and forests) are expected to be more resilient to invasions by exotic weeds and pests.
Use of biodiversity for food and agriculture to prevent natural or human-made disasters and/or reduce their effects on livelihoods, food security and nutrition	
Ireland	While it is widely acknowledged that, for example, vegetative structure can alter the potentially catastrophic effects of storms, floods and drought through its storage capacity and surface resistance and that coral reefs buffer waves and protect adjacent coastlines from storm damage, evidence of the capacity of Irish ecosystems to ameliorate and reduce damage caused by natural disasters is not available/known.

Source: Country reports prepared for *The State of the World's Biodiversity for Food and Agriculture* (FAO, 2019).

2.1.4 Ecosystem, landscape and seascape approaches for the management and use of biodiversity for food and agriculture

Reporting countries seem to have interpreted the terms ecosystem, landscape and seascape approaches in quite a number of different ways. (e.g. some countries consider organic farming to be an ecosystem approach rather than a management practice, while others do not). This leads to some ambiguity in the interpretation of the information provided on this issue.

Ecosystem and landscape approaches are at the very base of many national and European policies relevant to the diversity of food and agriculture.

Most countries mentioned adopting the ecosystem approach applied to fisheries in order to integrate fisheries and environmental-protection, conservation and management measures. EU Member States are implementing this approach in fisheries management under the Common Fisheries Policy and the European Marine Strategy Framework Directive. Practical steps towards the implementation of the approach include the development of management plans for specific areas (e.g. for the Barents and the Adriatic Seas) and a stronger ecosystem focus in the research and advisory work of marine scientific institutes. Some countries have also adopted an ecosystem approach to aquaculture.

In many countries, sustainable forest management lies at the basis of national forest policies and legislation. Measures taken to implement this approach include support schemes to assist forest owners with the development of sustainable forest management plans. These plans tend to address a range of issues linked to the multiple roles of forests, including the diversity of planted-tree species, the distance of conifers from watercourse banks and the maintenance of trees of biological interest. As forest management is a long-term process whose results often only become apparent after decades, a large number of small-scale and family forest owners, in particular, have adhered to the Programme for the Endorsement of Forest Certification (PEFC) scheme. The PEFC provides forest owners and managers with independent recognition of their responsible management practices.

In the case of crop production, organic farming and integrated pest management were described in the country reports as important forms of ecosystem approach. While organic agriculture occupies a relatively small proportion of the total agricultural area in the region – in 2015, 6.2 percent of utilized agricultural area in the EU was under organic management (EC, 2016) – quite a few countries are aiming to increase the number of organic farmers and the area under organic cultivation over the next decade. Poland noted a rise in the number of cultivated plant varieties and a trend towards more appropriate use of plant protection measures as a result of changes in the EU directives on integrated pest management, pollination management, conservation agriculture and organic agriculture.

In addition to national biodiversity action plans, agri-environmental schemes were mentioned in the country reports as key elements in the implementation of ecosystem and landscape approaches. Agri-environmental schemes are supporting, *inter alia*, the management of habitat for meadow birds, cultivation of rare crop varieties, long-term conversion of arable land into extensive grassland, nature-friendly management of clover–grass, alfalfa and red clover and management of border strips. The Netherlands (citing Noordijk *et al.*, 2010) reported that nature management in agriculture has generally had little positive effect on the nature value of the targeted systems, except for some localized successes, for instance with birds in arable lands.

Types of landscape and seascape initiative reported by several countries in the region include:

- terrestrial protected areas (e.g. to conserve high nature value farmlands and old-growth and herb-rich forests);
- wetland, marine and freshwater protected areas (e.g. Ramsar Sites and protected areas within river basins);
- national parks and nature reserves; and
- UNESCO-designated biosphere reserves and heritage sites.

2.1.5 Activities promoting the maintenance and use of traditional knowledge of associated biodiversity and wild foods

The term "traditional knowledge" is interpreted in various different ways in the country reports. The reports from Scandinavian countries mainly use the term to refer to the knowledge held by Sámi.[25] Reports from other countries use the term to refer to farmers' knowledge that has contributed to maintaining and promoting so-called traditional products.

In Finland, Sweden and Norway, the preservation of traditional knowledge held by Sámi, including knowledge of relevance to associated biodiversity and wild foods, has to a large extent been institutionalized. These countries address the issue via national laws and in specific sections of their respective national biodiversity strategies. They have also established programmes to collect, document, maintain and initiate research on Sámi traditional knowledge. The focus tends to be on how Sámi have been managing natural resources (e.g. reindeer, fish, berries and plants) to sustain their livelihoods. In Norway, the programme targets both the inclusion of traditional knowledge in educational programmes and the use of such knowledge in decision-making processes on the conservation and sustainable use of biological diversity. In Finland, the traditional knowledge of local land users is being utilized in regional planning of the conservation and management of traditional biotopes across the country.

A number of countries indicated that they have taken measures to incentivize management activities that support the maintenance of traditional knowledge of associated biodiversity. Norway mentioned providing grants to maintain and enhance traditional farming methods, such as small-scale transhumance, in order to preserve the richness and diversity of grasses and legumes in certain fields, farmlands and landscapes. Poland has agri-environmental schemes supporting, *inter alia*, the maintenance of species-rich grassland through low intensity management (including grazing with traditional breeds) and the management of traditional orchards. Quite a number of countries reported that they have documented traditional ethnobotanical practices, recording information on the historical uses of plants and plant extracts in food and medicine.

Public institutions, civil society and local interest groups were described as playing particularly important roles in promoting the maintenance and use of traditional knowledge of wild food species, both through publications and through the organization of training activities.

Overall, the maintenance and use of traditional knowledge of biodiversity for food and agriculture is experiencing a positive trend across the reporting countries. Several countries mentioned that this is largely the effect of increased interest among the wider public in typical local and regional products prepared "in the old-fashioned way", many of which are based on traditional crop varieties and animal breeds.

2.1.6 Needs and priorities

Countries indicated that they had restored biodiversity-rich sites for the conservation and sustainable use of natural resources. However, some noted that insufficient provisions had been made for covering recurrent costs and that ongoing efforts to protect and maintain these sites were being constrained by financial shortfalls.

Organic farming is considered by many countries to be a sustainable farming system that has potential to reduce the loss of biodiversity for food and agriculture. Organic farmers receive substantial support in the form of subsidy payments under EU and national legislation (Hole *et al.*, 2005). Norway mentioned that quite a few conventional farmers are very keen to improve soil fertility and soil health or have made efforts to actively manage the delivery of ecosystem services in their fields.

[25] The Sámi are the indigenous people living in the very north of Europe, in Sápmi, which stretches across the northern parts of Norway, Sweden, Finland and the Kola Peninsula. They are a minority in today's Finland, Russian Federation, Sweden and Norway, but a majority in the innermost parts of Finnmark county in Norway and in the municipality of Utsjoki in Finland (see: http://www.unric.org/en/indigenous-people/27307-the-sami-of-northern-europe--one-people-four-countries).

Some countries noted that there is considerable debate regarding the effects of aquaculture on the environment. With this being one of the fastest growing food-producing sectors, countries expressed the need for a thorough evaluation of the environmental effects of various forms of aquaculture. Also with respect to aquaculture, countries mentioned a lack of data on micro-organism management. It seems that, in particular, more information is required on the use of probiotics, which can contribute to the improvement of water quality and inhibit pathogens and thereby protect biodiversity and increase productivity.

A few countries indicated that they had only recently adopted ecosystem approaches. These countries are finding it difficult to develop adequate policies and strategies to ensure the application of these approaches. Strengthening cooperation between these countries and those that have more experience with the implementation of ecosystem approaches could contribute in this regard.

2.2 CONSERVATION

2.2.1 *In situ* conservation

Belgium, Bulgaria, Croatia, Estonia, Finland, France, Germany, Hungary, Ireland, the Netherlands, Norway, Poland, Slovakia, Sweden, Switzerland, Turkey and the United Kingdom indicated having *in situ* conservation initiatives in place targeting either a single or multiple associated biodiversity and/or wild food species.

Species and groups of species that are being conserved in situ *and conservation objective(s)*

A range of wild plant species, vertebrates, invertebrates and micro-organisms associated with food and agriculture were reported to be conserved *in situ* as part of general efforts to conserve biodiversity in terrestrial, freshwater and marine ecosystems. Most of the examples given referred to conservation programmes seeking to maintain, protect and restore habitats and the species associated with them in and around production systems, for example dead-wood management to maintain biodiversity associated with forests and woodlands, reintroduction of extensive mowing and grazing to allow the recovery of meadows and grasslands rich in flowers, insects and birds, buffer-zone management along field borders to support beneficial insects and designation of protected areas on land and at sea.

Species conserved through general biodiversity conservation efforts include, among many others:

(i) wild edible and medicinal plants: wild parsnip (*Pastinaca sativa*), Killarney fern (*Trichomanes speciosum*), petalwort (*Petalophyllum ralfsii*), geranio del Paular (*Erodium paularense*), sweet flag (*Acorus calamus*), wild grapes (*Vitis vinifera*);

(ii) invertebrates: pollinating insects such as bees (*Apis mellifera* and *Bombus subterraneus*) and butterflies, native snail species (e.g. *Vertigo geyeri* and *V. angistior*), freshwater pearl mussels (*Margaritifera margaritifera* and *M. durrovensis*) and crayfish (*Austropotamobius pallipes* and *Pacifastacus leniusculus*);

(iii) vertebrates: various types of bat, a large number of fish species, including grayling (*Thymallus thymallus*), brown trout (*Salmo trutta*), Atlantic salmon (*S. salar*), common nase (*Chondrostoma nasus*), and amphibians and reptiles (Switzerland reported having a data centre that provides detailed descriptions of the country's amphibians and reptiles and their distribution, as well as practical tips for conservation activities; Spain mentioned having developed recovery plans for two lizard species that are at risk of extinction); and

(iv) micro-organisms: fungi, lichen and algae.

The Fauna-Flora-Habitat and the European Bird Protection Directives, as well as Natura 2000, the EU-wide network of protected areas, were described as particularly important to the conservation and development of habitats and to species in need of special protection. Fishing

regulations, restoration of river and spawning habitats and the improvement of migration routes were mentioned as key activities for the conservation of wild fish species.

In situ conservation initiatives targeting specific associated biodiversity and/or wild food species are also common in the region. Special conservation programmes exist, inter alia, to recover, protect and reintroduce wild fruit trees, such as the European crab apple (*Malus sylvestris*), and wild animal species, including huntable species and "ecosystem engineers" such as the European beaver (*Castor fiber*) and the European hamster (*Cricetus cricetus*). Quite a number of countries reported having *in situ* conservation programmes for crop wild relatives to sustain genetic diversity within cultivated crops and their wild growing relatives.

Existing subregional/regional in situ *conservation initiative(s)*
No examples were given of subregional/regional collaboration in the *in situ* conservation of associated biodiversity and/or wild food species.

2.2.2 *Ex situ* conservation

Belgium, Croatia, Estonia, Finland, Germany, Hungary, the Netherlands, Norway, Poland, Spain, Sweden, Switzerland and the United Kingdom reported having *ex situ* conservation initiatives in place for several components of associated biodiversity and wild food species.

Species and groups of species that are being conserved ex situ *and conservation objective(s)*
Most reporting countries indicated having microbial culture collections containing taxonomically diverse groups of micro-organisms (archaea, bacteria, cyanobacteria, yeasts, filamentous fungi and viruses). These collections include organisms that can be utilized, *inter alia*, as biological control agents of pests and diseases in agriculture and horticulture, in microbial applications within the pharmaceutical (e.g. in diagnostic methods, efficacy testing of drugs, biocides, vaccine and disinfectants production or as a reference strains) or the agri-food (e.g. micro-organisms in dairy products, brewery yeasts and rhizobia) industries, or for other purposes such as composting, bioremediation of soil and detoxification of wastes. Some countries indicated keeping reference collections of organisms harmful to livestock and food crops (e.g. phytoplasmas, rusts, powdery mildews, oomycetes, basidiomycetes and other fungi) for research and teaching purposes.

In the absence of a centralized data system and information on microbial strains stored for commercial purposes (e.g. by dairy companies and breweries), no countries seem to have a complete overview of the microbial strains stored in culture collections.

Live specimens and seeds of many crop wild relatives, other wild plant species (herb, medicinal and aromatic) and wild fruit shrub and tree species are held in botanical gardens and in seed and field gene banks for long-term conservation, research, breeding and educational purposes. Countries mentioned conserving, among other species, wild onion and leek species (*Allium* spp.), wild celery (*Angelica archangelica*), blackberry (*Rubus fructicosus*), red currants (*Ribes spicatum* and *R. rubrum*) and plums (*Prunus* spp.) in seed and field gene banks. Some countries store wild plant accessions, including native endangered varieties, in their national gene banks for plant genetic resources. In Germany, for example, the national gene bank has approximately 18 000 accessions from around 3 000 wild species in long-term conservation. Wild fruit shrub and tree species are to some degree also stored in *ex situ* forestry collections.

The United Kingdom is establishing a national tree-seed collection for long-term conservation and to facilitate research into native tree species and their management in the landscape. Collections may also be used to study resistance and susceptibility to pests and diseases and other environmental stresses.

With regard to invertebrates, honey-bee and bumble-bee species (*Apis mellifera*, *Bombus terrestris*, *B. ignites* and *B. canariensis*) are bred and sold for pollination of field and horticultural crops; butterfly species (*Parnassius apollo* and *P. mnemosyne*) are grown in captivity for

conservation and reintroduction into semi-natural grasslands to restore native populations, and live nematodes are raised and supplied to hobbyist gardeners.

Germany mentioned having a scientific invertebrate collection with 3 million indigenous and exotic insect preparations to support biodiversity monitoring and nature-conservation planning.

In the case of aquatic resources, European crayfish (*Astacus astacus*), common carp (*Cyprinus carpio*), grayling (*Thymallus thymallus*), Arctic charr (*Salvelinus alpinus*), Atlantic salmon (*Salmo salar*) and sea trout (*S. trutta*) are among the most common species for which wild and domesticated strains are maintained in milt and live gene banks. These gene banks serve to facilitate the conservation of biodiversity in freshwater and marine ecosystems by reintroducing populations of endangered or vulnerable species into their natural habitats. Providing support to wild-food production systems is not usually their primary objective.

In several countries, captive-raised grey partridge (*Perdix perdix*) and common pheasant (*Phasanius colchicus*) are released into agricultural landscapes to restore native or introduced populations and sustain hunting.

For countries involved in the Global Biodiversity Information Facility (GBIF) initiative, more detailed information on ex situ collections and relevant research is available at http://www.gbif.org/species.

Existing subregional/regional ex situ *conservation initiative(s)*

Denmark, Norway, Sweden, Finland and Iceland have been cooperating to secure genetic diversity for agriculture and forestry in the Nordic countries for more than 30 years through the Nordic Genetic Resource Center (NordGen). Among other activities, the Center keeps broad collections of plant genetic resources for food and agriculture accessible to all Nordic countries free of charge. With respect to wild plant varieties in particular, NordGen keeps accessions of forage-plant species that have been collected from cultivated fields and from wild habitats. The Center also conserves seed samples of other wild flora species, including crop wild relatives and medicinal and aromatic plants.

2.2.3 Needs and priorities

Reoprting countries tend to agree that the conservation of biodiversity for food and agriculture requires an integrated approach that balances *in situ* and *ex situ* conservation strategies. While they gave quite a few examples of sectoral genetic resources being conserved through a combination of the two strategies, there were hardly any reported examples of this approach being used for associated biodiversity and/or wild food species. Some countries noted that this could be further investigated. The maintenance of species *in situ* allows natural selection to act, something that cannot be recreated *ex situ*. At the same time, even if the maintenance of viable and self-sustainable populations of associated and wild species in their natural state represents the ultimate goal, habitat destruction is inevitable and endangered species often need to be preserved *ex situ* before they become extinct in the wild. *Ex situ* conservation also provides the opportunity to study the biology of, and understand the threats to, endangered species and thereby facilitate species-recovery programmes, including restoration and reintroduction schemes. It also has the advantage of preserving plant material and making it available for research purposes without damaging natural populations. *Ex situ* conservation can thus act as an "insurance policy" when species are threatened in their natural habitats.

All reporting countries in the region seem to agree that breeding programmes, particularly in relation to sectoral genetic resources, are of great importance to the conservation and sustainable use of biodiversity for food and agriculture. However, some countries mentioned not being able to run their breeding programmes because of a lack of funding.

2.3 ACCESS AND EXCHANGE

Table 8 shows the main measures in the region (i) regulating access to and (ii) ensuring the fair and equitable sharing of benefits arising from the utilization of biodiversity for food and agriculture.

Table 8. Reported measures regulating access and benefit-sharing for biodiversity for food and agriculture in Europe and Central Asia[1]

Components of biodiversity for food and agriculture	Description of measures	Countries
Genetic resources that are covered by the Convention on Biological Diversity (CBD) and related traditional knowledge[2]	*The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS) to the Convention on Biological Diversity (Nagoya Protocol)* The Nagoya Protocol, which entered into force on 12 October 2014, provides a legal framework for the effective implementation of the fair and equitable sharing of benefits arising out of the utilization of genetic resources. EU Member States[3] are obliged to conform to EU Regulation 511/2014 on compliance measures for users from the Nagoya Protocol. This regulation entered into force on 9 June 2014 and all of its provisions apply since 12 October 2015.	Contracting parties Albania, Austria, Belgium, Belarus, Bulgaria, Croatia, Czechia, Denmark, Estonia, Finland, France, Germany, Hungary, Kazakhstan, Kyrgyzstan, Luxembourg, Netherlands, Norway, Portugal, Republic of Moldova, Serbia, Slovakia, Spain, Sweden, Switzerland, Tajikistan, United Kingdom and the EU Only signatories Cyprus, Ireland, Italy, Latvia, Lithuania, Poland, Romania, Slovenia, Ukraine Norway: Access to and use of genetic resources for food and agriculture are governed by the Nature Diversity Act, the Wildlife Act and the Marine Resources Act. Genetic resources under these acts can be used for any purpose. Access to and use of these resources are not subject to prior informed consent (PIC) or benefit-sharing requirements, even if these could be applied by royal decree or by law. Special rules exist for protected species. Switzerland: Legal amendments in the Federal Act on Protection of Nature and Cultural Heritage (NCHA) to implement the Nagoya Protocol entered into force on 12 October 2014. Efforts to further develop and/or amend regulations are ongoing. No decisions have been made on PIC and benefit-sharing yet. Access to and use of protected species/species in protected areas are subject to authorization from the Cantonal authorities. Some EU Member States, including Finland, Germany, the Netherlands, Poland, Spain and the United Kingdom, reported having revised/being in the process of revising national laws to facilitate the implementation of EU Regulation 511/2015; others acknowledged their obligation to comply with the Regulation. Belgium, France, Germany, the Netherlands, Slovakia and the United Kingdom indicated that access to genetic resources is not subject to PIC. Germany and the Netherlands mentioned that other legislation, for example on species or habitat protection, may apply and access may not be free of obligations. Belgium emphasized that this is true for material other than the crop and forage varieties listed in Annex I of the International Treaty on Plant Genetic Resources for Food and Agriculture. Bulgaria reported that it was reviewing its legislation to ensure the effective implementation of the Nagoya Protocol. The country was expected to ratify the Protocol in 2016. Estonia reported that access to genetic resources for food and agriculture was not regulated. It noted that removal of protected species from nature was regulated under its nature protection law. It indicated that it was planning to ratify the Nagoya Protocol in 2016 and that it expected to hold discussions on regulating access to genetic resources for food and agriculture in the near future. France reported that its draft law for the recovery of biodiversity, nature and landscapes was about to be finalized. This law was expected to include, inter alia, specific provisions for the regulation of access and benefit-sharing of a number of genetic resources for food and agriculture, as well as of their associated traditional knowledge. It was also expected to foresee the implementation of EU Regulation 511/2014, for which guidelines are being prepared, and the ratification of the Protocol. Ireland reported that it was examining the Commission's Legislative Proposal on the ratification of the Protocol. The Netherlands reported that under new legislation no specific access rules would apply to genetic resources occurring in *in situ* conditions. Poland reported that there was still no decision on whether or not to regulate access to genetic resources. It noted that the acquisition of certain protected plant, animal and fungi species was regulated by law. Spain amended its Natural Heritage and Biodiversity Law (Law 33/2015) in September 2015 to implement the Nagoya Protocol. Article 71 of this law

Table 8 *Cont'd*

Components of biodiversity for food and agriculture	Description of measures	Countries
		regulates access to and use of genetic resources from wild taxa, which are not subject to PIC or benefit-sharing requirements, even if these could be applied by royal decree. Article 71 does not apply to plant genetic resources for food and agriculture (PGRFA), fish resources or animal genetic resources for food and agriculture (AnGR), the access to and use of which is governed by other laws. In the United Kingdom, both EU Regulation 511/2014 and the country's Nagoya Protocol (Compliance) Regulations 2015 entered into force in October 2015.
PGRFA	*International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRA)* Contracting Parties to the ITPGRFA make plant genetic resources for food and agriculture available within the framework of the Treaty's Multilateral System.[4] Parties wishing to provide and receive material under the Multilateral System use the Standard Material Transfer Agreement.[5]	Contracting parties Albania, Armenia, Austria, Belgium, Bulgaria, Croatia, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Kyrgyzstan, Latvia, Lithuania, Luxembourg, Malta, Montenegro, Netherlands, Norway, Poland, Portugal, Republic of Moldova, Romania, Serbia, Slovakia, Slovenia, Spain,[6] Sweden, Switzerland,[7] Turkey, United Kingdom[8] and the EU Only signatories North Macedonia
Genetic resources and traditional knowledge belonging to indigenous peoples and local communities		Finland intends to draft specific national regulations for the access to and benefit-sharing of genetic resources and traditional knowledge held by the Sámi.[9] In Norway, the Nature Diversity Act provides the legal framework for the protection of Sámi culture, with Chapter VII focusing on access to genetic material. Since June 2013, the Act includes a paragraph on the right of indigenous peoples and local communities (IPLCs) to protect their interests when knowledge related to genetic material they developed, transmitted and preserved is being accessed and utilized. The Sámi University College coordinates the "inherited knowledge" project (Árbediehtu) documenting Sámi traditional knowledge that has been used to manage natural resources for livelihood purposes. The project is aligned with the conventions and declarations that have been ratified by Norway and are of relevance to IPLCs. Sweden runs a national programme (Naptek) to safeguard knowledge, innovations and practices of IPLCs in accordance with Article 8(j) of the CBD. Switzerland's Federal Act on Protection of Nature and Cultural Heritage contributes to ensuring that PIC or the approval and involvement of IPLCs is obtained and that Mutually Agreed Terms for benefit-sharing will be established, where applicable. France reported that its draft law for the recovery of biodiversity, nature and landscapes foresaw the regulation of access to traditional knowledge associated with genetic resources that is held by local communities and the equitable sharing of benefits arising from the utilization of such knowledge. A number of countries indicated having no measures in place regulating access to and use of genetic resources held by local communities.

[1] Measures facilitating access to the various components of biodiversity for food and agriculture usually vary according to the intended use of the resource (e.g. any use, research and development, commercial use). Examples of possible measures consist of the need to obtain prior informed consent (PIC), sharing benefits based on mutually agreed terms (MAT) and having special considerations in place for access to resources held by indigenous peoples and local communities.
[2] A number of countries reported not having any legally recognized indigenous communities.
[3] See http://europa.eu/about-eu/countries/member-countries for the list of EU Member States.
[4] The Multilateral System of the ITPGRFA has put 64 crops (listed in Annex 1 to the Treaty) into an easily accessible global pool of genetic resources that is freely available to potential users in the Treaty's ratifying nations for research, breeding and training for food and agriculture. Those who access genetic materials through the Multilateral System agree to share any benefits from their use through the four benefit-sharing mechanisms established by the Treaty.
[5] The Standard Material Transfer Agreement is a private contract with standard terms and conditions that ensures that the relevant provisions of the ITPGRFA are followed by individual providers and recipients of plant genetic material.
[6] When not appropriate and for non-Annex 1 crops, Law 30/2006 (IV on Plant Genetic Resources) applies.
[7] Genetic resources covered by the National Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture (NPA-PGRFA) can be used for research, development and commercial purposes. Access to this material requires PIC and benefit-sharing.
[8] In the United Kingdom, Annex 1 and non-Annex 1 material within government-supported collections is shared using Standard Material Transfer Agreements.
[9] The Sámi have been involved in various decision-making processes at the international level concerning the utilization of genetic resources and related traditional knowledge (e.g. in the context of the Convention on Biological Diversity, the Universal Declaration on Human Rights and the Convention for the Safeguarding of Intangible Cultural Heritage).
Source: Country reports prepared for *The State of the World's Biodiversity for Food and Agriculture* (FAO, 2019).

Most of the countries in the region that are contracting parties to the Nagoya Protocol have revised or are in the process of revising their national laws and regulations on access to and use of genetic resources to facilitate the implementation of the Protocol. Challenges in this respect include identification of the legislative changes needed to implement the Protocol, designation of competent authorities and development of rules and regulations for access to genetic resources. With respect to the latter, Parties are free to decide whether they want to establish access legislation or not. If they don't, access to their genetic resources is considered to be free. Some countries have already made a decision on this, while others consider doing so to be a priority.

The need to increase the availability of local crop varieties to large-scale producers to enhance the conservation and sustainable use of crop diversity was also noted. At present, local crop varieties are typically grown by small-scale farmers and in domestic gardens.

III. Policies, institutions and capacity

3.1 POLICIES, PROGRAMMES, INSTITUTIONS AND STAKEHOLDERS

3.1.1 Policies and programmes

Reporting countries have a series of national policies and programmes in place that are of relevance to the conservation and sustainable use of biodiversity for food and agriculture and these are often linked to regional policies and programmes.

For the conservation and sustainable use of animal, aquatic, forest and plant genetic resources, most countries mentioned having developed national policies, legal frameworks and action plans. Relevant laws and regulations are often laid down in specific legal acts addressing, for example, forests, marine fisheries or freshwater fisheries.

In EU Member States, these policies and legal frameworks are aligned with relevant EU policies and directives, for example with the EU's Common Fisheries Policy, which aims to ensure fishing and aquaculture are environmentally, economically and socially sustainable, the European Marine Strategy Framework Directive, which is based on the ecosystem approach and aims to protect aquatic species and marine habitats to prevent a decline in marine biodiversity, and the European Water Framework Directive, which seeks to improve the ecological condition of water bodies.

While the EU does not have a common forestry policy, a large number of its policies and initiatives affect forests both in the EU and in non-EU countries, including the EU reference framework for forestry, the Common Agricultural Policy, Natura 2000 and the EU Climate Policy (EU, 2016).

In terms of the conservation and sustainable use of biodiversity for food and agriculture, most EU Member States also mentioned the importance of direct support schemes under the Common Agricultural Policy, including payments for agricultural practices that are climate-friendly and beneficial to the environment[26] and payments in support of sustainable forest management practices (some 90 percent of EU funding for forests comes from the European Agricultural Fund for Rural Development).

With respect to the conservation and (to a far lesser extent) use of associated biodiversity and wild food species, most countries referred to the following national policies and programmes:

- national biodiversity strategy and action plans;
- national programmes on nature conservation/nature diversity acts;
- agri-environmental schemes and rural development programmes;
- policies related to the implementation of ecosystem approaches;
- national strategies on invasive alien species (non-existent but needed or under development in some countries); and
- pesticide and fertilizer reducing policies (in Germany, for example, the introduction of such policies contributed to reducing the country's annual nitrogen surplus from 124 kg/ha to 84 kg/ha between 1991 and 2014).

Regarding regional and international commitments related to the conservation and use of associated biodiversity and wild food species, reference was made to:

- the EU 2020 Biodiversity Strategy;
- EU Regulation 1143/2014 on invasive alien species;
- Directive 2009/147/EC on the conservation of wild birds;
- Council Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna;

[26] To be eligible for this form of payment, farmers need to comply with a set of standards that contribute to preventing soil erosion, maintaining soil organic matter and soil structure, ensuring a minimum level of maintenance, avoiding the deterioration of habitats and protecting and managing water on their land.

- Natura 2000;
- The Strategic Plan for Biodiversity 2011–2020, including the Aichi Biodiversity Targets; and
- The United Nations Convention on the Law of the Sea (UNCLOS).

Germany mentioned that it was developing a National Programme for the Conservation and Sustainable Use of Genetic Resources of Micro-organisms and Invertebrates. Within this framework, priority actions were being identified with respect to pollinators, human consumption, animal nutrition, animal health, renewable resources, functional soil biodiversity, plant health and plant breeding.

With respect to policies and programmes related to invasive alien species, a list of invasive alien species of EU-wide importance was drawn up under the EU's Regulation 1143/2014 on invasive alien species. This list serves as a basis for the development of relevant measures, including prevention, early detection, rapid response and control (see http://ec.europa.eu/environment/nature/invasivealien/list/index_en.htm). Also at regional level, the European and Mediterranean Plant Protection Organisation develops strategies to combat the introduction and spread of alien species. Internationally, the International Plant Protection Convention provides a framework and forum for international cooperation, harmonization and technical exchange between contracting parties to protect plants and plant products from the spread of pests. The Convention, inter alia, allows contracting parties to gain assurance through phytosanitary certification that imports will not introduce new pests into their territories.

Generally speaking, there are still significant information and knowledge gaps with respect to invasive alien species that need to be addressed before relevant national and regional programmes can be implemented. Studies on the impact of invasive species on various production systems and ecosystem services are in their teething stages and still focusing on methodology development.

In some areas of relevance to biodiversity for food and agriculture, diverging philosophies can lead to the development of policies that may not necessarily be mutually compatible. With respect to alien species, for example, some policy-makers tend to favour a very restrictive approach, while others are more open to considering the potential benefits that such species might provide. For example, the use of the exotic Sitka spruce (*Picea sitchensis*) is being intensely discussed in some parts of Europe. While this species is recognized to be a valuable resource by some (e.g. for its wood properties and its CO_2 retention capacity), others consider its spread to be a major threat to endangered habitats.

Some countries indicated that their policies and programmes for the conservation of wild species tend to be difficult to reconcile with those promoting extensive livestock grazing. Some sheep farmers were reported to be experiencing severe animal losses due to wildlife predation. While state-supported compensation schemes are in place to reimburse farmers for their losses, these were not always considered to be adequate.

As noted above, many of the national policies and programmes of EU Member States are aligned with relevant EU regulations, directives and payment schemes. Countries in the region not covered by these measures may have very different needs and priorities in terms of policy and programme development for the conservation and use of biodiversity for food and agriculture.

3.1.2 Interministerial cooperation

In 1999, Croatia developed a National Strategy and Action Plan for the Protection of Biological and Landscape Diversity to protect nature both through the conservation of species, habitats and protected areas and through the sustainable use of natural resources. The Strategy was developed through a participatory approach, involving representatives from different ministries, scientific institutions, NGOs and public enterprises. It was revised in 2008 and in 2014 by stakeholder groups representing all relevant sectors.

Most contracting parties to the Convention on Biological Diversity (CBD) have developed national strategies and enabling frameworks through collaborative processes involving all relevant

Box 4. Examples of the contribution of stakeholder groups to the sustainable management of biodiversity for food and agriculture in Europe and Central Asia

Several countries mentioned that small-scale farmers have been of major importance to the survival of native livestock breeds. In periods of agricultural intensification, they joined forces to maintain viable populations of several historical breeds through conservation and use. As a result of their efforts, quite a number of countries in the region have breeding societies or associations in place for endangered native breeds.

Organic farmers across the region actively contribute to the maintenance of healthy agricultural ecosystems and strengthen the conservation and use of crop diversity. They are often organized in organic farming associations to foster the improvement and widespread adoption of organic farming practices. In Switzerland, 32 organic farming associations, as well as the Research Institute of Organic Agriculture, are members of Bio Suisse, a private-sector umbrella organization that has developed common and uniform standards for organic agriculture and processing, as well as a common label. Organic produce carrying the label has a market share in Switzerland of about 60 percent.

Forest owners in Norway are voluntarily contributing to the conservation and protection of forest ecosystems. In Norway, 4.3 percent of productive forest area is classified as protected forest. Part of this protected forest zone falls under the voluntary protection scheme (frivillig vern). This means that forest owners voluntarily propose forest areas where they will not undertake logging activities, thereby helping to ensure the conservation of key biotopes.

In 2011, the Finnish Wildlife Consortium was founded under the auspices of the Ministry of Agriculture and Forestry. This taskforce comprises the Ministry and the following relevant publicly funded organizations: the Finnish Wildlife Agency; regional game councils; the Finnish Game and Fisheries Research Institute; the Finnish Forest Research Institute; Metsähallitus; and the the Finnish Food Safety Authority. Its tasks are to secure viable game populations, assure diversified and sustainable use of game and coordinate game management taking into account the expectations of various different groups of stakeholders. It adopts a strategy and working documents to guide implementation. Game administration aims to strike a balance between viable game-animal populations, ethical and responsible hunting, and keeping wildlife conflicts and damage caused by game animals under control.

Source: Country reports prepared for *The State of the World's Biodiversity for Food and Agriculture* (FAO, 2019).

ministries and civic groups to implement the Convention's Strategic Plan and achieve the Aichi Biodiversity Targets. The parties report to the CBD on progress made.

3.2 CAPACITY AND RESEARCH NEEDS

Higher education institutions in countries across the region offer courses on issues related to the conservation and sustainable use of associated biodiversity (agroecology, soil fertility and soil management, forest ecology, marine ecology and biodiversity, etc.). However, several countries noted that education and research programmes on topics relevant to the conservation of biodiversity tend to be run by different departments and institutions from those related to the use of biodiversity. As a result of this "decoupling", trained experts tend to lack skills in interdisciplinary work.

Overall, knowledge on associated biodiversity (particularly in soils) and ecosystem functioning is still limited. While reporting countries are aware of the importance of strengthening monitoring and research in these areas, none considered this to be an easy task. As mentioned in Norway's report, there is a need to determine selection criteria and species upon which to focus monitoring and research activities. In this respect, countries may wish to develop strategies prioritizing species for monitoring and management in multispecies conservation plans. This kind of research

will require a continuous and sufficient flow of financial resources, as well as the involvement of adequate human resources. With respect to the latter, the region is short of species specialists and taxonomists to conduct survey and identification work. Other research needs include assessment of the effects of so-called sustainable management practices on biodiversity for food and agriculture and the management of micro-organisms in aquaculture. Some countries expressed the need for a common strategy among research institutions of different sectors to support research and monitoring of biodiversity for food and agriculture.

IV. Regional and international cooperation

4.1 MAJOR REGIONAL INITIATIVES TO CONSERVE AND USE BIODIVERSITY FOR FOOD AND AGRICULTURE

Regional policies and programmes embedding the conservation and/or use of biodiversity for food and agriculture, and in particular of associated biodiversity, wild food species and ecosystem services are described in Table 9.

Table 9. Reported regional and international initiatives addressing the conservation and/or use of biodiversity for food and agriculture in Europe and Central Asia

Policy or programme	Description	Countries involved
Plant, animal, forest and aquatic genetic resources for food and agriculture		
European Regional Focal Point for Animal Genetic Resources (ERFP)	ERFP is part of a global network on animal genetic resources (AnGR) officially recognized by FAO. It was founded to support and strengthen the conservation and sustainable use of AnGR. Among other activities, ERFP facilitates the implementation of the Global Plan of Action for AnGR in Europe.	All 28 EU Member States,[1] Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Georgia, Iceland, Israel, Montenegro, North Macedonia, Norway, Republic of Moldova, Russian Federation, Serbia, Switzerland, Turkey, Ukraine
EUFORGEN	EUFORGEN facilitates collaboration on forest genetic resources under the framework of the pan-European forest policy process, FOREST EUROPE. The overall goal of EUFORGEN is to promote the conservation and appropriate use of forest genetic resources as an integral part of sustainable forest management in Europe.	All 28 EU Member States, Albania, Andorra, Belarus, Bosnia and Herzegovina, Georgia, Holy See, Iceland, Liechtenstein, Monaco, Montenegro, North Macedonia, Norway, Republic of Moldova, Russian Federation, Serbia, Switzerland, Turkey, Ukraine and the EU
European Cooperative Programme for Plant Genetic Resources (ECPGR)	A collaborative programme that aims to ensure the long-term conservation and facilitate the utilization of PGRFA in Europe. The programme operates through working groups dealing with groups of crops or with general PGRFA-related themes.	Albania, Austria, Azerbaijan, Belarus, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Montenegro, Netherlands, Norway, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom
European Union policies, regulations and programmes		
EU Common Agricultural Policy (CAP)	An EU-wide policy providing support to farmers and addressing food security, rural development and the environment. In 2013, the CAP underwent major reforms to better respond to the new economic, social, environmental, climate-related and technological challenges facing society. The reformed CAP can contribute more to developing intelligent, sustainable and inclusive growth and also takes greater account of the wealth and diversity of agriculture in the EU Member States.	All 28 EU Member States
EU Biodiversity Strategy COM/2011/0244 final	A strategy setting out 6 targets and 20 actions to halt the loss of biodiversity and ecosystem services in the EU and help stop global biodiversity loss by 2020. It reflects the commitments made by the EU in 2010 within the framework of the Convention on Biological Diversity. The mid-term review of the strategy shows progress in many areas, but highlights the need for much greater effort.	All 28 EU Member States

Table 9 *Cont'd*

Policy or programme	Description	Countries involved
European Environment Agency (EEA)	An agency of the EU that assists the European Community and Member States make informed decisions about improving the environment, integrating environmental considerations into economic policies and moving towards sustainability.	All 28 EU Member States, Iceland, Liechtenstein, Norway, Switzerland and Turkey.
LIFE Programme	The EU's financial instrument supporting environmental, nature conservation and climate action projects throughout the EU. Since 1992, LIFE has co-financed some 4 306 projects. For the 2014–2020 funding period, LIFE will contribute approximately EUR 3.4 billion to the protection of the environment and climate.	Countries referring to this programme in their country reports include Estonia and Slovenia.
NATURA 2000 ecological network – Directive 92/43/EEC Directive 2009/147/EC	A coordinated network of protected areas stretching over 18 percent of the EU's land area and almost 6 percent of its marine territory. The aim of the network is to ensure the long-term survival of Europe's most valuable and threatened species and habitats, as listed under the Birds Directive and the Habitats Directive.	All 28 EU Member States
Sustainable use of pesticides Directive 2009/128/EC	A framework targeting the sustainable use of pesticides. Under this Directive, EU Member States are obliged to adopt national action plans encouraging the development and introduction of integrated pest management and of alternative approaches or techniques to reduce risks and impacts of, as well as the dependency on, pesticide use.	All 28 EU Member States
Plant quarantine Directive 2000/29/EC and its follow-up Regulation (EU) 2016/2031 on protective measures against pests of plants, which will apply from 14 December 2019.	Directive aimed at protecting crops, fruits, vegetables, flowers, ornamentals and forests from harmful pests and diseases by preventing their introduction into or their spread within the EU. It contributes to sustainable agricultural and horticultural production through plant health protection and to the protection of public and private green spaces, forests and the natural landscape	All 28 EU Member States
EU Water Framework Directive 2000/60/EC	Framework addressing integrated river-basin management for Europe. The Directive aims to protect and enhance the ecological and chemical status of all ground and surface waters. Issues addressed include the integration of water-related policies.	All 28 EU Member States
Examples of relevant EU-funded projects		
ALTER-Net	Network that integrates research capacities across Europe to assess changes in biodiversity, analyse the effect of these changes on ecosystem services and inform policy-makers and the public.	Institutes from Austria, Belgium, Czechia, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Netherlands, Norway, Poland, Romania, Slovakia, Spain, Sweden, United Kingdom
Securing the Conservation of biodiversity across Administrative Levels and spatial, temporal, and Ecological Scales (SCALES)	The SCALES project seeks ways to build scale into policy and decision-making and biodiversity management. SCALES aims to provide the most appropriate assessment tools and policy instruments to strengthen biodiversity conservation across spatial and temporal scales.	31 research institutes from Australia,[2] Bulgaria, Cyprus, Czechia, Estonia, Finland, France, Germany, Greece, Hungary, Lithuania, Norway, Poland, Portugal, Slovenia, Spain, Sweden, Switzerland, Taiwan Province of China,[2] United Kingdom
Status and Trends of European Pollinators Project (STEP)	The overall aims of this project are to assess the current status and trends of pollinators in Europe, quantify the relative importance of various drivers and impacts of change, identify relevant mitigation strategies and policy instruments, and disseminate findings to a wide range of stakeholders.	21 research institutes from Belgium, Bulgaria, Denmark, Estonia, Finland, France, Germany, Greece, Italy, Netherlands, Poland, Serbia, Spain, Sweden, Switzerland, United Kingdom

Table 9 *Cont'd*

Policy or programme	Description	Countries involved
Integrating Spatial Processes into Ecosystem Models for Sustainable Utilisation of Fish Resources Project (INSPIRE)	The project sets out to fill the most persistent gaps in knowledge of the spatial ecology of the major commercial fish species and thereby support the effectiveness of relevant policies and the ecosystem-based management of the Baltic Sea.	Estonia, Denmark, Finland, Germany, Latvia, Poland, Sweden
Preparatory action on EU plant and animal genetic resources in agriculture	This project aims to support the EU in recognizing the potentials for added value in terms of the conservation and sustainable use of agricultural genetic resources (including animal, forest, plant, microbial and invertebrate genetic resources).	All 28 EU Member States
Baltic Sea Marine Biodiversity Project (BAMBI)	This project will contribute new and urgent scientific findings and suggest ecosystem-based management approaches to protect the evolvability of Baltic Sea populations and mitigate biodiversity loss due to direct or indirect effects of climate change.	Estonia, Finland, Germany, Sweden
Conventions and agreements		
Aarhus Convention	The Aarhus Convention establishes a number of rights of the public (individuals and their associations) with regard to the environment. The Parties to the Convention are required to make the provisions necessary so that public authorities (at national, regional or local level) will contribute to these rights becoming effective.	47 contracting parties from Europe and Central Asia (46 countries and the EU)
Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA)	Intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago.	76 contracting parties (40 from Eurasia, including the EU, and 35 from Africa)
Bern Convention on the Conservation of European Wildlife and Natural Habitats	Binding international legal instrument in the field of nature conservation, covering most of the natural heritage of the European continent and extending to some states of Africa. It aims to conserve wild flora and fauna and their natural habitats, as well as to promote European cooperation in this field.	47 Member States of the Council of Europe,[3] Belarus, the EU, Burkina Faso,[2] Morocco,[2] Senegal,[2] Tunisia[2]
Carpathian Convention	Subregional treaty to foster the sustainable development and the protection of the Carpathian region.	Czechia, Hungary, Poland, Romania, Serbia, Slovakia, Ukraine
Convention on Long-Range Transboundary Air Pollution (LRTAP)	Under the Convention's International Cooperative Programme on Effects of Air Pollution on Natural Vegetation (ICP Vegetation), European surveys of heavy metal accumulation in mosses are conducted every five years (mosses are a good bioindicator for heavy metal pollution). Since 2005. The study has included 28 European countries and 6 000 samples of mosses.	Countries that participate in the European moss surveys: Austria, Belarus, Belgium, Bulgaria, Croatia, Czechia, Denmark – Faroe Islands, Estonia, Finland, France, Germany, Iceland, Italy, Latvia, Lithuania, North Macedonia, Norway, Poland, Russian Federation, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom
Agreement on the Conservation of Population of European Bats (EUROBATS)	Agreement set up under the Convention on the Conservation of Migratory Species of Wild Animals. It aims to protect all 53 European bat species through legislation, education, conservation measures and international cooperation with Agreement members and with those who have not yet joined. The Agreement provides a framework of cooperation for the conservation of bats throughout Europe, Northern Africa and the Middle East.	63 Range States, 36 of which are Parties to the Agreement in 2015[4]

Table 9 *Cont'd*

Policy or programme	Description	Countries involved
European Landscape Convention	Promotes landscape protection, management and planning, and aims to organize European cooperation on landscape issues. The Convention has 38 parties.	Andorra, Armenia, Azerbaijan, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Finland, France, Georgia, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Montenegro, Netherlands, North Macedonia, Norway, Poland, Portugal, Republic of Moldova, Romania, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom
Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area	The Helsinki Convention aims to prevent and eliminate pollution of the marine environment of the Baltic Sea area, including inland waters as well as the water of the sea itself and the sea-bed. Measures are also taken in the whole catchment area of the Baltic Sea to reduce land-based pollution.	Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russian Federation, Sweden, EU
Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention)	OSPAR is a mechanism by which 15 European countries and the EU cooperate to protect the marine environment of the North-East Atlantic. An annex on biodiversity and ecosystems was adopted in 1998 to cover non-polluting human activities that can adversely affect the sea.	Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, EU
Other programmes and networks		
Araucaria programme	Programme initiated by the Spanish Agency for International Development Cooperation for the conservation of biodiversity and sustainable development in Latin America.	Latin American countries (Reported by Spain)
Azahar programme	Programme aiming to enhance human development in the countries of the Mediterranean Basin that is compatible with the international commitments these countries have in terms of the conservation of natural resources and environmental protection. Azahar focuses on the following three major subregions of the Mediterranean: North Africa, Middle East and Southeast Europe.	Albania, Algeria,[2] Bosnia and Herzegovina, Egypt,[2] Jordan,[2] Lebanon,[2] Morocco,[2] Mauritania,[2] Montenegro, Serbia, Syrian Arab Republic,[2] Palestine,[2] Tunisia[2]
East and South European Network on Invasive Alien Species (ESENIAS)	ESENIAS is a network that aims to create a single information portal to facilitate access to and exchange of information, identification of new invasive species, assessment and risk management, monitoring and control of the established species and to enhance cooperation between institutions and experts from Southeast Europe working in this field. In cooperation with the International Association for Danube Research (IAD), ESENIAS implemented the project Potential Threats to Sustainable Development in the Danube and Black Sea Region: the Danube – a Corridor of Invasive Alien Species (2012–2017).	Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Hungary (invited), Italy, Kosovo (under UNSC Resolution 1244/99), Romania, Montenegro, North Macedonia, Serbia, Slovenia (invited), Turkey
Regional cooperation on the European black bee	Organizations and beekeepers from many European countries informally work together in the field of genetic research and the restoration of black bee populations. Interest in protecting this bee species, which is found in Central Europe, the United Kingdom, North Africa, Madagascar and the Americas, is growing.	Central European countries (Reported by Poland)
Green Belt of Fennoscandia Network	Protected-area network covering a territory located across Finland, Norway and the Russian Federation. The network aims to ensure ecological connections crucial for habitats and for the migration and protection of species.	Finland, Norway, Russian Federation

Table 9 *Cont'd*

Policy or programme	Description	Countries involved
Nordic Council of Ministers	Official cooperation forum ensuring effective collaboration between the Nordic authorities in several fields, including in microbiology, animal health and welfare, and fisheries.	Denmark, Finland, Iceland, Norway, Sweden, Åland Island, Faroe Islands, Greenland

[1] See http://europa.eu/about-eu/countries/member-countries for the list of EU Member States.
[2] Countries and territories from outside the region.
[3] See http://www.coe.int/en/web/portal/47-members-states for the list of Member States of the Council of Europe.
[4] See http://www.eurobats.org/sites/default/files/documents/pdf/List_of_Parties_for_Profile_rev2.pdf for the list of Range States and Parties to the Agreement.
Source: Country reports prepared for *The State of the World's Biodiversity for Food and Agriculture* (FAO, 2019) and websites of the respective organizations, instruments and initiatives.

4.2 NEEDS AND PRIORITIES

Acidification of lakes and rivers is often caused by pollutants that have come from other countries and been transported in the atmosphere and deposited as acid rain. While liming makes lakes and rivers less acidic, improving the water chemistry and providing better conditions for fish and other freshwater organisms, the need to resolve this problem through international agreements to reduce the release of pollutants was noted.

Germany stressed the need to step up and prioritize international and regional collaboration in the field of associated biodiversity. It mentioned particularly that work on micro-organisms, invertebrates and ecosystem approaches should be strengthened within the framework of the FAO Commission on Genetic Resources for Food and Agriculture.

Worldwide, invasive alien species are considered to be the second most important threat to biodiversity behind land-use change. Norway mentioned that, given the fact that invasive alien species are of global concern, there might be a need to develop an international methodology to assess the possible environmental impacts posed by alien species.

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The Europe and Central Asia Regional Synthesis for *The State of the World's Biodiversity for Food and Agriculture* summarizes the state of biodiversity for food and agriculture in the region, based largely on information provided in nineteen country reports submitted to FAO as part of the reporting process for the report on *The State of the World's Biodiversity for Food and Agriculture*.

Biodiversity for food and agriculture is the diversity of plants, animals and micro-organisms at genetic, species and ecosystem levels, present in and around crop, livestock, forest and aquatic production systems. It is essential to the structure, functions and processes of these systems, to livelihoods and food security, and to the supply of a wide range of ecosystem services. It has been managed or influenced by farmers, livestock keepers, forest dwellers, fish farmers and fisherfolk for hundreds of generations.

The report was originally prepared as supporting documentation for an informal regional consultation on the state of Europe and Central Asia's biodiversity for food and agriculture, held in Bonn, Germany, in April 2016. It was later revised based on feedback received from the participants of the informal consultation. It provides a description of the drivers of change affecting the region's biodiversity for food and agriculture and of its current status and trends. It also discusses the state of efforts to promote the sustainable use and conservation of biodiversity for food and agriculture in the region, including through the development of supporting policies, legal frameworks, institutions and capacities.

ISBN 978-92-5-131963-5

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CA6995EN/1/11.19