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AFRICA REGIONAL SYNTHESIS FOR

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

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Foreword

Africa is home to a rich biodiversity in its forests, grasslands, mountains, lakes, rivers and oceans. Over millennia, native plants and animal species, varieties and breeds of crops and livestock have diversified, through adapting to the local environment, domestication and even natural selection. Across its range of landscapes and seascapes, humans have been co-existing with nature while sustaining their livelihoods and utilizing the region's lands, forests, grasslands and aquatic ecosystems to directly provide food, and to develop agriculture sectors. These sectors range from crop production to livestock and pastoral systems, forestry and agroforestry, as well as fisheries and aquaculture.

In all these production systems, micro-organisms, fungi, plants, animals and the agroecosystems, provide irreplaceable goods and services to food, agriculture, and people, including pollination, pest control, nutrient cycling, purification of water supplies, conversion of CO_2 into oxygen, regulation of local microclimates and provision of habitats for fish, non-wood forest products and other sources of wild and cultivated food. Moreover, many ecosystems used for food and agriculture supply services that are significant on landscape, continental or global scales.

Unfortunately, it is becoming ever clearer that Africa's biodiversity is under threat, putting at risk the sustainability of the region's production systems, livelihoods and food security and nutrition. On the positive side, there is an increasing awareness at the political level to conserve, manage and sustainably use biodiversity for food and agriculture.

This regional synthesis focuses on increasing awareness on the importance of biodiversity to food and agriculture in Africa as well as gathering evidence of threats and challenges of biodiversity loss.

The outcomes in this report contributed to the publication of a global Report this year on T*he State of the World's Biodiversity for Food and Agriculture*, which stemmed from a large number of individual country reports, and discussions of gaps, needs and priorities at the national, regional and global levels. Africa has always been an active partner for this collective effort by fostering regional dialogues on biodiversity for food and agriculture, and creating knowledge and evidence through this regional synthesis report.

The country reports from the Africa region indicate that there is a great deal of scope for improvements to biodiversity-related policies and programmes, whether by ensuring a greater focus on links to food and agriculture, improving cross-sectoral cooperation, deepening stakeholders involvement or strengthening implementation capacity. It is also abundantly clear that significant knowledge gaps need to be filled. Furthermore, knowledge of biodiversity threats needs to be improved and acted upon. On a positive note, many biodiversity-friendly management practices built on diversification, sustainable use and restoration are becoming more widespread in the Africa region's production systems.

The report calls on countries and partners to improve the use and conservation of Africa's biodiversity for food and agriculture, and to safeguard the rich biodiversity of the continent.

There is still hope despite the important challenges. Countries in collaboration with partners are joining in their efforts to sustainably manage their natural resources and restore forests and landscapes under different regional initiatives such as, for example, the African Union Great Green Wall and the AUDA-NEPAD African Forest Landscape Restoration Initiative (AFR100).

In this respect, FAO is planning to organize in collaboration with partners, an Africa Regional Multi-Stakeholder Dialogue on Mainstreaming Biodiversity across Agricultural Sectors in October 2019. This report provides an excellent opportunity to raise the profile of biodiversity for food and agriculture. It also serves as a basis to launch a constructive dialogue within Africa leading to developing a comprehensive road-map, guiding and facilitating concrete actions on conservation and sustainable use, management and restoration of Africa's biodiversity.

Conserving biodiversity is a must for Africa's future.

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About this report

BACKGROUND

This report summarizes the state of biodiversity for food and agriculture in Africa 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*. A first draft, based on 14 country reports, was prepared as supporting documentation for an informal regional consultation on the state of Africa's biodiversity for food and agriculture held in Addis Ababa, Ethiopia, 24 to 26 May 2016. The document was later revised based on feedback received from the participants of the informal consultation, on additional country reports (three) and country-report updates received by FAO before November 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]

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 agriculture 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;
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;

[1] See Annex 2 of *Report of the informal regional consultation on the state of Africa's biodiversity for food and agriculture* (CGRFA-16/17/Inf.11.1) (available at http://www.fao.org/3/a-mr766e.pdf).

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

The Africa report summarizes the state of biodiversity for food and agriculture in Africa 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 Africa's biodiversity for food and agriculture held in Addis Ababa, Ethiopia, 24 to 26 May 2016.

SUMMARY

The Africa region has a diverse range of production systems, varying from small and mostly mixed systems to large-scale industrial systems. In African smallholder agricultural landscapes, home gardens constitute a particularly important source of biodiversity for food and agriculture and their contribution to plant species richness and diversity is increasingly gaining interest among researchers. Naturally regenerated forests also represent an important repository of biodiversity for food and agriculture.

As with other regions, the state and trends of Africa's plant, animal, forest and aquatic genetic resources tend to be better documented than those of its associated biodiversity; only a few countries report having national databases or knowledge-management systems specifically focusing on associated biodiversity. Generally, countries report that the status of biodiversity for food and agriculture is declining. Land-use change, land degradation, pollution, climate variability and climate change, natural disasters, displacement of local species, varieties and breeds by improved ones, overexploitation, pests and diseases, and the spread of invasive alien species are among the main reported threats to biodiversity for food and agriculture in the region. Several countries report a gradual reduction in the diversity and availability of wild foods, especially in forests and freshwaters, noting, *inter alia*, the significance of wildlife–human conflicts, overexploitation and overharvesting. Overall, there is evidence that changes in biodiversity for food and agriculture, especially changes in crop and forest systems, also affect the supply of supporting and regulating ecosystem services.

Overall, the assessment and monitoring of associated biodiversity, wild foods and ecosystem services in the region are inadequate and severely hampered by a lack of human, technical and financial capacity, and they need to be strengthened.

Several countries report implementing management practices, often with the participation of local communities, to strengthen the sustainable use of biodiversity for food and agriculture. Generic measures are taken to limit unsustainable use and/or support the sustainable use of associated biodiversity and wild food resources. Many such measures are intended to protect forest ecosystems. More-specific interventions include the active management of associated biodiversity for the provision of ecosystem services, in particular pollination, soil formation and protection, nutrient cycling, pest and disease regulation and habitat provisioning. In the case of oxygen production and gas regulation services, countries tend to manage entire ecosystems, such as savannahs and rangelands.

Some countries report on initiatives, projects or frameworks promoting the use of biodiversity for food and agriculture to cope with climate change, natural disasters and control of invasive species. For example, quite a few countries mention rearing and using weevils (*Neochetina echhorniae* and *N. bruchi*) to biologically control the invasive species water hyacinth, a serious and growing threat to key fish reproducing sites.

The implementation of ecosystem, landscape and seascape approaches remains limited in the region. The intensive promotion of agroforestry over the past ten years is reported to have led to better productivity and resilience to droughts in some countries. In the case of fisheries, adoption of the ecosystem approach is a recent development and results have not yet been documented.

A significant number of national and international projects in the region are aiming to document, maintain and use traditional knowledge of the region's wild food species and associated biodiversity. While several country reports highlight gender specializations in this respect, few details of studies addressing this topic are provided. Countries identify a strong need for further and more wide-ranging studies in this field.

Knowledge of sustainable management practices and ecosystem approaches could be improved and efforts to promote these methods, for instance by improving and reinforcing rural extension services or training facilities (e.g. training on agroforestry management practices in local communities and on family farms), could be strengthened.

Several countries provided information on *in situ* conservation initiatives targeting associated biodiversity and/or wild foods. These generally involve the establishment of protected areas and/or the introduction of controls on activities such as agriculture, mining, hunting and the harvesting of wild products.

A few countries mention having national *ex situ* conservation programmes or activities for associated biodiversity and wild foods. Even if some countries report quite large collections of associated biodiversity species, the majority seem to lack or have limited *ex situ* collections of wild food species and associated biodiversity. In the case of wild foods, countries report the *ex situ* conservation of a wide range of plant species and also some fish and invertebrate species.

Associated biodiversity and ecosystem services tend to be neglected in conservation programmes, partly because of a lack of awareness of their importance to food and agriculture. While the conservation of wild food resources has been incorporated into policies addressing biodiversity in general, there is a need for policies that specifically address these resources, especially given their contribution to food security in vulnerable areas.

All the reporting countries are Parties to the Nagoya Protocol on Access and Benefit-sharing. A few of these countries have put in place domestic legislation on access and benefit-sharing, while others indicate being in the process of developing regulatory and legal frameworks including provisions on access to genetic resources and associated traditional knowledge, and the fair and equitable sharing of the benefits arising from the utilization of such resources. Overall, the institutional and human capacity needed to implement and enforce international treaties and national measures of relevance to access and benefit-sharing at national level needs to be strengthened.

The country reports indicate that many countries currently have no policies in place that explicitly address the management of biodiversity for food and agriculture and that associated biodiversity and wild foods are particularly commonly neglected in this regard. A number of countries, however, mention more broadly focused instruments such as national biodiversity strategy and action plans. Some countries note that national policies and legislation governing the conservation and use of biodiversity for food and agriculture tend to be sector-based and that multidisciplinary, multistakeholder consultation in the development of relevant policy and legal instruments needs to be strengthened.

Particularly with respect to associated biodiversity, establishing baseline datasets and long-term monitoring mechanisms to inform decision-making and information exchange is required. Several countries also mention the need for capacity development at national level to support the development of legislation and policies that comply with international laws, conventions, treaties

and protocols. Countries also mention the need to support targeted research and to develop new models of partnership and cooperation that strengthen capacity building in scientific research and development. Support for information collection and dissemination is regarded as an essential basis for bridging knowledge gaps and ensuring sound implementation of relevant measures and activities.

Most countries adhere to regional and international initiatives but fail to take appropriate measures to implement the recommendations arising from these initiatives. Reported reasons for this generally relate to limited capacity and a lack of effective enforcement and follow-up mechanisms.

I. Assessment and monitoring of biodiversity for food and agriculture

1.1 INTRODUCTION

The world's population continues to rise steadily, especially in developing countries. Population growth in sub-Saharan Africa, estimated to have been 2.74 percent in 2016 (World Bank, 2017), is one of the highest in the world. Providing safe and nutritious food to this fast-growing population poses serious challenges to plant, forest, aquatic and animal production. Substantially increasing the production of food and other ecosystem goods and services while preserving the environment is a major present and future challenge for the region.

The richness of Africa's biodiversity for food and agriculture is in part a consequence of the diversity of the region's landscapes and seascapes: elevations ranging from below sea level to 5 895 m at the summit of Kilimanjaro; climatic and ecological zones ranging from deserts to rain forests; a wide variety of soil types; diverse freshwater environments, with some of the longest rivers and largest lakes on the planet; and thousands of kilometres of coastline, washed by tropical and temperate seas. This diversity, in combination with some of the world´s most ancient crop and livestock systems and the region's traditional coastal, river and lake fisheries, has given rise to a diverse range of crop, livestock, aquatic, forest-tree and associated biodiversity species and rich within-species diversity that is essential as a source of resilience in the face of climate variability and change and the region's growing demand for food, fibre and energy. Wild foods, including fruits, vegetables, mushrooms, spices, and terrestrial and aquatic animals, are an important source of nutrients for both rural and urban families across the region. They are mainly consumed to fill food gaps and for supplementary purposes. Within the different countries, the consumption of wild foods can vary significantly. In some areas, more than two-thirds of the population is reported to consume wild edible plants.

Much of the potential of Africa's biodiversity for food and agriculture is being underutilized or abandoned. For example, among crops, a few recently introduced species such as maize and cassava are now grown on a large proportion of the continent's agricultural land and are displacing local crops such as sorghum and millet (McCann, 2005). Similar trends can be observed with the spread of exotic breeds of livestock and with the introduction of invasive fish species. Exotic tree species such as eucalyptus have been introduced to many parts of the continent to replace local species, particularly in the East African highlands (Omoro and Luukkannen, 2011). In the fisheries sector, especially off the coast of West Africa, the use of large vessels has threatened various locally important fish species and artisanal fishing livelihoods (Bassey, 2017).

Despite repeated warnings about the rapid loss of biodiversity for food and agriculture the focus of agricultural research for development in recent decades has been on simplifying cropping and livestock systems, and with this has come a great loss of biodiversity from the agricultural landscape. Intensification of production has also come at a high cost to the environment and to the livelihoods of smallholders.

1.2 REGIONAL CONTEXT

As of November 2016, the following 14 countries out of a total of 47 in the Africa region[1] had submitted a country report as a contribution to the preparation of *The State of the World's Biodiversity for Food and Agriculture*: Burkina Faso, Cameroon, Chad, Ethiopia, Gabon, the

[1] 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/.

Table 1. Percentage of land, water, agricultural and forest areas in Africa lying in countries that provided country reports

	Total area	Land area	Water area[1]	Agricultural area	Forest area[1]
% covered by country reports	25.8	25.5	38.3	25.6	31.7

[1] Does not include data from South Sudan.
Source: Calculated from FAOSTAT data for 2014.

Gambia, Guinea, Kenya, Mali, Senegal, Togo, the United Republic of Tanzania, Zambia and Zimbabwe. These countries combined cover an area of approximately 7 827 520 km^2, including land and water, which is about 26 percent of the region's total territory (30 318 630 km^2) (Table 1).

Although the area covered by the country reports represents only about one-quarter of the region, the countries in question represent a significant share of the region's diversity in terms of climate, soils, vegetation and agroecosystems (including their cultural components). The zones represented include the Sahel and the Sudan savannah (Burkina Faso, Cameroon, Chad, the Gambia, Mali and Senegal), the upper (Guinea and Togo) and lower (Cameroon) Guinea forests, the Congo basin, even if only marginally represented (Gabon and Cameroon), the Rift Valley (Ethiopia and Kenya), the Great Lakes (Kenya and the United Republic of Tanzania), the East and Southern African highlands and savannahs (Ethiopia, Kenya, the United Republic of Tanzania, Zambia and Zimbabwe), and the West African (Cameroon, Gabon, the Gambia, Guinea, Senegal and Togo) and East African (Kenya and the United Republic of Tanzania) coastlines.

The region dominated by soils formed on Kalahari sands is only partly represented – via the country report from Zimbabwe. Areas not represented include the Mediterranean vegetation zone of the continent´s southern tip, including South Africa's fynbos and temperate acid-soil wine highlands, the highland region of Burundi, Rwanda, Uganda and eastern Democratic Republic of the Congo, where endemic highland bananas are the major staple food (and dwarf goats and a diverse range of chicken landraces are also prominent), the rich coastal and marine zone of Mozambique and the Strait of Madagascar, the Niger delta region, and the densely populated region around Lake Malawi.

As indicated in Table 2, the region has a diverse range of production systems. A total of 11 production systems are identified in the country reports. The major production systems reported are mixed systems, self-recruiting capture fisheries, livestock grassland-based systems, livestock landless systems, rainfed crop systems, naturally regenerated forests and planted forests. Irrigated rice and other irrigated crop systems, culture-based fisheries and fed aquaculture systems are less commonly reported. Other production systems mentioned include traditional agroforestry systems, artisanal and industrial apiculture, peasant agriculture and industrial agriculture.

Classifying production systems according to the categories set out in the country-reporting guidelines caused countries some problems. Most smallholder production systems in Africa are mixed systems that include different forms of crop and livestock production in combination with forestry and sometimes fishing or aquaculture. In some cases, industrial or cash-crop agriculture, such as sugar-cane, coffee, oil-palm or cotton production, coexists on the same farm with mixed agriculture practised to provide for household consumption. Even in irrigated rice production schemes, families grow a range of other crops (mostly rainfed) and/or keep livestock to cover their household needs and as an investment.

Home gardens constitute an important source of biodiversity for food and agriculture in African smallholder agricultural landscapes. These gardens are small parcels of land close to the homestead, where perennial and annual crops, fruit trees and horticultural crops, and sometimes small livestock such as poultry or pigs, are raised together, mostly to provide food for the household. Although generally less documented than in Latin American and Asia, the role of home gardens in Africa, including in terms of their contribution to plant species

Table 2. Main production systems reported by countries in the region

Production system	Countries reporting
Livestock grassland-based systems	Burkina Faso, Cameroon, Chad, Ethiopia, Gabon, Gambia, Guinea, Kenya, Mali, Senegal, Togo, United Republic of Tanzania, Zambia, Zimbabwe
Livestock landless systems	Burkina Faso, Cameroon, Chad, Ethiopia, Gabon, Guinea, Kenya, Senegal, Togo, United Republic of Tanzania, Zambia, Zimbabwe
Naturally regenerated forests	Burkina Faso, Cameroon, Ethiopia, Gabon, Gambia, Guinea, Kenya, Mali, Senegal, Togo, United Republic of Tanzania, Zambia, Zimbabwe
Planted forests	Burkina Faso, Cameroon, Ethiopia, Gambia, Guinea, Kenya, Mali, Senegal, Togo, Zambia, Zimbabwe
Self-recruiting capture fisheries	Burkina Faso, Cameroon, Chad, Ethiopia, Gabon, Gambia, Guinea, Kenya, Mali, Senegal, Togo, Zambia, Zimbabwe
Culture-based fisheries	Burkina Faso, Cameroon, Kenya, Mali, United Republic of Tanzania, Zambia, Zimbabwe
Fed aquaculture	Burkina Faso, Cameroon, Gabon, Gambia, Guinea, Kenya, Senegal, Togo, United Republic of Tanzania, Zambia, Zimbabwe
Non-fed aquaculture	Cameroon, Senegal, Togo, United Republic of Tanzania, Zambia, Zimbabwe
Irrigated crops (rice)	Burkina Faso, Cameroon, Gambia, Guinea, Kenya, Mali, Senegal, Togo, United Republic of Tanzania
Irrigated crops (other)	Burkina Faso, Cameroon, Chad, Ethiopia, Gabon, Gambia, Kenya, Mali, Senegal, Togo, United Republic of Tanzania, Zambia, Zimbabwe
Rainfed crops	Burkina Faso, Cameroon, Chad, Gabon, Gambia, Guinea, Kenya, Mali, Senegal, Togo, United Republic of Tanzania, Zambia, Zimbabwe
Mixed systems (livestock, crop, forest and /or aquatic and fisheries)	Burkina Faso, Cameroon, Chad, Ethiopia, Gambia, Guinea, Kenya, Mali, Senegal, Togo, United Republic of Tanzania, Zambia, Zimbabwe

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).

richness and diversity, has increasingly gained interest among researchers (Bernholt *et al.*, 2009; Gbedomon *et al.*, 2015, 2017). The country reports indicate the presence of home gardens in rainfed crop systems and in irrigated crop systems.

Some smallholder families practise dry-season irrigated horticulture in lowland or riverine areas, growing either cash crops or crops for home consumption. These systems fall within the irrigated (non-rice) systems category. However, they are not irrigated all year round.

Livestock landless systems in the region are often so-called zero-grazing systems, i.e. systems in which animals are confined in stalls and fed through a cut-and-carry system. Crossbred dairy cattle or goats are often managed in this way in order to secure milk production from a costly animal asset. However, farmers who keep one or two animals in a stall often also keep locally adapted animals that graze freely or are herded as part of a village herd. Thus, landless and grassland-based systems often coexist.

Naturally regenerated forests represent an important repository of biodiversity for food and agriculture in Equatorial West Africa, for instance in Cameroon, where a range of food crops are grown under a secondary forest canopy.

1.3 REGIONAL STATE, TRENDS AND DRIVERS OF CHANGE OF BIODIVERSITY FOR FOOD AND AGRICULTURE

1.3.1 Main drivers of change affecting genetic resources for food and agriculture across sectors in the region

The Africa region is home to important wild and domesticated biological diversity. However, countries report negative trends in the diversity of many components of this diversity (see FAO, 2010, 2014a, 2015a for further details of the status and trends of crop, livestock and forest genetic resources). For example, loss of diversity is reported in crop varieties, crop wild relatives, wild edible plants and associated biodiversity. The main drivers of the changes reported by countries to be affecting crop genetic resources, including tree crops, are:

- displacement of local varieties by improved varieties;
- a shift to market-oriented crop production;

– pests and diseases; and
– frequent droughts and unreliable rainfall.

The country reports point to a number of other drivers, although some are mentioned only in one report. The report from Cameroon, for example, mentions that volcanic eruptions frequently cause the loss of cropping systems and hence crop genetic resources. It also reports that a lack of land-tenure rights for women is a driver of biodiversity loss. In most country reports, the main drivers identified as threats to crop wild relatives are habitat loss (including as a result of urbanization), habitat degradation and habitat fragmentation.

Threats to forest genetic resources and wild edible plants as identified in the country reports include:

– deforestation;
– habitat destruction;
– spread of invasive (native and non-native) species;
– agricultural expansion and settlement;
– forest fires;
– illegal logging;
– fuelwood collection; and
– livestock grazing.

In Ethiopia, a total of 103 tree and shrub species are considered to be endangered according to the International Union for Conservation of Nature's (IUCN) Red List. Among these, *Boswellia papyrifera* (Sudanese frankincense) and *Oxytenanthera abyssinica* (lowland bamboo) are classified as threatened (the country report cites EBI [2014]).

Threats to domesticated animal diversity mentioned in the country reports include:

– feed shortages as a result of pasture degradation;
– human resettlement;
– competition for agricultural land;
– overgrazing and overstocking;
– invasion of exotic weeds and shrubs;
– pests and diseases;
– use of exotic breeds for upgrading local breeds and market demand for improved breeds; and
– pesticide use (particularly affects domestic bees).

The country report from Zambia mentions that the threat caused by pests and diseases is being aggravated by climate change, which is affecting the distribution of disease vectors. It notes, for example, that as a result of climate change, the distribution of the tick *Rhipicephalus appendiculatus*, the main vector involved in the transmission of East Coast fever (an often-deadly tick-borne disease of cattle, caused by the protozoal parasite *Theileria parva*), is projected to expand in the country.

The major threats to aquatic and terrestrial wild animals in Ethiopia are reported to be:

– habitat degradation;
– change in land use;
– overharvesting;
– unbalanced water utilization;
– siltation; and
– mining and pollution.

While most of the drivers noted above as threats to crop, forest, livestock, fishery or aquaculture genetic resources are also detrimental to associated biodiversity, other major threats to the region's soil biodiversity are land degradation and desertification, including soil degradation. The United Nations Convention to Combat Desertification (UNCCD) estimates that land degradation affects up to two-thirds of productive land area in Africa (UNCCD,

2013; Jones *et al.*, eds, 2013). Burkina Faso reports that soil erosion caused by water and wind affects as much as 50 and 20 percent, respectively, of the country's total land area.

Overall, there is a significant amount of information on the state and trends of domesticated plants and animals and forest genetic resources. However, little is known about associated biodiversity.

Several countries report that their responses to the threats identified have included the establishment of conservation strategies. Reported measures include the establishment of community seed banks (e.g. Ethiopia reports 12 community seed banks, of which six are functional) and on-farm field genebanks in different agroecological zones (e.g. Ethiopia reports that over 6 000 accessions of coffee, spices and root and tuber crops are being conserved in five field genebanks). Some countries also report that they have established *ex situ* genebanks.

1.3.2 National information systems on associated biodiversity

Few countries report a national information system for associated biodiversity. Where systems are reported, they may include newsletters, national reports on the state of biodiversity produced by relevant ministries (e.g. forestry or environment), radio and television programmes and Internet resources. Only a few countries report national databases or knowledge-management systems specifically focusing on associated biodiversity. The following list provides examples of the information systems reported:

- Cameroon reports six different paper-based information systems (periodic reports and newsletters) and three radio and television programmes. Cameroon, the Gambia and Togo report activities related to the Clearing House Mechanism of the Convention on Biological Diversity (CBD), which covers all biodiversity.
- Kenya reports the electronic databases of the Botanical Research and Herbarium Management System. The main components of associated biodiversity reported to be covered by the country's information systems are fungi (mushrooms and mycorrhizae), bryophytes and some invertebrate and vertebrate species.
- Mali reports having two information systems in place that contribute to the management of associated biodiversity: the Information System for Sustainable Land Management (Système d'information sur la gestion durable des terres) includes recommendations for sustainable land management, including pollination management, in different ecosystems; and the national information system for agriculture sectors (Système national d'information sur les filières agricoles), established under the Law on Agricultural Orientation (Loi d'orientation agricole),[22] includes data related to the management of micro-organisms in the context of climate change adaptation.
- The United Republic of Tanzania reports several ongoing programmes that contribute to building national-level information systems by strengthening institutions and agencies that manage biodiversity, including the Tanzania Forest Services Agency, Tanzania Fisheries Research Institute, Tanzania Wildlife Research Institute, Tanzania Forestry Research Institute and several agricultural research institutes. The longest-term monitoring initiative targeting associated biodiversity in the United Republic of Tanzania is the National Forest Resources Monitoring and Assessment programme.
- Zimbabwe mentions a national information system known as Zimstat, in which information on various components of associated biodiversity is stored in the form of electronic and hard-copy reports. It also mentions the Zimbabwe Research Council database, which contains information on various components of associated biodiversity, mostly in the form of scientific research papers. Other information systems reported by Zimbabwe pertain mostly to crop and livestock genetic resources.

[2] Available, in French, at http://www.fao.org/faolex/results/details/en/c/LEX-FAOC067609/

– Chad mentions several committees that contribute to monitoring associated biodiversity, including at local and regional levels (*comités locaux et regionnaux d´action*). It also mentions its national strategy and action plan for biodiversity.
– Togo reports national information systems on marine and fishing resources and several information systems that mostly feature crop and livestock genetic resources, i.e. do not specifically focus on associated biodiversity.

1.3.3 Associated biodiversity species most frequently reported by countries in the region as being actively managed for the provision of ecosystem services

Several country reports provide information on associated biodiversity species actively managed for the provision of ecosystem services (Table 3). Most reports list a broad range of components of biodiversity, including species that are cultivated or domesticated but provide essential supporting or regulating ecosystem services. Among these, the most frequently listed were *Apis mellifera* and *Eucalyptus* spp.

The main ecosystem functions and services provided by the species listed in the country reports are pollination, soil formation and protection, nutrient cycling and habitat provisioning. A large number of species, ranging from fish to trees and grasses, are reported to contribute to pest and disease regulation. In the case of oxygen-production and gas-regulation services, countries often report entire ecosystems, such as savannahs and rangelands. Among the plant species reported to be managed for their contributions to nutrient cycling, several cultivated tree species used in agroforestry systems (improved fallows, alley cropping, etc.) are mentioned, as are several naturally occurring tree species found in parkland agricultural landscapes, which are common in West Africa. Some countries report domestic animal species as being managed for their contributions to nutrient cycling.

Table 3. Associated biodiversity species most frequently reported by countries in the region to be actively managed for the provision of ecosystem services

Ecosystem services	Species and ecosystems	Countries reporting
Pollination	European honey bee (*Apis mellifera*) and other bee species Beetles (Coleoptera) Flies (Diptera) Bats Birds Butterflies	Burkina Faso, Cameroon, Chad, Gambia, Guinea, Kenya, Mali, Kenya, Senegal, Togo, United Republic of Tanzania, Zambia, Zimbabwe
Pest and disease regulation	<u>Biological control organisms</u> Ladybird beetles (Coccinelidae) Other natural predators (raptors, insects, small rodents) of pest species <u>Disease treatment</u> Senegal mahogany (*Khaya senegalensis*) (bark used in trypanosomiasis treatment) <u>Function not specified</u> *Acerophagus papaya* (an anthropod) Baobab (*Adansonia digitate*) Laysan teal (*Anas platyrhynchos*) Rhodes grass (*Chloris gayana*) Crayfish (*Astacoidea*) Palmyra palm (*Borassus aethiopum*) Western cattle egret (*Bubulcus ibis*) *Encarsia guadeloupe* *Encarsia haitiensis* Tilapia (*Oreochromis niloticus*) Egyptian riverhemp (*Sesbania sesban*) *Tephrosia* spp.	Burkina Faso, Chad, Kenya, Togo, Zimbabwe

Table 3 *Cont'd*

Ecosystem services	Species and ecosystems	Countries reporting
Natural-hazard regulation	Natural barrier mangrove species *Avicennia* spp. True mangroves (*Rhizophora* spp.)	Gambia, United Republic of Tanzania
Nutrient cycling	Plant species Prairie acacia (*Acacia angustissima*) Gum arabic tree (*Acacia nilotica*) Bluestem grass (*Andropogon gayanus*) Sunn hemp (*Crotalaria juncea*) Winter thorn (*Faidherbia albida*) White leadtree (*Leucaena leucocephala*) *Piliostigma reticulatum* Invertebrates Earthworms Insects Myriapoda (Julida, Lithobiomorpha, Scolopendromorpha, Symphyla) Vertebrates Bats Cattle Goats Sheep Other organisms Fungi (including mycorrhizae) Micro-organisms (including soil bacteria) Ecosystems Forests Savannahs Wetlands	Burkina Faso, Cameroon, Chad, Gambia, Kenya, Senegal, Togo, United Republic of Tanzania, Zambia, Zimbabwe
Soil formation and protection	Soil engineer organisms Earthworms Mycorrhizae Scavengers Stabilization and fixation of sand dunes Cashew (*Anacardium occidentale*) Australian beefwood (*Casuarina equisetifolia*) Long-beak Eucalyptus (*Eucalyptus camaldulensis*) Winter thorn (*Faidherbia albida*) Improvement of soil fertility Senegal gum (*Acacia Senegal*) *Acacia tortilis* subsp. *raddiana* Winter thorn (*Faidherbia albida*) Mycorrhizae Detritivores Function not specified Acacias (*Acacia* spp.) Eucalyptuses (*Eucalyptus* spp.) Vetiver (*Chrysopogon zizanioides*) Jatropha (*Jatropha curcas*) Land snails Mangroves *Moringa* spp. Monkeypod (*Pithecellobium dulce*) Adrenaline grass (V*etiveria nigritana*)	Cameroon, Chad, Gambia, Kenya, Senegal, Togo, Zambia, Zimbabwe

Table 3 *Cont'd*

Ecosystem services	Species and ecosystems	Countries reporting
Water cycling	Plant species African oil palm (*Elaeis guineensis*) Adrenaline grass (*Vetiveria nigritana*) Invertebrates *Macrotermes* spp. Ecosystems Wetlands	Burkina Faso, Gambia, Togo
Habitat provisioning	Tree species Acacias (*Acacia* spp.) African mahogany (*Afzelia africana*) *Anogeissus leiocarpus* Burkea (*Burkea africana*) Bushwillows (*Combretum* spp.) Santan (*Daniellia oliveri*) Sweet dattock (*Detarium microcarpum*) Eucalyptuses (*Eucalyptus* spp.) Large red-heart (*Hymenocardia acida*) *Isoberlinia doka* Large-leaved mahogany (*Khaya grandifoliola*) Senegal mahogany (*Khaya senegalensis*) *Monotes kerstingii* Ironwood (*Prosopis africana*) Marula (*Sclerocarya birrea*) Tamarind (*Tamarindus indica*) Teak (*Tectona grandis*) *Terminalia macroptera* Shea tree (*Vitellaria paradoxa*) Grass species Adrenaline grass (*Vetiveria nigritana*) Ecosystems Mangrove forests Wetlands	Burkina Faso, Cameroon, Chad, Gambia, Togo, United Republic of Tanzania
Production of oxygen, gas regulation	Tree species Eucalyptuses (*Eucalyptus* spp.) Jatropha (*Jatropha curcas*) Large-leaved mahogany (*Khaya grandifoliola*) Senegal mahogany (*Khaya senegalensis*) Teak (*Tectona grandis*) Insects Mayflies (Ephemeroptera) Shore flies (Ephydridae) Non-biting midges (Chironomidae) Caddisflies (Trichoptera) Ecosystems Forests Shrublands Wetlands Wooded savannahs	Burkina Faso, Chad, Gambia, Togo, United Republic of Tanzania
Other	Control of shrubs in pastures Cattle Goats Sheep	Senegal

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

1.3.4 Wild food species most frequently reported by countries in the region

Wild foods are an important source of nutrients and incomes for rural families in most of the countries of sub-Saharan Africa. Recent studies in the region also indicate the importance of wild-food consumption in the urban areas of certain countries and show that these foods are accessed through quite sophisticated market chains. For example, an analysis of 371 households and urban markets in Cameroonian cities revealed that many traditional wild foods, including fruits, vegetables, spices and insects, are physically available to urban dwellers most of the time (Sneyd, 2013). Cameroonians spend considerable shares of their food budgets on wild foods. However, the high cost of city living is pushing urban families to opt increasingly for cheaper staples, such as imported rice, instead of wild foods, and this is having negative consequences for their nutrition. A study on local traditional vegetable species consumed by rural households in Kenya revealed that a wide range of naturally occurring herbaceous species, often regarded as "weeds" in agriculture, contribute substantially to household nutrition throughout the year (Figueroa-Gomez *et al*., 2008).

Table 4 lists the wild food species mentioned most frequently in the country reports. Ten countries supplied information in this regard. Only species reported by at least two countries are presented in the table. In total, countries reported 100 species of trees, 31 species of herbaceous plants, 20 species of mammals, 7 species of birds and 3 species of reptiles. Cameroon mentioned more than 500 wild food species, including fruit, vegetable, herb, fungi, invertebrate, mammalian, fish, amphibian, reptile and bird species. With respect to edible mushrooms, the country listed 11 *Termitomyces* species. The national biodiversity study conducted in Zambia estimated that one-third of rural households harvest wild food resources in the form of fruits, mushrooms and roots/tubers, with a gross annual output of about 31 kg per household. Referring to activities that do not involve wild foods *per se* but are nevertheless significant in terms of the use of local biodiversity, Kenya mentions that Acacia tree and shrub species are used to produce charcoal.

The country report from Ethiopia notes that in the country's Benishangul Gumuz region, where wild foods contribute a far greater proportion of the food supply than in other parts of the country, 30 to 40 percent of food consumption comes from wild edible plants. It further notes (citing Mekuanint *et al*., 2014) that in some parts of the country as much as 66.7 percent of the population consume wild edible plants. In the country's Gambella region, the proportion of the population consuming wild food of animal origin is reported to exceed 50 percent, although there is also no information on the proportion of the diet that comes from wild foods. Wild foods are reportedly consumed mainly in order to fill food gaps and for supplementary purposes.

1.3.5 Main drivers of change affecting associated biodiversity, ecosystem services and wild food resources

The reported state and trends of components of associated biodiversity within production systems vary from country to country across the region. Overall, little information is available on the state and trends of associated biodiversity. Where information is available, country reports mainly indicate a decline in associated biodiversity in intensively managed or exploited production systems such as planted forests self-recruiting capture fisheries and irrigated crops (non-rice) systems. The following paragraphs provide a non-exhaustive description of drivers reported by two or more countries.

Overgrazing

The country report from Kenya points to overgrazing, especially among nomadic communities, as a factor that reduces vegetative cover, negatively affects micro-organism diversity and favours the spread of insect disease vectors such as tsetse flies. Similarly, the report from the Gambia mentions that the seasonal pattern of livestock concentration and movement between

Table 4. Wild food species reported by two or more countries in the region

Wild food species	Countries reporting
Shrub/tree species	
Gum arabic tree (*Acacia nilotica*)	Chad, Senegal
Gum acacia (*Acacia senegal*)	Chad, Senegal
Baobab (*Adansonia digitata*)	Cameroon, Chad, Ethiopia, Gambia, Guinea, Kenya, Senegal, Zambia, Zimbabwe
Wild custard apple (*Annona senegalensis*)	Cameroon, Chad, Gambia, Senegal
Tasselberry (*Antidesma venosum*)	Cameroon, Ethiopia
Balanites spp.	Chad, Ethiopia, Senegal
African fan palm (*Borassus aethiopum*)	Cameroon, Chad, Ethiopia, Senegal
Boscia spp.	Cameroon, Chad, Ethiopia
Bridelia spp.	Cameroon, Ethiopia
Hackberries (*Celtis* spp.)	Cameroon, Chad, Ethiopia
Cola spp.	Cameroon, Gambia, Senegal
Bushwillows (*Combretum* spp.)	Cameroon, Ethiopia
Manjack (*Cordia* spp.)	Cameroon, Ethiopia
Bush mango (*Cordyla pinnata*)	Cameroon, Gambia, Senegal
Crateva adansonii	Cameroon, Ethiopia
Rattlepods (*Crotalaria* spp.)	Ethiopia, Kenya
Detarium spp.	Cameroon, Chad, Gambia, Senegal
Velvet tamarind (*Dialium guineense*)	Gambia, Senegal
Dioscorea abyssinica	Chad, Ethiopia
Air potato (*Dioscorea bulbifera*)	Chad, Ethiopia, Senegal
Wild yam (*Dioscorea dumetorum*)	Cameroon, Chad, Ethiopia
Dioscorea mangenotiana	Cameroon, Chad
Dioscorea minutiflora	Chad, Kenya
Bush yam (*Dioscorea praehensilis*)	Cameroon, Chad, Ethiopia
Dioscorea spp.	Cameroon, Chad, Ethiopia, Senegal, Zambia
West African ebony (*Diospyros mespiliformis*)	Cameroon, Chad, Ethiopia, Senegal
Ebony trees (*Diospyros* spp.)	Cameroon, Chad, Ethiopia
African oil palm (*Elaeis guineensis*)	Cameroon, Gambia, Kenya, Senegal
River sandpaper fig (*Ficus capreifolia*)	Cameroon, Ethiopia
Mountain rock fig (*Ficus glumosa*)	Cameroon, Ethiopia
Red-leaved rock fig (*Ficus ingens*)	Cameroon, Ethiopia
Ficus platyphylla	Cameroon, Ethiopia
Large-fruited sycamore fig (*Ficus sycomorus*)	Cameroon, Chad, Ethiopia, Senegal
Giant forest fig (*Ficus thonningii*)	Cameroon, Ethiopia
Haroni fig (*Ficus vallis-choudae*)	Cameroon, Ethiopia
Fig trees (*Ficus* spp.)	Cameroon, Chad, Ethiopia, Senegal
Chinese waterberry (*Flueggea virosa*)	Cameroon, Ethiopia
Saptrees (*Garcinia* spp.)	Cameroon, Ethiopia
Gnetum spp.	Cameroon, Gabon
Silver raisin (*Grewia bicolor*)	Cameroon, Ethiopia
Sandpaper raisin (*Grewia flavescensI*)	Cameroon, Ethiopia
Mallow-leaved cross-berry (*Grewia villosa*)	Cameroon, Ethiopia
Grewia spp.	Cameroon, Ethiopia
Hexalobus monopetalus	Cameroon, Chad
Large red-heart (*Hymenocardia acida*)	Cameroon, Chad
Doum palm (*Hyphaene thebaica*)	Cameroon, Chad, Ethiopia
Wild mangoes (*Irvingia* spp.)	Cameroon, Gabon
Landolphia rubber (*Landolphia heudelotii*)	Gambia, Senegal
Landolphia spp.	Cameroon, Ethiopia
Lannea acida	Cameroon, Senegal
Lannea microcarpa	Cameroon, Chad
Lannea welwitschii	Cameroon, Ethiopia
Lannea spp.	Ethiopia, Zimbabwe
Lecaniodiscus spp.	Cameroon, Ethiopia
Lepisanthes senegalensis	Cameroon, Ethiopia
Leptadenia hastata	Chad, Ethiopia
Leptadenia spp.	Chad, Senegal
Manilkara spp.	Cameroon, Ethiopia
Moringa spp.	Cameroon, Chad, Ethiopia, Senegal
White mulberry (*Morus alba*)	Cameroon, Ethiopia

Table 4 *Cont'd*

Wild food species	Countries reporting
African mulberry (*Morus mesozygia*)	Cameroon, Ethiopia
Myrianthus spp.	Cameroon, Kenya
Nauclea spp.	Cameroon, Gambia
Mobola plum (*Parinari curatellifolia*)	Cameroon, Zimbabwe
Guinea plum (*Parinari excelsa*)	Cameroon, Gambia
Parinari macrophylla	Gambia, Senegal
Parkia spp.	Cameroon, Chad, Gambia, Guinea, Senegal
Phoenix spp.	Cameroon, Ethiopia, Gambia
Phyllanthus spp.	Cameroon, Ethiopia
Pokeweed (*Phytolacca dodecandra*)	Cameroon, Ethiopia
Pouteria altissima	Cameroon, Ethiopia
Prosopis spp.	Cameroon, Chad, Ethiopia
Pseudospondias microcarpa	Cameroon, Gambia
Raphia spp.	Cameroon, Gabon
Saba comorensis	Cameroon, Ethiopia
Senegal saba (*Saba senegalensis*)	Chad, Gambia, Guinea, Senegal
Marula (*Sclerocarya birrea)*	Cameroon, Chad, Ethiopia, Zambia
Tropical chestnuts (*Sterculia* spp.)	Cameroon, Ethiopia, Senegal
Strychnos innocua	Cameroon, Chad, Ethiopia
Spiny monkey-orange (*Strychnos spinose*)	Cameroon, Zimbabwe
Strychnos spp.	Cameroon, Ethiopia, Zimbabwe
Syzygium spp.	Cameroon, Chad, Zimbabwe
Tamarind (*Tamarindus indica*)	Cameroon, Chad, Gambia, Senegal
Teclea spp.	Cameroon, Ethiopia
Trichilia spp.	Cameroon, Ethiopia
False-fig (*Trilepisium madagascariense*)	Cameroon, Ethiopia
Tristemma mauritianum	Cameroon, Ethiopia
Uapaca spp.	Cameroon, Zambia, Zimbabwe
Uvaria spp.	Cameroon, Ethiopia, Guinea
Babul (*Vachellia nilotica*)	Chad, Ethiopia, Senegal
Thorn trees (*Vachellia* spp.)	Chad, Ethiopia, Kenya
Vangueria spp.	Cameroon, Ethiopia
Shea butter (*Vitellaria paradoxa*)	Cameroon, Chad, Ethiopia, Guinea, Senegal
Black plum (*Vitex doniana*)	Cameroon, Gambia, Ethiopia, Senegal
Chaste trees (*Vitex* spp.)	Cameroon, Zimbabwe
Ximenia spp.	Cameroon, Chad, Ethiopia, Zimbabwe
Zanha spp.	Cameroon, Kenya
Zanthoxylum spp.	Cameroon, Ethiopia, Kenya
Indian jujube (*Ziziphus mauritiana*)	Cameroon, Gambia, Ethiopia, Senegal, Zimbabwe
Ziziphus spp.	Cameroon, Ethiopia
Wild plant/herb species	
Acanthus (*Acanthus* spp.)	Cameroon, Ethiopia
Aframomum spp.	Cameroon, Ethiopia
Slim amaranth (*Amaranthus hybridus*)	Cameroon, Ethiopia
Spiny amaranth (*Amaranthus spinosus*)	Cameroon, Ethiopia
Amaranth (*Amaranthus* spp.)	Mali, Togo, United Republic of Tanzania, Zimbabwe
Sticktight (*Bidens pilosa*)	Ethiopia, Zimbabwe
Caperbushes (*Capparis* spp.)	Cameroon, Ethiopia
Spider flowers (*Cleome* spp.)	Ethiopia, Zimbabwe
Corchorus spp.	Cameroon, Chad, Ethiopia, Mali, Zimbabwe
Rattlepods (*Crotalaria* spp.)	Ethiopia, Kenya
Nut grass (*Cyperus esculentus*)	Chad, Ethiopia
Fringed cock's-spur grass (*Echinochloa stagnina*)	Chad, Mali
Lovegrass (*Eragrostis* spp.)	Chad, Ethiopia
Eriosema spp.	Ethiopia, Kenya
Gardenia spp.	Cameroon, Chad, Ethiopia
Hibiscus (*Hibiscus* spp.)	Cameroon, Ethiopia
Ipomoea spp.	Ethiopia, Kenya

Table 4 *Cont'd*

Wild food species	Countries reporting
Launaea spp.	Ethiopia, United Republic of Tanzania
Forest star (*Mussaenda arcuate*)	Cameroon, Ethiopia
Waterlillies (*Nymphaea* spp.)	Chad, Ethiopia
African wild rice (*Oryza barthii*)	Chad, Ethiopia
Red rice (*Oryza longistaminata*)	Chad, Ethiopia
Fountaingrasses (*Pennisetum* spp.)	Cameroon, Togo
Spurflowers (*Plectranthus* spp.)	Ethiopia, Zambia
Satyrium spp.	Ethiopia, Zambia
Ethiopian nightshade (*Solanum aethiopicum*)	Cameroon, Chad
Black nightshade (*Solanum nigrum*)	Cameroon, Chad, Ethiopia
Solanum spp.	Cameroon, Chad, Ethiopia
Fameflowers (*Talinum* spp.)	Cameroon, Ethiopia
Zombie pea (*Vigna vexillata*)	Chad, Ethiopia
Vigna spp.	Chad, Ethiopia
Mammal species	
Golden jackal (*Canis aureus*)	Cameroon, Chad
Cephalophus spp.	Cameroon, Chad, Togo
Guenons (*Cercopithecus* spp.)	Cameroon, Chad
Colobuses (*Colobus* spp.)	Cameroon, Chad, United Republic of Tanzania
Gambian pouched rat (*Cricetomys gambianus*)	Cameroon, Gambia
Gambian sun squirrel (*Heliosciurus gambianus*)	Cameroon, Gambia
Hippopotamus (*Hippopotamus amphibious*)	Chad, Gambia
Crested porcupine (*Hystrix cristata*)	Cameroon, Chad, Gambia
Hares (*Lepus* spp.)	Chad, Gambia
African bush elephant (*Loxodonta africana*)	Cameroon, Chad, Senegal
Pangolins (*Manis* spp.)	Cameroon, Togo
Aardvark (*Orycteropus afer*)	Chad, Gambia
Lion (*Panthera leo*)	Chad, Senegal
Leopard (*Panthera pardus*)	Cameroon, Chad
Warthogs (*Phacochoerus* spp.)	Chad, Togo
Red river hog (*Potamochoerus porcus*)	Cameroon, Chad
Cape buffalo (*Syncerus caffer*)	Cameroon, Chad
Marsh cane rat (*Thryonomys swinderianus*)	Cameroon, Chad
Tragelaphus spp.	Cameroon, Chad, Gambia
African civet (*Viverra civetta*)	Cameroon, Chad
Bird species	
Pied crow (*Corvus albus*)	Cameroon, Chad
Francolinus spp.	Cameroon, Chad, Gambia, Togo
Tufted guineafowl (*Numida meleagris*)	Cameroon, Chad, Gambia
Spur-winged goose (*Plectropterus gambensis*)	Chad, Gambia
Streptopelia spp.	Cameroon, Chad, Gambia
Common ostrich (*Struthio camelus*)	Chad, Senegal
Tockus spp.	Cameroon, Chad
Reptile species	
Hinge-back tortoises (*Kinixys* spp.)	Cameroon, Chad
Savannah monitor (*Varanus exanthematicus*)	Chad, Togo
Nile monitor (*Varanus niloticus*)	Cameroon, Chad
Invertebrate species	
Western honey bee (*Apis mellifera*)	Cameroon, Togo
Fungi species	
Chanterelles (*Cantharellus* spp.)	Cameroon, Kenya
Termitomyces spp.	Cameroon, Togo

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

the uplands and the lowlands in search of grazing and water has been partly responsible for accelerated habitat degradation and loss. The report from Ethiopia mentions that overgrazing and excessive browsing by livestock has contributed to the degradation of the country's rangeland and forest ecosystems and their associated biodiversity.

Invasive species
The water hyacinth – a plant that spreads across water bodies and asphyxiates other aquatic organisms – is a growing concern in several countries and is regarded as a threat to the survival of some aquatic species. It also provides habitat for many organisms that are vectors of disease. The country report from Mali mentions that ponds and structures such as water-storage and irrigation installations near the Niger River are the sites most affected by this species.

Pollution
The country report from Zambia, citing Chama and Siachoono (2015), mentions that effluents from the mines in the Copperbelt discharge into the country's main river systems and negatively affect the diversity of butterflies and dragonflies and other benthic invertebrates as a result of elevated levels of redox, electrical conductivity and turbidity. Mali reports that the advent of gold mining has negatively affected the flora of the Sudano Guinean zone, which is home to the best timber species in the country. Ethiopia, citing Kifle, Hora and Merti (2014), reports that herbicide use is a major contributor to the decline of bee colonies.

Natural disasters
Kenya reports that frequent uncontrolled fires destroy forests and grasslands leading to the loss of plant, insect and micro-organism diversity. Cameroon also notes the threat posed by fires and also mentions volcanic eruptions. Ethiopia mentions that river floods, hailstorms and droughts have caused a significant amount of damage to livestock and crops in mixed systems and are likely to have resulted in the loss of a considerable amount of biodiversity, including associated biodiversity.

Climate change
Senegal reports that land salinization brought about by global warming is causing the death of many woody species. It also notes that land acidification is eliminating vegetative cover and that erosion is reducing plant biomass and degrading soil fertility, leading in turn to the emergence of parasitic plants such as *Striga* spp.

1.3.6 State and trends of associated biodiversity, ecosystem services and wild food resources

Kenya reports an increase in associated plant biodiversity in mixed and in irrigated (non-rice) crop production systems. In forest countries such as Cameroon, while there is reported to be an increase in biodiversity in natural forest production systems, there is a continuous decrease in biodiversity in other agro-ecosystems (livestock, fishery and crop systems). Overall, there is evidence that such changes in biodiversity for food and agriculture, especially changes in crop and forest systems, have affected the supply of supporting and regulating ecosystem services. According to the country reports, the main causes of these changes are (i) uncontrolled and illegal logging (in forest countries such as Cameroon and Gabon) and (ii) land conversion for agriculture. The country reports provide little information on the effects of changes in biodiversity in livestock and aquatic production systems.

The decline of forest genetic resources negatively affects the availability and diversity of wild food species. Countries report that land conversion for agriculture, climate change and invasive alien species are driving these effects. Overexploitation and overharvesting are also widely reported to be affecting the availability of wild foods, especially in the forest and fishing sectors. Zambia mentions a gradual depletion of timber resources that in turn

Box 1. Countermeasures taken to reduce adverse effects of drivers on associated biodiversity, ecosystem services and/or wild foods – examples from Ethiopia and Kenya

Countermeasures to overharvesting in Ethiopia

Overharvesting is one the drivers of associated biodiversity loss in Ethiopia. Where resources are considered to be communal property (e.g. grazing land, natural forests and lakes) overharvesting is common, as users try to maximize their current benefits. Various policies, laws and initiatives (projects) target the conservation of such resources. There is a need to ensure effective implementation of these measures.

Continuous assessment of threatened species and their conservation in Kenya

Species' IUCN Red-List statuses are under continuous review. In the case of plants, the East African Plant Red-Listing Authority holds committee meetings once or twice a year, involving taxonomists and conservation experts from the region, at which the conservation status of potentially threatened species is reviewed.

Source: Country reports of Ethiopia and Kenya.

affects the availability of non-wood forest products, including wild-food resources such as edible caterpillars and edible orchids. Similar trends are described for fish species in Zambia´s major rivers. Kenya reports a reduction in the diversity of natural products from forestry and fisheries, mentioning in particular saddle wood trees and the *omena* fish (the silver cyprinid, *Rastrineobola argentea*) in Lake Victoria. Cameroon and the Gambia report a gradual reduction in the diversity and availability of wild foods and note the significance of wildlife–human conflicts. Changes in wild-food availability in naturally regenerated forests are not documented in the country reports.

1.4 NEEDS AND PRIORITIES IN TERMS OF THE ASSESSMENT AND MONITORING OF BIODIVERSITY FOR FOOD AND AGRICULTURE

The main gaps, needs and priorities highlighted in the country reports with regard to the assessment and monitoring of associated biodiversity, wild foods and ecosystem services include the following:

- There is insufficient knowledge of associated biodiversity, wild foods and ecosystem services. Data on the status and populations trends are limited to wildlife species such as large mammals and threatened tree species. There is a need for wide-ranging studies on the status, trends and conservation of components of biodiversity and on the traditional knowledge pertaining to them.
- Institutions working on biodiversity focus mainly on the provisioning aspect of biodiversity for food and agriculture or on the conservation of wildlife and do not directly address associated biodiversity.
- Access to data on associated biodiversity, wild foods and ecosystem services needs to be improved.
- A lack of trained human resources, technology and finance is hampering the development of methods for the assessment and monitoring of associated biodiversity, wild foods and ecosystem services.
- Staffing shortages often mean that collection management and curation, the arbiters of correct species names, are inadequate. There is also a lack of growth/expansion of collections, largely as a result of changing policies on the collection of, and access to, genetic resources.

- Research on associated biodiversity and wild foods suffers from a general lack of funding, a lack of appropriate facilities (especially collection centres) and a lack of basic research on taxonomy and molecular systematics.
- Turnover of experienced taxonomists from collection facilities (e.g. museums) to universities, without replacement, coupled with diminishing interest in taxonomy among the younger generation of scientists, is contributing to a lack of capacity in this field.
- Institutional capacity and policy frameworks relevant to the assessment and monitoring of associated biodiversity, wild foods and ecosystem services need to be strengthened.
- Although the conservation of wild food resources has been integrated into general biodiversity policies, there are no specific policies or institutional arrangements directly targeting these resources. Given their contribution to food security in vulnerable areas, there is a need for policies that specifically address these resources.
- Legal frameworks addressing assessment, monitoring and national information systems need to be put in place, reviewed and/or strengthened and need to be enforced.
- There is a need to raise awareness of the importance of associated biodiversity, wild foods and ecosystem services to food security, nutrition and livelihood sustainability.

The country reports indicate that associated biodiversity is a rather new concept for policy-makers and agricultural researchers in the region and has seldom been incorporated, as such, into research and conservation programmes addressing biodiversity or genetic resources for food and agriculture. Most country reports highlight the need for research on wild food resources and the need to create awareness of their importance in local cultures and diets. With regard to protecting livestock diversity, several countries mention the need to expand and intensify surveillance and control activities for vector species of major diseases, many of which are benefiting from the effects of drivers such as overgrazing and climate change.

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

2.1 SUSTAINABLE USE

The livelihoods of rural people in sub-Saharan Africa have traditionally been closely tied to the use of biodiversity as a source of food, energy, fibre and other provisioning ecosystem services. However, these links are weakening. Reasons include increasing rural population densities, land fragmentation and habitat degradation. Closer ties between urban and rural cultures are often increasing pressure on natural resources and contributing to the homogenization of production systems. These trends are aggravated by changes in the climate and in global demand for food, timber, land and minerals. Ensuring the sustainable use and conservation of biodiversity for food and agriculture in sub-Saharan Africa requires urgent measures to counteract these trends.

A number of country reports provide information on the implementation of various management practices relevant to the sustainable use of biodiversity for food and agriculture (Table 5). However, the reports provide limited information on the extent of area coverage of these management practices within production systems, on trends in their use or on their impacts on biodiversity for food and agriculture. The management practices reported by countries span almost all of the production systems identified above (Table 2). In most cases, their implementation is reported to be increasing or stable. Several of the successful examples of the implementation of management practices reported by countries involve the participation of the local communities (Box 2).

Several countries report generic measures taken to limit unsustainable use and/or support the sustainable use of associated biodiversity and wild food resources. Many such measures are intended to protect forest ecosystems. The report of Mali, for example, mentions, *inter alia*, the following measures:

- updating the list of target species actively managed in conservation programmes;
- development of a resource-conservation policy;
- establishment of local agreements for the management of community forests in several localities;
- promotion of synergy between forestry research and development;
- conservation of forest seeds;
- application of methods for evaluating non-timber forest products (NTFPs);
- application of techniques for the domestication of forest species;
- application of methods for the sustainable management of forest species;
- wide dissemination of research results (assessment of 30 years of forestry research, dissertations, theses, scientific articles and technical sheets);
- development of participatory approaches;
- establishment of a multi-institutional committee to monitor the conservation of forest species and the development of incentives for the conservation of forest species; and
- provision of material and financial resources.

The country reports generally reflect a perception that there are close links between associated biodiversity and wild foods and forest ecosystems. The report from Zambia states that harvested forest products make a significant contribution to the incomes of the rural poor. Citing Puustjärvy, Mickels-Kokwe and Chakanga (2005), it notes that forests have been estimated to supply 20.6 percent of the income of rural households.

Table 5. Reported trends in the adoption of selected management practices and approaches in the region

Practices and approaches	Production systems	Countries reporting	Reported trends in the adoption of the practice
Landscape management	Livestock grassland-based systems, Livestock landless systems, Naturally regenerated forests, Planted forests, Irrigated crops (rice), Irrigated crops (other), Mixed systems	Burkina Faso, Ethiopia, Gambia, Kenya, Mali, Togo, Zambia, Zimbabwe	Largely unknown; increasing tendencies in mixed systems and in naturally regenerated forests; mixed trends in irrigated crop systems
Ecosystem approach to capture fisheries	Self-recruiting capture fisheries, Culture-based fisheries, Fed aquaculture, Mixed systems	Burkina Faso, Ethiopia, Kenya, Mali, Togo, Zambia, Zimbabwe	Mixed trends in self-recruiting capture fisheries; increasing in culture-based fisheries and mixed systems
Restoration practices	Livestock grassland-based systems, Naturally regenerated forests, Planted forests, Irrigated crop (rice) systems, Irrigated crop (other) systems, Mixed systems	Burkina Faso, Ethiopia, Gambia, Kenya, Mali, Togo, Zambia, Zimbabwe	Strongly increasing in naturally regenerated and planted forests, and in mixed systems; Upward or unknown trends in livestock grassland-based systems
Diversification	Livestock grassland-based systems, Livestock landless systems, Naturally regenerated forests, Planted forests, Self-recruiting capture fisheries, Irrigated crop (rice) systems, Irrigated crop (other) systems, Mixed systems	Burkina Faso, Ethiopia, Gambia, Kenya, Mali, Togo, Zambia, Zimbabwe	Generally increasing in all production systems and strongly increasing in rainfed crop systems; trends are largely unknown in naturally regenerated forests
Home gardening	Livestock grassland-based systems, Livestock landless systems, Planted forests, Irrigated crop (other) systems, Mixed systems	Burkina Faso, Cameroon, Ethiopia, Gambia, Kenya, Mali, Togo, Zambia, Zimbabwe	Unknown or increasing in most systems, with upward trends particularly in irrigated crop (other) and mixed systems; decreasing in rainfed crop systems in Zimbabwe
Agroforestry	Livestock grassland-based systems, Naturally regenerated forests, Planted forests, Irrigated crop systems, Mixed systems	Burkina Faso, Cameroon, Ethiopia, Gambia, Kenya, Mali, Togo, Zambia, Zimbabwe	Generally unknown or increasing, with upward trends particularly prominent in naturally regenerated forests; mixed trends in irrigated crop systems
Polyculture/aquaponics	Naturally regenerated forests, Planted forests, Self-recruiting capture fisheries, Irrigated crop systems, Mixed systems	Burkina Faso, Ethiopia, Gambia, Kenya, Mali, Togo, Zambia, Zimbabwe	Largely unknown or stable trends; increasing in naturally regenerated and planted forests (polyculture)
Organic agriculture	Livestock grassland-based systems, Livestock landless systems, Naturally regenerated forests, Planted forests, Irrigated crop (rice) systems, Irrigated crop (other) systems, Mixed systems, Apiculture	Burkina Faso, Cameroon, Ethiopia, Gambia, Kenya, Mali, Togo, Zambia, Zimbabwe	Largely unknown; stable or increasing in irrigated crop (other) and mixed systems and stable or decreasing in irrigated rice systems
Low external input agriculture	Livestock grassland-based systems, Livestock landless systems, Naturally regenerated forests, Planted forests, Irrigated crop (rice) systems, Irrigated crop (other) systems, Mixed systems	Burkina Faso, Ethiopia, Gambia, Kenya, Mali, Togo, Zambia, Zimbabwe	Largely unknown; increasing in mixed systems, mixed trends in rainfed crop systems and naturally regenerated forests and stable or decreasing in irrigated rice systems
Sustainable soil management practices	Livestock grassland-based systems, Naturally regenerated forests, Planted forests, Irrigated crops (rice), Irrigated crops (other), Rainfed crops, Mixed systems	Burkina Faso, Cameroon, Ethiopia, Gambia, Kenya, Mali, Togo, Zambia, Zimbabwe	Increasing in all systems except livestock grassland-based systems, where trends are unknown
Management of micro-organisms	Naturally regenerated forests, Planted forests, Irrigated crop (other) systems, Mixed systems	Burkina Faso, Ethiopia, Gambia, Kenya, Mali, Togo, Zambia, Zimbabwe	Strongly increasing in naturally regenerated and planted forests, and in mixed systems Upward or unknown trends in rainfed and irrigated crop (other) systems
Conservation agriculture	Livestock grassland-based systems, Livestock landless systems, Naturally regenerated forests, Planted forests, Irrigated crops (rice), Irrigated crops (other), Rainfed crops, Mixed systems	Burkina Faso, Ethiopia, Gambia, Kenya, Mali, Togo, Zambia, Zimbabwe	Generally increasing; unknown in Ethiopia and the Gambia; decreasing in irrigated crop (other) systems in Zimbabwe

Table 5 *Cont'd*

Practices and approaches	Production systems	Countries reporting	Reported trends in the adoption of the practice
Integrated plant nutrient management	Livestock grassland-based systems, Livestock landless systems, Naturally regenerated forests, Planted forests, Irrigated crops (rice), Irrigated crops (other), Mixed systems, Rainfed crops	Burkina Faso, Ethiopia, Gambia, Kenya, Mali, Togo, Zambia, Zimbabwe	Generally unknown or increasing; in Zimbabwe, decreasing in rainfed crops and stable in planted forest systems
Integrated pest management	Livestock grassland-based systems, Livestock landless systems, Naturally regenerated forests, Planted forests, Irrigated crops (rice), Irrigated crops (other), Rainfed crops, Mixed systems	Burkina Faso, Ethiopia, Gambia, Kenya, Mali, Togo, Zambia, Zimbabwe	Generally unknown or increasing, but decreasing in rainfed-crop and mixed systems
Pollination management	Livestock grassland-based systems, Naturally regenerated forests, Planted forests, Irrigated crops, Mixed systems, Apiculture	Burkina Faso, Cameroon, Ethiopia, Gambia, Kenya, Mali, Togo, Zambia, Zimbabwe	Generally unknown; in Zimbabwe, increasing in irrigated, rainfed crop and mixed systems, as well as in apiculture; in Kenya, increasing in mixed systems; in Togo, increasing in irrigated crop systems
Enrichment planting	Livestock grassland-based systems, Naturally regenerated forests, Planted forests, Mixed systems	Burkina Faso, Ethiopia, Gambia, Kenya, Togo, Zambia, Zimbabwe	Strongly increasing in naturally regenerated and planted forests, and in mixed systems; in Kenya, decreasing in mixed systems
Reduced impact logging	Livestock grassland-based systems, Naturally regenerated forests, Planted forests, Mixed systems	Burkina Faso, Ethiopia, Kenya, Togo, Zambia, Zimbabwe	Mixed trends in naturally regenerated forests and rainfed and irrigated crop (other) systems; particularly negative trends in Zimbabwe, but positive trends in Burkina Faso; increasing in mixed systems
Domestication	Livestock grassland-based systems, Livestock landless systems, Naturally regenerated forests, Planted forests, Irrigated crop (other) systems, Mixed systems	Burkina Faso, Ethiopia, Gambia, Kenya, Mali, Togo, Zambia, Zimbabwe	Generaly unknown or stable; mixed trends in naturally regenerated forests; increasing in mixed systems
Base broadening	Livestock grassland-based systems, Livestock landless systems, Planted forests, Self-recruiting capture fisheries, Irrigated crop (rice) systems, Irrigated crop (other) systems, Mixed systems	Burkina Faso, Ethiopia, Gambia, Kenya, Togo, Zambia, Zimbabwe	Generally increasing in most production systems; strongly increasing in livestock grassland-based, livestock landless, rainfed crop and mixed systems

Note: For a description of the management practices and approaches, see Chapter 5 in FAO (2019).
Source: Country reports prepared for *The State of the World's Biodiversity for Food and Agriculture* (FAO, 2019).

2.1.1 Examples whereby diversity *per se*, or its lack, has had a direct effect on productivity, food security and nutrition, rural livelihoods, ecosystem services, sustainability, resilience or sustainable intensification

Biodiversity, food security and nutrition

The country reports generally include few documented examples of direct positive effects of diversity on productivity, food security and nutrition or rural livelihoods. However, several mention that the loss of biodiversity has had negative effects on food security and nutrition. For example, Ethiopia reports that the use of inappropriate fishing gear, overfishing and the spread of alien invasive species (specifically water hyacinth) have significantly affected fish yield and diversity, reducing the availability of fish for consumption and increasing fish prices on the market. The report further mentions that drainage of nitrogen and phosphorus from irrigated agricultural fields and greenhouses into freshwater bodies has led to gradual depletion of fish diversity, again with negative effects on the availability of fish for local consumption. The same report also indicates that high levels of pesticide use have affected local bees and other pollinators, with negative consequences for crop productivity. The report

Box 2. Successful sustainable management programmes involving local communities

The Gambia's Expansion of Community Participation in the Management of Forests and Protected Areas project aims to promote the management of forest resources as a continuous source of products that can contribute to sustainable livelihoods. More specifically, it aims to improve and maintain biological diversity in forest and woodland ecosystems, to minimize soil desiccation and soil movement caused by water and wind erosion, and to empower communities and enhance their capacity to manage their local forests. Positive outcomes have included an increase in the earnings of the communities involved, the establishment of a community tree nursery network for large-scale tree planting, an increase in the supply of forest resources and the regeneration of forest areas.

In **Kenya**, the involvement of communities in the co-management of fishing resources has been strengthened through the enactment of legislation that established beach-management units, set standards for fishing gear, banned destructive fishing gear and practices and established closed fishing seasons to allow stocks to recover

In 1998, the World Agroforestry Centre initiated a long-term research initiative on participatory domestication of high-value indigenous fruit and nut trees and medicinal plants with income-generating and nutritional potential in West and Central Africa, specifically in **Cameroon, the Democratic Republic of the Congo, Equatorial Guinea, Gabon and Nigeria** (Leakey, Schreckenberg and Tchoundjeu, 2003; Tchoundjeu *et al.*, 1998, 2006, 2010). "Participatory tree domestication" refers to a process in which rural communities select, propagate and manage trees according to their own needs, in partnership with scientists, civic authorities and commercial companies (Tchoundjeu *et al.*, 2006). The process involved: (i) a first participatory priority species selection – there proved to be high demand for fruit and nut species such as bush mango (*Irvingia gabonensis*) and African plum (*Dacryodes edulis*); (ii) development of propagation methods for the selected priority species, based on appropriate low-technology methods and adapted to farmers' capacities; (iii) selection of mother trees with desired traits; and (iv) training of farmers on the management of pilot nurseries and on participatory tree-domestication techniques (Leakey, Schreckenberg and Tchoundjeu, 2003). Over the years, rural communities have increasingly reported improvements in their livelihoods, diets, health and incomes. As of 2010, over 6 000 farmers from around 300 communities were engaged in the programme (Tchoundjeu *et al.*, 2010).

The report from **Zimbabwe** mentions the implementation of community-managed protected areas for indigenous resources (CAMPFIRE) and community-based natural resource management (CBNRM) practices. Community-based sensitization and educational programmes have been implemented through local leaders and farmer groups. Programme activities have aimed to empower local people with knowledge about the importance of sustainably using associated biodiversity and wild foods. Among other objectives, these interventions focus on the need for sustainable harvesting of wild food plants in order to ensure that they remain available for future generations.

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

from Zimbabwe refers to rural people having less access to medicinal plants due to the loss of various herb and tree species and/or the degradation or disappearance of the ecosystem patches where they occurred. Zambia, as noted above, mentions that loss of forest cover is affecting the availability and accessibility of wild foods that are key to some local diets.

The report from Ethiopia notes that in order to strengthen the contribution of biodiversity to food security and nutrition, new varieties of fruits and vegetables – and associated management practices – have been introduced in various parts of the country, mostly in mixed production systems. For example, in southwestern Ethiopia, new varieties of fruits and vegetables, use of

organic manure and integrated pest management have resulted in a 70 percent improvement in nutrition and a 60 percent increase in crop yields (the country report cites Scialabba and Hattam, eds, 2002). The report further notes that the productivity of agricultural crops increased by 40 percent between 2005 and 2010 as result of the integration of different crop management systems and the use of improved varieties. Most of these varieties were developed from landraces by agricultural research centres within the country. Finally, the report also mentions that marketing opportunities are vital to efforts to improve rural livelihoods. It notes that up to 47 082 households in the Oromia, Amhara and Southern Nations, Nationalities and Peoples' Regions are benefiting from improved marketing strategies for agricultural products (coffee, durum wheat, teff and enset) (the report cites UNDP, 2013).

Where livestock are concerned, Ethiopia reports that efforts have been made to improve livelihoods in grassland-based systems by devising strategies to improve pasture management within a value-chain approach. Zambia mentions a government programme that promotes local small-ruminant and chicken breeds through the "pass-on"[3] system and has helped to improve productivity, food security and rural livelihoods. A project in Senegal promoting locally adapted livestock breeds that are resistant to diseases is described in Box 3.

The report from Burkina Faso notes that NTFPs are important contributors to food, nutrition and incomes and offer opportunities to improve people's lives while protecting forest resources. NTFPs are reported to contribute to the diets of more than 43 percent of the country's households and to provide rural households with 23 percent of their income. The report mentions (citing MEDD, 2011) the generation of approximately CFA franc 25.6 billion from NTFPs and notes that an increasing number of small and medium-sized forest enterprises have been created. It further notes (citing Lamien and Vognan, 2001) that NTFPs represent 44 percent and 26 percent, respectively, of women's and men's incomes in the southwestern part of the country. Another study cited (Somda *et al.*, 2010) showed that the value of timber resources and NTFPs represented, respectively, 37 percent and 21 percent of the overall economic value attributed to the Sourou Valley (located in the north of country). Wild game meat reportedly contributes significantly to food security in villages close to hunting areas and even in some medium-sized towns.

The report from Senegal mentions the country's rich fish biodiversity: about 799 species, including 652 marine species and 147 freshwater species (the report cites FishBase, 2012); of these, 142 species are reported to be of commercial and economic interest. The report also mentions the presence of nearly 260 species of multipurpose marine algae, which are harvested by some fishers and other coastal people, especially women. Daily harvests can reportedly reach as much as 500 tonnes of biomass, although the report notes that in the absence of a monitoring system, precise levels of harvesting remain unknown. In the case of river and lake ecosystems, fisheries reportedly provide only about 25 percent of fresh-produce requirements and are therefore complemented by aquaculture. The report further notes that fishing is a crucial activity for the country's poor people, with artisanal sea fishing accounting for more than 95 percent of output. The output of industrial fisheries is reported to have declined during the period 2005 to 2011, while the value of the catch rose. The latter trend is explained by the export of fish to the highly profitable European market – a factor that is, at the same time, creating strong tensions in domestic markets due product scarcity.

[3] The Government of Zambia has initiated a livestock-stocking and restocking programme, based on the pass-on repayment system. In this system, smallholders receive animals and agree, through a signed contract, to transfer the equivalent first female offspring to another member of the group when the animals reach 6–12 months of age. Male offspring will be reared and sold, with the income generated used to purchase female stock. One-third of the smallholder group that participates in the programme will receive a predefined livestock investment package, which will be passed on in the following year to the other group members. It is expected that each group will engage in at least two pass-on cycles (IFAD, 2014).

Box 3. Regional Project for Sustainable Management of Globally Significant Endemic Ruminant Livestock

Trypanotolerant Ndama cattle and Djallonké sheep and goats are under threat because of habitat degradation caused by deforestation and abusive logging and because of agricultural policies that promote the intensification of production and the introduction of exotic breeds.

The Regional Project for Sustainable Management of Globally Significant Endemic Ruminant Livestock (commonly referred to using the French acronym PROGEBE) took action to improve the management of natural resources and endemic livestock breeds and their products in several West African countries. Land-use plans were discussed and validated by rural communities and rules for the use of natural resources in target areas established. Action was also taken in the fields of animal health and nutrition, access to water and access to markets.

Source: Country reports of Guinea, Mali and Senegal.

The report from Mali notes that the country's rural populations have a long tradition of maintaining home gardens – plots located close to dwelling places that combine fruit trees, forest trees and horticultural plants and provide products for commercial purposes and home consumption. It highlights the fact that these gardens are important to the diets of rural households and notes that they have contributed to the maintenance of many fruit and horticultural varieties.

Relevant initiatives not mentioned in the country reports include the NutriHAF-Africa "Diversifying agriculture for balanced nutrition through fruits and vegetables in multi-storey cropping systems" project. Launched in 2015 and involving the Center for Development Research (ZEF)[4] of the University of Bonn, Germany, the Global Horticulture Initiative (GlobalHort)[5] the World Vegetable Center[6] and others, the initiative promotes the introduction of new varieties of fruits and vegetables with the aim or reducing malnutrition and conserving biodiversity and natural resources in Ethiopia and Madagascar.[7]

Biodiversity, ecosystem services, sustainability and resilience

Biodiversity is the basis for ecosystem service provision and hence for value production in rural landscapes and seascapes. The most widely accepted definition of ecosystem services follows the "cascade" approach proposed by Haines-Young and Potschin (2010), according to which the structures and processes of an ecosystem result in a number of ecological functions. These functions are seen as services when they "serve" human societies in one way or another. Societies ascribe values, monetary or otherwise, to such services according to their needs, priorities and culture. A somewhat alternative view is that ecosystem services are co-produced by humans and nature and hence that their assessment requires a social–ecological approach (Reyers *et al.*, 2013).

In a diverse landscape, ecosystem functions and services are highly interdependent. For example, a landscape with sufficient associated biodiversity in the form of trees, shrubs and grasses to provide shelter and feed for insect pollinators is also likely to host a wide range of arthropods that can act as pest-control agents, to have rich soil biodiversity, to contribute to

[4] https://www.zef.de/zefhome/
[5] http://www.globalhort.org/
[6] https://avrdc.org/
[7] https://www.zef.de/projects/project-details.html?project=44&contact=1767&cHash=a2a1f682b1ccbffdf063d0601119166d

regulation of the microclimate by providing shade or shelter from the wind and to contribute to water regulation by controlling infiltration, runoff and evapotranspiration. This is why there is now a tendency to refer to ecosystem service bundles (Raudsepp-Hearne, Peterson and Bennett, 2010) and/or multifunctional landscapes (Turner *et al.*, 2014). A study in Kenya by Henry *et al.* (2009) showed a strong positive relationship between perennial plant biodiversity and carbon sequestration at farm level. However, ecosystem services may come at the expense of one another and potential trade-offs needs to be considered when planning management interventions (Wang and Fu, 2013).

The report from Ethiopia mentions that a participatory forest management scheme has been developed and implemented to strengthen the contribution of the country's forests to ecosystem services and resilience. It notes that participatory forest management has been implemented on 82 000 ha of natural forests in Amhara National Regional State and in ten forest areas covering a total of 333 704 ha in Oromia National Regional State. In the latter region, 76 cooperatives consisting of 148 796 members of local communities are reported to have been established. The report from Burkina Faso notes (citing PAGREN, 2012) that enrichment of the gazetted forests of Dindéresso and Kou with baobab, grafted jujube (*Ziziphus* spp.) and the local plum tree (*Sclerocarya birrea*) increased the quantity of NTFPs exploited by women (ibid.), ensured food security and brought substantial revenues to local populations. These changes have contributed to sustainable forest management and to reducing vulnerability. The Gambia notes that, in addition to contributing about 1 percent to its gross domestic product, the country's forests provide 85 percent of its domestic energy requirements, in the form of fuelwood and charcoal, and 17 percent of the population's timber requirements, and also serve as an important source of medicines and livestock forage. The Gambia's National Forest Assessment 2008–2010 notes that forests also provide a number of other services to the country's people, including windbreaks, grazing areas, shade, and soil and water conservation.

Biodiversity, sustainable intensification and landscape restoration

The concept of sustainable intensification generates much debate, partly because of the "soft", subjective nature of the term "sustainability". What is perceived as being sustainable by one individual or community may be regarded as unsustainable by others. The concept of ecological intensification, in contrast, refers specifically to strategies that pursue intensive use of the natural functionalities of an ecosystem through species diversification (Tittonell, 2014). An example of such an approach is the so-called push–pull pest management strategy. The push–pull is a stimulus–deterrent strategy that consists of repelling (or "pushing") insect pests away from a crop and simultaneously attracting (or "pulling") them to a "trap" crop. Natural enemies are also attracted to the crop to provide biological pest control. Push–pull effects may be achieved through a number of ecological mechanisms mediated by volatile compounds called semiochemicals (semio = signal). These substances are produced by plants, insects and other organisms and send specific chemical signals to target insects, in this case pushing undesirable insects away from the crop and attracting predator or parasitoid insects into the area.

Although the chemical ecology of many of the plant defence mechanisms behind the push–pull effect is not fully understood, there is strong evidence, especially from Africa (Box 4), that careful planning of cropping systems in space and time can substantially reduce pest infestation. The right choice of companion plants, trap crops and intercropping systems can greatly influence pest population dynamics. Kebede *et al.* (2018) show that the abundance and dynamics of pests and natural enemies in farmers' fields in highly populated and intensively farmed landscapes of southern Ethiopia are greatly influenced by the surrounding biodiversity.

Other examples of the use of biodiversity for ecological intensification in Africa can be found in the field of integrated soil fertility management and soil restoration. For example, Nezomba *et al.* (2015) show the potential of using indigenous, naturally occurring herbaceous

Box 4. Ecological intensification through push–pull in Kenya

The International Centre for Insect Physiology and Ecology (ICIPE), located in western Kenya, has developed one of the most successful and best known push–pull cropping systems for the tropics: maize–legume intercrops surrounded by fodder grasses to reduce infestation by a major insect pest known as the maize stemborer. The adult stemborer lays eggs on a maize plant and the larvae that emerge after hatching enter the stem of the plant and eat it hollow from inside. Observations in the field indicated that legume species such as silverleaf desmodium repel stemborers, probably through semiochemicals known as homoterpenes, which also act as attractants of parasitoid species. It was also observed that common grass-fodder species such as Napier grass, which belong to the same botanical family as maize, are able to attract egg laying by stemborers. Growing a maize crop in rows interspaced with rows of desmodium and surrounded by rows of Napier grass can both repel (push) stemborers and attract (pull) them to the field margins. There are also additional benefits. Desmodium, like most legume species, is able to fix atmospheric nitrogen and thus contribute to soil fertility. Napier grass rows can act as physical barriers that reduce water runoff and soil erosion during heavy rainfall and can also provide feed for livestock.

Source: ICIPE (2015).

legume species as "improved" fallows to restore soil fertility in Zimbabwe. Taking advantage of remaining soil moisture, these legumes can continue growing into the dry season, providing soil cover, producing biomass and fixing atmospheric nitrogen. Kintché *et al.* (2015) show the potential of short-period fallows that promote associated biodiversity to reduce long-term yield decline in continuously cropped agricultural soils in Togo. In Ethiopia, community exclosures to remove grazing pressure resulted in the recovery of the organic-matter content of farmland soils and in greater carbon sequestration and water regulation (Corral-Nuñez *et al.*, 2014). In the Sahel, farmers have been using native ligneous species in combination with other soil conservation measures to manage long-term soil productivity. For example, shrub species of the genera *Piliostigma* and *Guiera* can be seen growing in and around crop fields in Burkina Faso, Mali, Niger and Senegal, where they are managed by famers to serve as islands of fertility that trap nutrient-rich sediments, host soil biodiversity and/or provide hydraulic lift effects (Lahmar *et al.*, 2012). Soil amendment with woody biomass collected from shrubs and trees has contributed substantially to the restoration of degraded soils – or halting degradation – in Burkina Faso (Félix *et al.*, 2018).

In the United Republic of Tanzania, *ngitili* is a traditional management practice whereby grazing in areas of rangeland is restricted during wet seasons to provide forage for livestock during dry periods (Barrow and Mlenge, 2003). There are two types of *ngitili*: enclosures owned by individuals or families and communal enclosures owned and managed in common. Both were originally developed by the Sukuma people in response to acute animal-feed shortages caused by droughts, conversion of grazing land into cropland and declining land productivity (ibid.). The Shinyanga Soil Conservation Programme, better known by its Swahili acronym HASHI, aims to work with local people to revive *ngitili*, first by identifying areas requiring urgent land restoration and then by restoring these areas according to customary practice (WRI, 2005). In many villages, residual natural seed and rootstock have been used to restore *ngitili* enclosures. Some of the restored *ngitili* date back to the 1960s and 1970s, before "villagization" in the United Republic of Tanzania, and others have been newly created. Restoration and tree planting around homesteads has helped improve soil fertility and provided fuelwood. It has also had the additional benefit of helping farmers to stake out and formalize their land rights within villages (ibid.).

The country report from Ethiopia describes a "system of crop intensification" based on raising seedlings and transplanting them at a young age with wide spacing. The country's Agricultural Transformation Agency is applying, evaluating and extending these concepts and practices as a means of increasing production of Ethiopia's main staple grain, teff. In the 2012/13 cropping season, 160 000 Ethiopian farmers who participated in on-farm trials using the less-intensive, direct-seeded version of the system obtained an average yield increase of 70 percent, while another 7 000 farmers who used the recommended, more-intensive method, which involves transplanting, obtained yield increases of 200 to 300 percent, while using 50 to 90 percent fewer seeds (the report cites ATA, 2013). The approach does not necessarily involve the use of a wider range of biodiversity. However, it contributes to farmers' incomes and thereby to maintaining a rural population active in agriculture, which is essential to the conservation of biodiversity for food and agriculture.

2.1.2 Countries in the region reporting the use of biodiversity for food and agriculture for coping with climate change, invasive alien species or natural or human-made disasters

The country reports do not provide extensive information on the use of biodiversity for food and agriculture to cope with climate change, natural disasters or control invasive species. The focus is mostly on reporting genetic improvement programmes aimed at increasing the ability of crops to withstand increasing climatic variability. Where the country reports do note initiatives, projects or frameworks promoting the use of biodiversity for food and agriculture to cope with climate change, natural disasters or invasive species they generally provide little detail. Actions mentioned are included among the examples presented in Table 6.

Seed banks and farmer–researcher partnerships are mentioned in several country reports as a means of ensuring the uptake and conservation of crop and animal genetic diversity that builds resilience to the effects of climate change. Tree plantations are also mentioned as a mechanism for coping with climate change. Some countries – Kenya for example – have national climate change adaptation strategies that, where agriculture is concerned, place great emphasis on diversification and the management of genetic resources. Use of local varieties and switching to drought-resistant crops and cultivars in dry years is mentioned in several country reports. Both Kenya and the United Republic of Tanzania have launched open seed source projects, sponsored by FAO. The following list of actions presented in the country report from Senegal provides a good illustration of the types of measures most countries are taking to adapt their agriculture to climate change:

- use of very early crop varieties in agricultural production systems;
- raising several species within the holding;
- planting various species to fix dunes along the whole coast and in other areas that are being reforested and to promote the conservation of soil in the face of wind or water erosion; and
- integrated pest management.

The country report from Gabon refers to forest conservation in general and specifically to the creation of 13 national parks as actions that promote climate regulation through carbon sequestration and storage. The forest cover also provides other goods and services relevant to climate change adaptation, including the supply of food, energy and medicines. The report from Guinea also emphasizes forest management and conservation as mechanisms through which biodiversity's contributions to climate change adaptation and mitigation can be enhanced. Actions mentioned include the following:

- creation of forest plantations;
- provision of protected areas;
- implementation of agrosilvopastoral practices;
- co-management of classified forests; and
- creation and management of community forests.

Table 6. Examples from countries in the region of use of biodiversity for food and agriculture to cope with climate change, invasive alien species or natural or human-made disasters

Countries	Description
Objective 1: Use of biodiversity for food and agriculture to adapt to and mitigate climate change	
Ethiopia	Ethiopia has an advanced and decentralized scheme based on community seed and gene banks, through which farmers and researchers cooperate to test, adopt and conserve landraces of the country's most important crops – teff, barley, chickpea, sorghum and faba bean – that were nearly lost during the drought of the 1980s. The plant species and varieties conserved in community seed banks also serve as a backup of planting material in cases of crop failure. The scheme serves as a repository of locally adapted crop diversity, including enhanced farmers' varieties that are competitive in yield and other desirable characteristics with high-input varieties, which can be poorly adapted to local conditions. Another study demonstrated that when farmers expect low rainfall, they increase farm diversity. *Source*: FAO, 2015b, c; Di Falco, Bezabih and Yesuf, 2010; Worede, 2011.
Mali	Mali has included the intensification of the use of agrobiodiversity in its National Adaptation Programme of Action (NAPA). The long-standing vulnerability of Mali's agriculture sector to variability in precipitation and drought has sensitized the government to the need for climate change-related planning. Some relatively high-profile, internationally funded projects with agrobiodiversity components linked to climate change have also probably contributed to the inclusion of some activities of this kind in the Mali NAPA. Large-scale plantations of the gum arabic tree (*Acacia senegal*) are being promoted in Mali and other Sahelian countries, including through the Great Green Wall for the Sahara and the Sahel Initiative, to promote climate change mitigation, restore degraded landscapes and create jobs. *Source*: FAO, 2015b; GGW, 2018; Mali NAPA, 2007.
Kenya	The National Climate Change Response Strategy provides a framework for the use of biodiversity for food and agriculture to cope with climate change. An action plan to implement this strategy is in place. Kenya is keen to employ multipronged mitigation initiatives and is focusing on exploiting genetic resources to combat climate change. The country has launched a national strategy on genetic resources within the context of climate change for the 2016–2020 period. The strategy outlines constraints and opportunities and sets out mitigation and adaptation strategies. An open seed source project sponsored by FAO is being implemented in the country. *Source*: FAO, 2014b; GeRRi, 2015; MoE, 2016.
United Republic of Tanzania	An open seed source project sponsored by FAO is being implemented in the country. Widely practised traditional coping strategies in the semi-arid zone include switching to drought-tolerant species or varieties. Farmers use improved maize and sorghum varieties, combined with continued use of local varieties. Recycling of improved varieties is also widely practised. *Source*: Westengen and Brysting, 2014; FAO, 2018.
Senegal	Activities include: • use of very early crop varieties in agricultural production systems; • raising of several species within the holding; • planting of different species to fix dunes along the whole coast and in other areas that are being reforested and to enhance soil conservation in the face of wind or water erosion; and • integrated pest management. *Source*: Country report.
Objective 2: Use of biodiversity for food and agriculture to manage the spread/control of invasive alien species	
Ethiopia	Within the framework of a Global Environment Facility (GEF) funded project, Ethiopia has developed a National Invasive Species Strategy and Action Plan. The plan features integrated approaches to the control of invasive alien species that include biological interventions. Laboratory facilities have been developed over the course of the project to mass-rear weevils for use in controlling water hyacinth. *Source:* Boy and Witt, 2013.
Zambia	The weevils *Neochetina echhorniae* and *N. bruchi* have been released as part of a long-term strategy to control water hyacinth infestations on the Maramba River through a GEF-funded project. The project has also promoted the use of other biocontrol agents at pilot sites, including use of the leaf-mining beetle lantana hispid (*Uroplata girardi*) to control largeleaf lantana (*Lantana camara*) shrubs. The beetles are imported from South Africa under the terms of Zambia's Plant Quarantine and Phytosanitary Act. Signs of the efficacy of this method of controlling *Lantana camara* are now widely evident in the Mosi-oa-Tunya National Park. After the removal of the invasive species, a wide range of native species have been planted to rehabilitate the sites or have naturally regenerated. *Source*: Boy and Witt, 2013.
Objective 3: 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	
Ethiopia	In many areas of the country where drought causes famine, coping mechanisms include increased use of wild edible plants and use of early-maturing crop varieties. In some parts of southern Ethiopia, use of food from wild trees increases during famines; about 12 species that are not consumed during normal periods are consumed and the consumption of wild food plants reportedly ranks second as a coping mechanism for surviving famines (Assefa and Abebe, 2011). Short-season crop varieties have been deployed in cases where the crop growing season was affected by climate variability or other factors. *Source*: Country report; IRI, 2007.
Zambia	Non-wood forest products, such as caterpillars and wild fruits, have become important means of generating household income in major towns and cities as an alternative to traditional crops affected by drought. *Source*: Country report.

Many country reports mention the invasive species water hyacinth as a serious and growing threat. For example, the report from Chad highlights the impact of water hyacinth and other invasive species of the genus *Typha* on the hydrology of Lake Chad and habitats where key fish species reproduce, noting that this poses a threat to fishing livelihoods. It further notes that such invasions are greatly influenced by human interventions upstream. Similarly, Mali mentions problems with water hyacinth, typhas and water ferns (*Salvinia molesta*), all of which are associated with water pollution. Senegal notes that pollution is affecting river and lake environments, including in the valley of the Senegal River, where the use of chemicals in agriculture has led to eutrophication of water, which in turn has greatly contributed to the proliferation of southern cattail (*Typha domingensis*). In many cases, countries do not mention any biological or biodiversity-based approaches to control water hyacinth. In Cameroon, for example, control efforts are reported to be based mainly on manual removal or in some cases the use of sprays. Ethiopia, however, reports that activities under its National Invasive Species Strategy and Action Plan (associated with a Global Environment Facility project) include the development of facilities to rear weevils (*Neochetina echhorniae* and *N. bruchi*) used in the biological control of water hyacinth. Zambia mentions that this method has been used to control water hyacinth in the Maramba River. It also mentions the use of biological control measures against invasive shrubs in national parks.

Some countries note that biodiversity for food and agriculture provides key resources for rural communities during drought-driven famines and other disasters. Ethiopia and Zambia mention trees and other species that are harvested as food during droughts but not during years when rainfall is normal.

2.1.3 Ecosystem/landscape/seascape approaches[8] that have improved the management and use of BFA in the region

Although some examples are provided, the country reports suggest that the implementation of ecosystem, landscape and seascape approaches remains limited in the region. In some cases, plans and programmes that may follow an ecosystem approach are in place but are not reported as such in the country reports. In other cases, initiatives reported as ecosystems approaches do not really follow this approach. Reported cases are summarized in Table 7. A good example can be found in the report from Zambia, which describes the adoption of an ecosystem approach to fisheries, forestry and rainfed crop production. The report mentions that adoption of the ecosystem approach in forestry is being promoted through the involvement of local communities and traditional leaderships in the implementation of interventions. In the case of rainfed crop production, agroforestry has been intensively promoted over the past ten years and this has led to better productivity and resilience to droughts. In the case of fisheries, adoption of the ecosystem approach is a recent development and results have not yet been documented.

The report from the Gambia states that most of the relevant institutional frameworks in the country follow an ecosystem approach to natural-resources management. For example, the Gambia Environmental Action Plan (2009–2015), which addresses the protection of existing forests, vegetative cover and coastal wetlands, the Agricultural and Natural Resources Policy

[8] The ecosystem approach concept is generally understood to encompass the management of human activities, based on the best understanding of the ecological interactions and processes, so as to ensure that ecosystems structure and functions are sustained for the benefit of present and future generations. Ecosystem approaches include the Convention on Biological Diversity's Ecosystem Approach, Integrated Land Use Planning, Integrated Water Resource Management, Sustainable Forest Management, Code of Conduct for Responsible Fisheries, Ecosystem approach to fisheries management, etc. A "landscape approach" means taking both a geographical and socio-economic approach to managing the land, water and forest resources that form the foundation – the natural capital – for meeting our goals of food security and inclusive green growth. By taking into account the interactions between these core elements of natural capital and the ecosystem services they produce, rather than considering them in isolation from one another, we are better able to maximize productivity, improve livelihoods and reduce negative environmental impacts.

Table 7. Initiatives that use an ecosystem/landscape/seascape approach as reported by countries

Country	Ecosystem/landscape/seascape approach
Burkina Faso	Numerous ecosystem and landscape approaches have been adopted, to a greater or lesser extent, in a number of production systems. Examples include active enrichment, controlled grazing, and deployment of vegetation for erosion and wildfire control in naturally regenerated and planted forests. Use of a participatory approach has facilitated the training of stakeholders in the sustainable management of agroforestry systems. The ecosystem approach to fisheries involves multistakeholder decision-making and co-management alongside the right of the state to distribute fishing concessions in ways that ensure sustainable use of resources. Other relevant practices adopted include sustainable soil and integrated plant nutrient management, integrated pest management, organic agriculture and conservation agriculture, although the latter two practices are not as widely implemented as the others.
Cameroon	Since the development of the first and second National Biodiversity Strategies and Action Plans (1999 and 2012), the ecosystem approach has been applied in all production systems throughout the country to comply with ecosystem-specific targets. The country report provides few details of the actions taken. However, specific crop varieties (including plantain, cassava, cocoa and coffee varieties) have been selected for their suitability for use in the country's five agroecological zones.
Ethiopia	The ecosystem approach is widely adopted in forest systems. Integrated watershed development and sustainable forest management have been promoted via awareness-raising and participatory activities in planted forests in Tigrai, Amhara, Oromia, the Southern Nations, Nationalities and Peoples Regional State and other parts of the country. Naturally regenerated forests have been the target of national policies and extensive monitoring, which have increased stakeholder awareness and willingness to participate in the development of sustainable management plans. As a result, communities have been able to increase the use of non-timber products (e.g. forest coffee, honey and spices) and to benefit from ecosystem services such as pollination, soil protection, nutrient recycling and water availability. To further promote ecosystem approaches, partnerships between business, government and civil society will be created through the Global Partnership for Development. In some lakes (e.g. Lake Haramaya, Lake Hawassa, Lake Chitu and Lake Tana), integrated watershed management is being used to restore biodiversity. Integrated pest management is recommended in irrigated (non-rice) crop systems. In mixed systems, integrated watershed management has been applied in 57 000 community-based watersheds (covering nearly 13 million ha) and has improved food security.
Gambia	Integrated pest management is widely applied in grassland-based livestock and irrigated (non-rice) crop systems. Other approaches, such as mixed rice cultivation–aquaculture systems and agroforestry in planted forests, are applied less widely.
Kenya	Integrated land-use planning is applied in irrigated rice systems and has led to increased mechanization and higher yields. The Water Act 2002, which established the Water Resources management Authority and the Water Resources Users Association, has resulted in improved management of catchment areas in rice systems through the application of integrated water-resource management. In the case of naturally regenerated and planted forests, the Forest Act 2005 has improved resource management, reduced deforestation and increased benefits to communities. Awareness of forest management and conservation has been increased.
Togo	A number of management plans for fisheries are being implemented in inland water bodies, including the Nangbeto and Koumfab dams. Outcomes are not yet evident as the initiatives are still in the first stages of implementation.
Zambia	Sustainable forest management and the ecosystem approach to fisheries management are being applied, with the active participation of local communities, in (respectively) naturally regenerated forests and self-recruiting capture fisheries. However, as these approaches have only recently been introduced, no outcomes have yet been observed. In the case of rainfed crops, conservation agriculture and agroforestry have been intensely promoted during the last decade and have led to increased productivity and resilience to droughts as compared to conventional practices. Other relevant activities include integrated soil fertility management, integrated pest management, water harvesting, crop diversification and reduced use of external inputs.
Zimbabwe	Pasture and field-crop intercropping are being applied to some extent in pastures and rangelands. In rainfed crop systems, conservation agriculture, agroforestry and agroecological principles have been intensively promoted.

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

(2009–2015), which advocates a multifocal approach to natural resources management, the National Climate Change Adaptation Plan of Action (2007), which involves strengthening integrated management of coastal and terrestrial zones to preserve biological diversity, the Gambia Biodiversity Policy (2003), the National Biodiversity Strategy and Action Plan (1999) and the National Action Programme to Combat Desertification (2015) seek to discourage uncontrolled expansion of agriculture into virgin forests, wetlands, marginal lands and other environmentally sensitive areas and to promote the development of sound communal grazing management systems.

The country report from the United Republic of Tanzania mentions that some of the country's ecosystems and biodiversity are protected at levels surpassing the 2020 Aichi Targets, noting that about 40 percent of the country's total land area is protected. It reports that this has been achieved as a result of direct interventions by the relevant ministries – which have established policies, legislation, strategies and guidelines for the protection of biodiversity – supported by research and development programmes.

The report from Cameroon provides extensive information on the application of ecosystem, landscape and seascape approaches in naturally regenerated and planted forests, as well as in self-recruiting capture fisheries and culture-based fisheries (Tables 8 and 9). It emphasizes that the involvement of local communities is crucial in the implementation of these approaches. With regard to community management of naturally regenerated forests, it notes the need for more training and education and strengthening institutions that enforce relevant legislation. In the case of planted forests, the report mentions a lack of planting material and identifies the need to improve state regulation and financial support. Another initiative mentioned is the establishment of community cooperatives targeting the use of fishery and marine resources, in particular shrimps. Here again, the report emphasizes the need for awareness raising about environmental impacts, especially the effects of uncontrolled fishing.

2.1.4 Examples of activities undertaken in the region to maintain and use traditional knowledge of associated biodiversity and wild foods

A large and growing number of ethnobotanical and ethnological studies are documenting traditional knowledge of the region's wild food species and associated biodiversity, including knowledge of species' management, traits and uses. Many studies are also investigating the scientific foundation of this knowledge and how it can be improved or utilized (e.g. through documentation of recipes, traditional food-processing techniques or best practices or through diversity fairs) (Azokpota, 2005; Madode, 2012; Munyi, Grum and Sdungu-Skilton, 2008; Sidibe *et al.*, 2016). However, limited information on traditional knowledge of associated biodiversity has been generated to date, at least not explicitly in such terms. For example, ethnomycological studies on associated fungal biodiversity have not been reported. On the other hand, the above-mentioned work of Lahmar *et al.* (2012) documenting farmers´ use of native shrubs for soil fertility management in the Sahel is an example of the management of associated biodiversity to provide very specific local ecosystem services using traditional knowledge. The management of termite mounds, parkland trees and indigenous legumes to maintain and restore soil productivity are examples of the use of local traditional knowledge to manage associated biodiversity. A significant number of national and international projects in the region are aiming to document, maintain and use knowledge of this kind.

Several country reports highlight gender specializations with respect to traditional knowledge of wild foods and associated biodiversity. However, few details of studies addressing this topic are provided. Countries identify a strong need for further and more wide-ranging studies in this field.

The country report from Cameroon mentions that the Ministry of Culture is collecting and recording information on the traditional knowledge of some communities and storing it in the National Museum in the form of books, pictures and carvings. It also notes that agroforestry research is recognizing the need to valorize and utilize traditional knowledge, as some of the tree species planted on crop farms have important nutritional, medicinal and cultural values. The creation of the Institute of Medical and Medicinal Plants Research and the survey of medicinal plants that led to the publication of The National Pharmacopeia (Adjanohoum *et al.*, 1996) are reported to have led to progress in the study of medicinal plants and animals. Traditional practitioners are reported to collaborate with the Ministry of Health.

Guinea provides the following examples of the use traditional knowledge of associated biodiversity and wild species used for food:

- use by indigenous farmers of different ecosystems in the context of transhumance;
- use of various plants in traditional medicine (e.g. use of the bark of dry zone mahogany [*Khaya senegalensis*] in the treatment of trypanosomiasis and use of latex from *Ficus iteophylla* in the treatment of dermatosis and wounds); and
- use of wild plant species in human diets (e.g. oil from dwarf red ironwood [*Lophira lanceolate*] seeds, young leaves and buds of the wild African black plum [*Vitex doniana*] or *koronfinfin* in the Bambara language).

Table 8. Implementation of ecosystem/landscape approaches in naturally regenerated and planted forests in Cameroon

Production system	Specific action	Observed result	Plans for adoption
Naturally regenerated forest	Attribution of community forest	Better management of forest for sustainable use	Promote education and sensitization
	Introduction of forest regulations	Reduced crime levels, income from fines	Improve law enforcement
	Law enforcement in logging and hunting	Sanctions, seizures, fines, imprisonment	Recruit more eco-guards
	Application of exploitation quotas, inclusion of more species in logging and placement of limitations on post-logging waste	Sustained yield in the country's forest resources	Review and adapt forestry regulations
	Enhancement of capacity to apply regulations	Need for more control personnel	Attach importance to training personnel
	Community ownership and management of forests Education on forest management practices	Community dwellers more knowledgeable in forest management	Facilitate norms for attributing community forests
Planted forest	Creation and management of state plantations	Expansion of forest estate	Create more forest nurseries
	Creation and management of private plantations	More privately owned forest plantations	Create more forest nurseries
	Implementation of special regeneration programmes: Sahel Vert	Increased desire to improve artificial regeneration	Provide more planting material
	Regulation of tree felling for fuel and charcoal	Better forest management techniques	Augment control with council/ community guards
	Implementation of artificial regeneration programmes by politicians and elites	Increased knowledge on forest regeneration	Politicians/elites to assist with financial aid for tree planting
	Creation of forest product cooperatives	Joint ventures by eucalyptus planters in the Western Region	

Source: Country report of Cameroon.

Table 9. Implementation of ecosystem/seascape approaches in self-recruited and capture-based fisheries in Cameroon

Specific action	Observed result	Plans for adoption	Lessons learned
Optimization of the exploitation of freshwater and marine resources	Fishing communities set up fishing cooperatives	Reduce pressure on the capital	Knowledge of the harmful effects on uncontrolled fishing necessary
Promotion of the sustainable exploitation of shrimp resources	Fishing communities set up fishing cooperatives	Reduce pressure on the capital	Awareness of the harmful effect of uncontrolled fishing necessary
Minimization of ecological impact	Sensitization of actors	Find alternatives	Awareness of the positive impact necessary
Improvement to governance	Establishment of the rules	Respect the established rules	Public awareness necessary

Source: Country report of Cameroon.

Zambia reports that it has developed a policy on the documentation of traditional knowledge to support the recognition and maintenance of this knowledge, particularly in the fields of biodiversity and folklore. It also mentions that traditional knowledge has been used to inform conservation and use decisions through the involvement of local communities in the planning of programmes in the forest and fisheries sectors.

Mali reports that farmers' seed purchases are generally not subject to financial transactions and that maintaining informal mechanisms is essential to the maintenance of the country's crop diversity. Farmers in the villages obtain seeds from other farmers. Traditional self-help systems allow seedless farmers to obtain seeds free of charge from other self-help group members. Seed exchange or barter takes place between farmers according to links of kinship, neighbourhood and/or marriage.

Kenya reports that its government, within the framework of Vision 2030 (the country's long-term development policy),[9] has committed to protecting traditional knowledge under intellectual property laws. It also notes that the National Museums of Kenya documents

[9] http://www.vision2030.go.ke

traditional knowledge through various research activities, usually coordinated through the Kenya Resource Centre for Indigenous Knowledge.

Zimbabwe reports that its National Biodiversity Strategy and Action Plan 2014 aims to utilize traditional knowledge in efforts to protect the environment and conserve and sustainably use ecosystems and biodiversity. It notes that although there is ample traditional knowledge on the use of traditional foods and wild foods, especially insects, this knowledge has not been fully documented. It also mentions that traditional knowledge is supported via national legislation, including Statutory Instrument 61 of 2009 on access to genetic resources and indigenous resource-based knowledge.

2.1.5 Needs and priorities in terms of the sustainable use of biodiversity for food and agriculture, and in particular of associated biodiversity and wild foods

Countries reported the following needs and priorities in terms of the sustainable use of biodiversity for food and agriculture:

- improving the awareness of local communities about the importance of natural heritage and the intangible benefits it provides to the environment and humanity;
- implementing studies on the economic value of associated biodiversity, sustainable management practices and the contribution of wild foods to food security, and utilizing the outcomes as a basis for awareness raising;
- establishing inventories of associated biodiversity and wild foods and making these inventories accessible;
- ensuring that inventories are based on participatory surveys involving local communities;
- strengthening knowledge of sustainable management practices and ecosystem approaches and promoting these methods for instance by improving and reinforcing rural extension services or training facilities (e.g. training on agroforestry management practices in local communities, on family farms, etc.);
- establishing investment plans to combat the degradation of biodiversity for food and agriculture and securing sufficient funding to ensure the implementation of sustainable management practices and ecosystem approaches;
- facilitating collaboration and coordination between stakeholders working in the fields of biodiversity restoration, genetic resources management and desertification;
- strengthening links between rural communities and government policy-makers and improving communities' communication with and access to institutions that provide services;
- improving the technical and management capacities of personnel within institutions dedicated to the conservation and sustainable use of biodiversity for food and agriculture and improving the facilities of these institutions; and
- ensuring that sustainable management plans adequately address the utilization of the indigenous species found in specific local areas (e.g. to ensure the use of appropriate tree species in agroforestry).

Several country reports note that accounting for the economic/demographic dynamics affecting rural landscapes is an important component of sustainable use and conservation. For example, the report from Mali notes that the introduction of cash crops (cotton, groundnuts, etc.) has increased farmers' incomes, but has also changed traditional production systems, causing migration to cities and pushing some populations towards less-productive agricultural areas that are more ecologically sensitive.

2.2 CONSERVATION

2.2.1 *In situ* conservation

A debate about strategies for *in situ* biodiversity conservation has been apparent in Africa – and other developing regions – for some time. Although *in situ* conservation programmes

Table 10. Reported *in situ* conservation activities or programmes for associated biodiversity for food and agriculture

Country	Examples of species	Examples of sites	Conservation objectives	Actions taken
Burkina Faso	Bluestem grass (*Andropogon gayanus*)	Dinderesso National Forest and Arbolle agroforestry park	Protection of soils, use for fodder, domestic use (fencing, roofing, etc.)	Direct seeding
Cameroon	At least 232 tree species reported to be in association with tree mycorrhiza	Various parks and reserves, botanic gardens	Ecosystems services	Protected area regulations forbid human activities
	Insects, frogs, *Achatina* spp. (a genus of snails)	Inland waterways, forest floor farms and plantations	Food, research, preservation of the species	Avoidance of agriculture and mining activities that can pollute waterways
	Various amphibians, reptiles, birds and mammals	Various parks and reserves	Income generation, food, research and preservation of the species	Protected-area regulations that forbid human activities; special hunting seasons in parks and reserves, peripheral zones and hunting zones
	Various species of nitrogen-fixing bacteria Mycorrhizal associations	Various sites covering about 9 124 666 ha	Protection of biodiversity	Protected-area regulations that forbid human activities
Ethiopia	Spirulina (*Arthrospira fusiformis*)	Lakes Chitu, Killole and Arenguade, Oromiya region	To conserve micro-algal diversity in alkaline water ecosystems for future utilization	Construction of physical and biological conservation structures around the lakes harbouring the micro-organisms and reduction of human interference through community participatory action
Gambia	Many mushroom species	Bijilo and Pirang Forest Parks	Ecotourism and conservation	Protection against illegal activities
	Spirulina (*Arthrospira fusiformis*) and *Rhizobium* spp. and many other unknown species	All protected areas	Biodiversity conservation Maintenance of microalgal diversity in alkaline water ecosystems for future utilization	Construction of physical and biological conservation structures around the lakes harbouring the micro-organisms Reduction of human interference through community participatory action Species-management actions
	Invertebrate (e.g. *Dacus* spp. and *Bactrocera* spp.) and vertebrate species and their habitats	All protected areas	Fauna conservation	Species-management actions
Kenya	All forest species, whole forest ecosystems	Githitho, several kaya forests (sacred groves)	Biodiversity conservation, research, education and livelihood enhancement	Monitoring and protection of forest types, including their associated biodiversity and ecosystems services
	Micro-organisms	Coastal kaya forests, Taita hills and Kereita forest	Protection of forests and associated biodiversity (including ecosystem services)	Monitoring for protection

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

have the advantage of preserving species in their habitats and, in the case of domesticated species, allowing them to undergo constant breeding by farmers, livestock keepers etc., the risk of habitat loss through land-use change and population growth is high in many developing countries. Sub-Saharan Africa is one of the fastest growing regions in the world in terms of human population and will continue to be so for at least the next 40 years (FAO, 2015b). Moreover, agricultural methods promoted by governments, companies and most international development agencies tend to reduce biodiversity for food and agriculture by encouraging producers to adopt "high-yielding", modern crops, cultivars and breeds (DeClerck *et al.*, 2011; Khoury *et al.*, 2014). In the case of associated biodiversity, it is often argued, for similar reasons, that conservation is only possible within reserves and protected areas. On the other hand, a recent study by Kebede *et al.* (2018), quantifying the effects of population growth on biodiversity over the last 30 years in the basin of Lake Hawassa in southern Ethiopia, observed that although population growth tends to lead to a decline in associated biodiversity as a result of deforestation, land fragmentation and monoculture, further population growth beyond a certain threshold leads to an increase in

Table 11. Reported *in situ* conservation or management activities or programmes for wild food species

Country	Examples of wild species	Actions taken	Conservation objectives	Examples of sites
Burkina Faso	Desert date (*Balanites aegyptiaca*) *Lannea microcarpa* African locust bean tree (*Parkia biglobosa*) Marula (*Sclerocarya birrea*) Tamarind (*Tamarindus indica*) Shea tree (*Vitellaria paradoxa*) Indian jujube (*Ziziphus mauritiana*)	Protection and maintenance	Seed production	Dinderesso, Djibo, Dori, Gampéla, Gonsé, Saponé, Saria
Cameroon	Beecroft's scaly-tailed squirrel (*Anomalurops beecrofti*) Groot otter (*Aonyx capensis*) African brush-tailed porcupine (*Atherurus africanus*) Bush buttertree (*Dacryodes edulis*) *Garcinia africana* African mango (*Irvingia gabonensis*)	Protected area regulations Control measures Awareness raising on sustainable conservation and use	Food, research and trade	Various protected areas
Ethiopia	*Arundinaria alpina* *Ficus ovata* Bindura bamboo (*Oxytenanthera abyssinica*) *Podocarpus falcatus*	Awareness-raising activities Site demarcation and fencing	Species germplasm conservation	Masha, Mandura, Bishan Gari
Gambia	Bee species Oyster species	Sensitization Site demarcation Measures to combat recurrent bush fires Formation of farmers' associations	Biodiversity conservation, livelihood improvement, improvement, food supplementation	Tanbi Wetland National Park, Niumi, Abuko, Nyambai Forest, Bolong Fenyo, Kiang West National Park
Togo	Senegal mahogany (*Khaya senegalensis*) African locust bean tree (*Parkia biglobosa*) *Paspalum orbiculare* Pink-backed pelican (*Pelecanus rufescens*) African rock python (*Python sebae*) Shea tree (*Vitellaria paradoxa*)	Participation of local communities and use of local knowledge in the processing of wild food species	Reduction of genetic erosion, promotion of sustainable use of biological resources, protection of forests for spiritual, scientific, education, recreational and touristic objectives	Fazao Malfakassa and Oti-Keran National Parks; Galanchi, Oti Mandouri and Togodo Wildlife Reserves

Source: Country reports prepared for T*he State of the World's Biodiversity for Food and Agriculture* (FAO, 2019).

associated biodiversity in the form of more frequent hedgerows, home gardens, woodlots, etc. This results, for example, in the expansion of alternative habitats for species that serve as biological control agents of insect pests.

Among the countries that provided country reports, Burkina Faso, Cameroon, Ethiopia, the Gambia and Kenya report *in situ* conservation initiatives targeting associated biodiversity (Table 10). Burkina Faso, Cameroon, Ethiopia, the Gambia and Togo report *in situ* conservation initiatives or related activities for wild food species (Table 11). It should, however, be noted that the distinction between these two components of biodiversity for food and agriculture is not clear-cut. For example, Ethiopia reports on *in situ* conservation initiatives for spirulina (*Arthrospira fusiformis*) algae in the alkaline water ecosystems of Lakes Chitu, Killole, Arenguade and other lakes in the country's Oromiya region. Although this is reported as an example of an *in situ* conservation initiative targeting associated biodiversity, it could also be considered to be an *in situ* conservation initiative for a wild food species. Spirulina algae are used to produce a dietary supplement to combat malnourishment, malnutrition and protein deficiencies such as *kwashiorkor*. Spirulina algae are also a source of highly available iron; 5 grams of the algae cover the entire daily requirement of an adult person (Ciferri, 1983). Likewise, many of the species reported as wild food sources by Burkina Faso (desert date [*Balanites aegyptiaca*], tree grapes [*Lannea microcarpa*], African locust bean [*Parkia biglobosa*], marula [*Sclerocarya birrea*], tamarind [*Tamarindus indica*], shea butter tree [*Vitellaria paradoxa*], jujube [*Ziziphus mauritiana*]) could also be considered associated biodiversity species, as they are important sources of ramial wood and leaves used by some farmers to mulch or boost organic matter in degraded soils (Félix *et al.*, 2015) .

Table 12. Reported *ex situ* conservation or management activities or programmes for associated biodiversity for food and agriculture

Country	Associated biodiversity species	*Ex situ* conservation strategy	Size of Collections	Objectives	Evaluation/state of characterization
Burkina Faso	Bluestem grass (*Andropogon gayanus*)	Not known	At national level	Use of vegetation for erosion control Seed collection	Characterized
Ethiopia	Acetic acid bacteria Fungi (including mycorrhizae, rhizobia and yeast) Lactic acid bacteria	Short- and long-term cryopreservation in genebanks	381 species	Conservation	Characterized at species and subspecies level
Gambia	*Anacardium* spp.		Not known	Commercial uses	Incomplete
	Rhizobium spp.		Unknown	Conservation of soil fertility	
Kenya	Many vertebrate species and specimens (including amphibians and reptiles)	Wet or skin collections	30 000 amphibians and reptiles, 43 000 fishes, 30 000 birds	Research and education	Not known
	Several micro-organism species (including cultures)	Herbarium collection and slides	More than 5 000	Systematics and research Conservation and restoration of threatened flora	Done, including ethnobotanical information
	Invertebrates including bees and butterflies	Dry collections Live butterfly collection	More than 2 million	Research on systematics, conservation and biogeography Education Income generation	Many unidentified and undescribed
Zimbabwe	*Azorhizobium caulinodans* *Bradyrhizobium* spp. *Mesorhizobium* spp. *Microvirga lupini* *Rhizobium* spp. *Sinorhizobium* spp.	At 4 °C, lyophilized and stored at room temperature	149 strains	Genetic conservation Source of legume inoculants Source of study material	Evaluation through effectiveness ranking on original host

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

2.2.2 *Ex situ* conservation

Burkina Faso, Ethiopia, the Gambia, Kenya and Zimbabwe report national *ex situ* conservation programmes or activities for associated biodiversity and wild foods. Many countries seem to lack or have limited *ex situ* collections of wild food and associated-biodiversity species. Some countries, however, report quite large collections of associated-biodiversity species (Table 12). In the case of wild foods, countries report the *ex situ* conservation of a wide range of plant species and also some fish and invertebrate species (Table 13).

In the case of plant (crop) genetic resources, there are several regional conservation initiatives, including a major initiative in each of the three main subregions: East, West and Southern Africa. For example, the Southern African Development Community (SADC) Plant Genetic Resource Centre (SPGRC) works in coordination with centres in each of its member states to conserve the genetic diversity and viability of Southern African plant stocks. This is achieved through the collection, documentation and long-term storage of seed samples.

2.2.3 Needs and priorities

The country reports identify the following gaps and priorities with respect to the conservation of associated biodiversity:

- Assessment of the status and trends of associated biodiversity and ecosystem services is inadequate. Research has focused mainly on the provisioning aspect of biodiversity. A lack of awareness has contributed to the neglect of associated biodiversity and ecosystem services.
- Limitations in terms of skills, technology, methodology and financial resources hamper research and development relevant to conservation.
- Policies addressing natural resources are in place. However, in addition to shortcomings in their implementation, these instruments focus on biodiversity in general and do not specifically address associated biodiversity.

Table 13. Reported *ex situ* conservation or management activities or programmes for wild food species

Country	Wild food species	*Ex situ* conservation strategy	Size of Collections	Conservation objectives	Evaluation/state of characterization
Burkina Faso	Tree species: Baobab (*Adansonia digitata*) Desert date (*Balanites aegyptiaca*) Palmyra palm (*Borassus aethiopum*) *Borassus akeassii* Sweet dattock (*Detarium microcarpum*) West African ebony (*Diospyros mespiliformis*) *Lannea microcarpa* African locust bean tree (*Parkia biglobosa*) Senegal saba (*Saba senegalensis*) Marula (*Sclerocarya birrea*) Tamarind (*Tamarindus indica*) Indian jujube (*Ziziphus mauritiana*)	Preserved at 4 °C	Single collection	Gene reservoir	Characterized
	Fungi species: False parasol (*Chlorophyllum molybdites*) *Phlebopus sudanicus*	Dried	22 accessions	Inventory of mushrooms	Characterized
	Fish species: Mudfish (*Clarias anguillaris*) North African catfish (*Clarias gariepinus*)	Breeding ponds	15 sites	Improvement of scientific knowledge Valorization of aquaculture	Morphological and genetic (microsatellite) characterization
	Plant species: Indian jute (*Corchorus olitorius*)	Genebanks	100 accessions	Diversity conservation and species improvement	Morphological characterization
	Fish species: Tilapia (*Oreochromis niloticus*)	Breeding ponds	2 sites	Improvement of scientific knowledge Valorization of aquaculture	Genetic (microsatellite and SNP) characterization
	Plant species: Shea tree (*Vitellaria paradoxa*)	Wooded park	1 site	Gene reservoir	Characterized
Cameroon	Forage (grasses, legumes)	Genebank	Experimental, in trial plots	Improvement of fodder Soil enrichment	Unknown
	Fruit trees (19 forest tree species)	Genebank	Not known	Characterization: microsatellite loci, clonal variations, phenotypic diversity, etc.	Most of the research has been completed
	Vegetables, *Gnetum* spp.	Genebank	Experimental, in trial plots	For food	Unknown
Ethiopia	At least 36 tree species		Collection of varying sizes	Conservation and research	Not done
Gambia	Oysters, cockles and other shellfish		Not known	Food and commercial uses	Incomplete
Zimbabwe	Tree species: Baobab (*Adansonia digitata*) *Azanza garckeana*	–21 °C	1 accession	Regeneration for future use	Not done
	Plant species: Amaranth (*Amaranthus* spp.)	–21 °C	29 accessions	Regeneration for future use	Not done
	Plant species: Spiderwisp (*Cleome gynandra*)	–21 °C	9 accessions	Conservation	Not done
	Butterfly species: *Gonimbrasia belina*	Natural regeneration	Mopane woodlands	Food security	Not done
	Tree species: Horseradish tree (*Moringa oleifera*)		1 accession	Regeneration for future use	Not done
	Tree species: Mobola plum (*Parinari curatellifolia*)	Natural regeneration	Parinari woodlands	Fruit jam making and food security	Not done
	Tree species: Mahobohobo (*Uapaca kirkiana*)	Field genebank	168 accessions	Woodland expansion and food security	Done
	Tree species: Marula (*Sclerocarya birrea*)	Natural regeneration	Amarula woodland	Amarula brew or liquor and amarula oil	Not done

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

- Knowledge gaps relevant to conservation need to be addressed through research.

Additional priorities identified include awareness raising on the importance of associated biodiversity and ecosystem services, strengthening institutional capacity and addressing weaknesses in policy frameworks.

The country reports identify the following gaps and priorities with respect to the conservation of wild food species:

- The state of knowledge of wild edible plants is inadequate in many countries.
- There is a strong need for further and more wide-ranging studies on the status, trends and conservation of wild food resources and on the associated traditional knowledge pertaining to them.
- Limitations in terms of financial resources, awareness and human and material resources need to be addressed.
- Although the conservation of wild food resources has been incorporated into policies addressing biodiversity in general, there are no specific policies directly targeting these resources. There are similar limitations with respect to institutional arrangements.
- Given the contribution of wild foods to food security in vulnerable areas, there is a need for policies that specifically address these resources.
- Knowledge of wild food resources needs to be improved through research.
- Awareness raising on the importance of wild food resources needs to be strengthened.

2.3 ACCESS AND EXCHANGE

All reporting countries are Parties to the Nagoya Protocol on Access and Benefit-sharing (CBD, 2018). Domestic legislation on access and benefit-sharing has been put in place in a few countries. For example, Ethiopia requires prior informed consent (PIC) and benefit-sharing arrangements for access to genetic resources, including associated biodiversity and wild foods, for commercial use. In the case of access to genetic resources for research purposes it requires PIC only. Kenya requires PIC and benefit-sharing agreements for access to genetic resources both for research and commercial purposes. In Kenya, access and benefit-sharing is regulated by Legal Notice No. 160[10] (implementing the Environmental Management and Co-ordination Act of 2009),[11] which covers both genetic resources and local knowledge. Ethiopia issued a proclamation on access to genetic resources and traditional knowledge in 2006[12] and regulations in 2009[13] (Medaglia, Perron-Welch and Phillips, 2014). The Ethiopian Institute of Biodiversity Conservation is the competent national authority empowered to monitor and ensure the compliance of the domestic access and benefit-sharing permit system with the Nagoya Protocol, including the granting of PIC by the institute for both commercial and non-commercial applications. The institute also issued a code of conduct that establishes the basic principles for access to, and utilization of, genetic resources and traditional knowledge; these principles include integrity and good faith, confidentiality, conservation and sustainable use, PIC, mutually agreed terms and benefit-sharing (ibid.).

In 2012, Cameroon adopted its National Strategy on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization. In this Strategy, Cameroon committed to putting in place a "national ABS legal and institutional framework".

[10] Environmental Management and Co-ordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 (L.N. No. 160 of 2006) (available at http://www.fao.org/faolex/results/details/en/c/LEX-FAOC071757/).

[11] Environmental Management and Co-ordination Act, 1999 (Cap. 387) (available at http://www.fao.org/faolex/results/details/en/?details=LEX-FAOC041653).

[12] Access to Genetic Resources and Community Knowledge, and Community Rights Proclamation (No. 482/2006) (available at http://www.fao.org/faolex/results/details/en/?details=LEX-FAOC080475).

[13] Council of Ministers Regulation to provide for Access to Genetic Resources and Community knowledge and Community Rights (No. 169/2009) (available at http://www.fao.org/faolex/results/details/en/c/LEX-FAOC121678/).

Starting in 2013, Cameroon began preparing a regulation to lay down modalities covering genetic resources, including any material from plants, animals, micro-organisms or other organisms that contains functional units of heredity. Indigenous and local communities are defined separately in the regulation (ibid.).

The Environmental Management Act (2004)[14] of the United Republic of Tanzania includes provisions on access to genetic resources and associated traditional knowledge, and the fair and equitable sharing of the benefits arising out of the utilization of such resources. In its country report, the Gambia notes that it is currently working with its partners to secure funds to put in place a legislative framework that will ensure the smooth implementation of the Nagoya Protocol. None of the other reporting countries indicate that they have national policy and legal frameworks specifically regulating access and benefit-sharing for genetic resources and associated biodiversity. The legal instruments related to biodiversity management in these countries do not necessarily take into account, at least not explicitly, the interests of indigenous and local communities.

2.3.1 Implementation challenges

The implementation and enforcement of international treaties and national measures are still challenging in most of the region's countries, not least because of the need to adjust institutional channels in order to do so. For example, the country report from Kenya notes that the implementation of its legal notice on access and benefit-sharing (see above) faces many constraints, including a lack of clarity as to the roles and responsibilities of the structures involved. It also notes that in many circumstances it is difficult to sign a PIC agreement because of a lack of clear institutional structures at community level, which can mean that an agreement signed by one group within the community may be disputed by other community members. The report from Cameroon mentions that the principle of PIC is not being taken seriously at community level and that biodiversity users in rural areas have not mastered their rights and benefits with respect to genetic resources.

The country report of Ethiopia reports the country's experience in regulating access to genetic resources and the sharing of benefits arising from their use. In 2005, Ethiopia signed access and benefit sharing agreements for tef (*Eragrostis tef*) and and vernonia (*Vernonia galamensis*) with the Dutch company Health and Performance Food International (Andersen and Winge, 2012). However, the benefit-sharing aspects of these agreements have never been properly implemented, which has led to some frustration and disagreement (ibid.). Despite this experience, Ethiopia's country report mentions that the Ethiopian Biodiversity Institute has recently signed an agreement with a private company based in the United States of America on access to and the sharing of benefits arising from the use of sicklebush (*Dichrostachys cinerea*), wild tea plant (*Osyris quadripartita*) and Indian ginseng (*Withania somnifera*) for the purpose of producing essential oils, cosmetics and herbal medicine. Ethiopia earned an upfront payment, and the agreement stipulates that benefits accruing from access to these genetic resources will be shared equitably between the company and the local communities/ the Government of Ethiopia. The country report notes that the benefits serve as incentives to the local communities/the government to conserve and sustainably utilize biodiversity. Local companies that are using genetic resources such as aloe and cabbage tree (*Moringa stenopetala*) for various commercial purposes have come to similar legal agreements.

2.3.2 Needs and priorities

Aside from addressing the challenges illustrated by the examples presented above, the three main needs identified in the country reports with respect to access and benefit-sharing were:

[14] Environmental Management Act, 2004 (No. 20 of 2004) (available at http://www.fao.org/faolex/results/details/en/c/LEX-FAOC061491/).

- provision of more funding for research on access and benefit-sharing;
- development and adoption of domestic legislation on access and benefit-sharing; and
- development of the institutional and human capacity needed to implement and enforce the Nagoya Protocol at national level.

Countries have established policies pertaining to natural resources. However, in addition to shortcomings in their implementation, these instruments focus on biodiversity in general rather than directly addressing associated biodiversity.

III. Policies, institutions and capacity

3.1 POLICIES, PROGRAMMES, INSTITUTIONS AND STAKEHOLDERS

This section discusses the main policies and programmes that countries in the region have adopted and are implementing to support the conservation and sustainable use of biodiversity for food and agriculture, and the extent to which these instruments address associated biodiversity and wild foods. Relevant policies and programmes include those that address:

- coordinated use and conservation of sectoral genetic resources;
- food security and nutrition;

sustainable use and conservation of associated biodiversity;

- ecosystem services;
- the resilience and sustainability of production systems;
- adoption of practices that strengthen the conservation and use of biodiversity for food and agriculture in crop, livestock, forest and aquatic production systems; and
- ecosystem/landscape/seascape approaches.

The country reports indicate that many countries currently have no policies in place that explicitly address the management of biodiversity for food and agriculture and that associated biodiversity and wild foods are particularly commonly neglected in this regard. A number of countries, however, mention more broadly focused instruments such as national biodiversity strategy and action plans.

Examples of reported policies and programmes addressing the topics listed above are presented in Table 14. Several countries report policies targeting food security and nutrition. However, the focus of most of these initiatives is on increasing productivity using "conventional" technologies such as mineral fertilizers and improved crop varieties or animal breeds. Few reports mention initiatives that focus specifically on the use of biodiversity for food and agriculture (i.e. on the use of associated biodiversity or the use of more diverse portfolios of crops, livestock, trees, etc.) to promote food security. Some countries mention "diversification" as one of the components of their national food security programmes. However, few details are provided.

Another field in which countries reported policy mechanisms was seeds and genetic resources. The seed policy of Zambia, for example, aims to ensure that plant genetic resources of actual and potential economic value will be collected, preserved, evaluated and utilized for crop development. It stipulates that the government will encourage the participation of farmers in local germplasm conservation and utilization (ISSD Africa, 2012). The government (through the Seed Control and Certification Institute of the Zambia Agriculture Research Institute) and some non-governmental organizations (NGOs) involved in agricultural development and poverty reduction formulated and initiated programmes to encourage the on-farm production and marketing of seeds from multiple improved crop varieties to increase their availability (ibid.). The country's informal seed systems include those in which farmers themselves multiply seeds, barter them, or buy and sell them in rural grain markets and those in which NGOs assist community groups or farmer cooperatives in seed multiplication and marketing (USAID, 2016). Smallholder farmers in Zambia who grow crops other than maize nearly always acquire seeds through these two systems, which do not involve any formal inspection by the country's official seed certification system (ibid.). In Mali, the government supports a variety release and seed system, which is regulated by a national law[15] that is based on a regional regulation adopted by member countries of the Economic and Monetary Union of

[15] Loi 10-032 du 12 juillet 2010 relative aux semences d'origine végétale (available, in French, at http://www.fao.org/faolex/results/details/en/?details=LEX-FAOC141928).

Table 14. Examples of policies and programmes for the sustainable use and conservation of biodiversity for food and agriculture reported by countries in the region

Domain	Policy/programme	Description	Country
Coordinated use and conservation of genetic resources	National Policy on Traditional Knowledge, Genetic Resources and Traditional, Cultural Expressions	The policy aims "to enhance the preservation, protection, and promotion of sustainable use of traditional knowledge, genetic resources and traditional cultural expressions in Kenya".	Kenya
Food security and nutrition	National Programme on Food Security and National Agricultural Policy/Rural Development Policies	For example, Chad's National Programme on Food Security aims to promote a sustainable increase in food production. Intervention targets: (i) adding value to natural resources; (ii) sustainable intensification of crop production; (iii) diversification of production systems; (iv) processing and marketing; (v) health and nutrition; (vi) emergency food assistance and early warning; and (vii) accompanying measures.	Chad, Ethiopia, Zambia
Preservation of natural resources	Gambia Sustainable Land Management and Investment Framework	Objectives include preservation of forest cover and restoration of soil health.	Gambia
	National Agriculture Policy (2012)	The policy stresses the need for natural resources (land, soil, water and forests) to be managed so as to sustain agriculture and the need for measures that minimize encroachment of public lands, including forests, woodlands, wetlands and pasture.	United Republic of Tanzania
Maintenance of ecosystem services	Forest Management, Development and Utilisation Policy (2007)	Aims to "meet public demand in forest products and foster the contribution of forests in enhancing the economy of the country through appropriately conserving and developing forest resources."	Ethiopia
Resilience and sustainability of production systems	Climate-Resilient Green Economy Strategy	Objectives include exploiting the country's vast hydropower potential, large-scale promotion of advanced rural cooking technologies, implementing efficiency improvements to the livestock value chain, and reducing emissions from deforestation and forest degradation (REDD).	Ethiopia
	National Agricultural Policy (Draft)	The draft policy aims to facilitate and support the development of a sustainable and competitive agriculture sector that ensures food security at national and household levels and maximizes the sector's contribution to gross domestic product. The policy encourages the promotion of crop and animal species diversity as a strategy for reducing the vulnerability of households to drought-induced food insecurity associated with monocropping.	Zimbabwe
Supporting the adoption of practices that strengthen the conservation and use of biodiversity for food and agriculture	Polices that ensure that research results in the fields of agriculture, fisheries, forestry and livestock production are made available to local populations via research centres located all over the country	Public demonstrations of research findings are organized for the benefit of farmers, pastoralists, etc.	Cameroon
	National Biodiversity Strategy and Plan of Action	The strategy and action plan aims to promote conservation and restoration activities for species, habitats and ecosystems, along with the sustainable use of natural resources, by fostering a greater sense of responsibility among local populations.	Burkina Faso
Application of an ecosystem/landscape/ seascape approach	National Policy on Environment (2007)	The policy creates a comprehensive framework for effective natural-resource utilization and environmental conservation that will be sensitive to the demands of sustainable development.	Zambia

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

West African Nations (UEMOA).[16] The system is flexible enough to accept adapted (resistant to biotic and abiotic stresses, good cooking qualities, high nutritional values or adapted to local

[16] Règlement n°03/2009/CM/UEMOA portant harmonisation des règles régissant le contrôle de qualité, la certification et la commercialisation des semences végétales et plants dans l'UEMOA (available, in French, at http://www.fao.org/faolex/results/details/en/?details=LEX-FAOC148414).

dishes) and high-performing local varieties. Certified seeds of these varieties are produced and made available to farmers.

Biodiversity conservation strategies and environmental policies were mentioned in several country reports. For example, the Conservation Strategy of Ethiopia (1997) covers national and regional strategies and sectoral and cross-sectoral policies, action plans and programmes and provides the basis for the development of appropriate institutional and legal frameworks for implementation. Institutions with specific mandates to work on conservation, development and utilization of forest, aquatic, animal and plant genetic resources have been established and are functional. In Cameroon, the National Biodiversity Strategy and Action Plan was developed following the ecosystem approach and involving all biodiversity stakeholders. It recommends a cross-sectoral approach to conservation and sustainable use. The Ministry of Environment's conservation strategy aims to have 30 percent of the national territory designated as protected area. Chad's National Action Plan for Environment, drafted in 2005, is a general framework for reflection/exchange and for sustainable management of natural resources. It comprises several action plans: the National Action Plan for Combating Desertification, the National Action Plan for Adaptation to Climate Change, the National Strategy for the Sustainable Development of Chad, the National Strategy on Biological Diversity and the National Profile for the Management of Chemical Products.

Several country reports mention international conventions and agreements as mechanisms that support the sustainable use of biodiversity for food and agriculture, including the Nagoya Protocol, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora. For example, Ethiopia mentions that, after ratifying CBD and ITPGRFA and adopting international model laws and guidelines, it issued Regulation 169/2009 and Proclamation No. 482/2006 on Access to Genetic Resources and Community Knowledge and Community Rights (see above). It also notes that its recent ratification of the Nagoya Protocol will enhance the implementation of national access and benefit-sharing laws.

3.1.1 Strengths and weaknesses

Only a few of the country reports discuss the strengths and weaknesses of current policies and programmes. On the one hand, some reports describe governmental support and commitment to national policies as major strengths. On the other, some outline a number of weaknesses in national policies and legislation. For example, the report from the Gambia mentions that the country's policies and legislation governing the conservation and use of biological diversity are too sector based and that most instruments are obsolete, too rigid and/or have been formulated in a top-down fashion. It notes that although the country's National Environment Management Act[17] seeks to establish a general framework for the conservation of biodiversity its provisions are too general to serve this purpose. Provisions for public participation in the country's sectoral legislation are reported to be virtually absent. The report further notes that the regulatory regime is riddled with gaps and serious legal conflicts and that the situation is exacerbated by poor enforcement caused by a lack of trained staff, poor logistics and shortages of funds and other resources. Specific gaps identified in the country's legislation include a lack of explicit provisions addressing *ex situ* conservation, control of alien species, risks associated with genetically modified organisms, protection of threatened species and populations, regulation of access to genetic resources, protection of indigenous knowledge and the intellectual property rights of local people, and joint development and transfer of technologies that use genetic resources. The report concludes that existing sectoral legislation on biodiversity is generally not adequate to ensure successful conservation and sustainable use

[17] National Environment Management Act, 1994 (Act No. 13 of 1994) (available at http://www.fao.org/faolex/results/details/en/?details=LEX-FAOC006275).

Box 5. Zambia's Biodiversity Community Network

In Zambia, the Biodiversity Community Network, an NGO working within the International Federation of Organic Agriculture Movements (IFOAM) framework and involved in building the capacity of communities in the conservation and use of biodiversity, implemented a project to strengthen community-based on-farm conservation and sustainable use of crop diversity in the semi-arid Zambezi Gwembe Valley. The project was supported by the Benefit Sharing Fund of the International Treaty on Plant Genetic Resources for Food and Agriculture. It focused on the conservation of crop diversity and strengthening local seed systems for sorghum, pearl millet, cowpea and bambara nuts.

Source: Country report of Zambia.

of biodiversity under the prevailing socio-economic circumstances. Lack of financial resources is also mentioned as a major constraint to national policies in Cameroon, Chad and Gabon.

3.1.2 Interministerial cooperation and collaboration mechanisms

Although several country reports mention collaboration and cooperation among the various ministries and institutions involved in implementing national biodiversity strategies and action plans,[18] few details of specific cooperation mechanisms are provided. Even where mechanisms are mentioned, there is often a lack of clarity regarding mandates and responsibilities. Some examples of reported initiatives are presented below. What is not always clear from the country reports is how successful the initiatives mentioned have been.

The report from Cameroon describes a decentralized cooperation mechanism and indicates the responsibilities of some ministries, as follows:

- All biodiversity-related ministries are active participants in the implementation of the National Biodiversity Strategy and Action Plan. Their front-line and field representatives who work with rural communities on a day-to-day basis are also involved.
- Every ministry informs other biodiversity-related ministries before enacting any policy or regulation addressing the management of any sector of biodiversity.
- The Ministry of Scientific Research and Innovations disseminates research findings in all sectors of biodiversity and collaborates with all other ministries in building capacity in the management of biological resources.
- There is regular collaboration and sharing of information through meetings and seminars on biodiversity issues.
- All biodiversity-related ministries have been sensitized regarding the Aichi Targets and each ministry is programming efforts to meet relevant Aichi Targets into its work.

Ethiopia has a centralized and functional cooperation mechanism, with responsibility for coordination lying with the Ethiopian Biodiversity Institute. Other major actors involved include the Ministry of Agriculture, the Ethiopian Institute of Agricultural Research, the Ethiopian Wildlife Conservation Authority, the Ministry of Environment and Forests, higher learning institutions, the Ministry of Culture and Tourism, the regional bureaus of agriculture, the recently established biodiversity offices, and regional pastoral agencies. The report from Guinea mentions, as an example of successful interministerial cooperation, the

[18] Most of the countries in the region have a National Biodiversity Strategy and Action Plan: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cabo Verde, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Djibouti, Eritrea, Eswatini, Ethiopia, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Togo, Uganda, United Republic of Tanzania, Zambia, Zimbabwe.

partnership between the Ministry of Livestock and the Ministry of the Environment within the framework of the implementation of the PROGEBE project (see Box 3). It notes that the project signed agreements with the Environmental Monitoring and Information Centre on environmental monitoring and with the National Water and Forestry Directorate on the sustainable management of natural resources (development of land-use plans, training of staff in various forestry techniques and establishment of community forests).

In Kenya, a secretariat has been established to coordinate the Kenya Vision 2030 programme across all government ministries. In the Gambia, conservation, management and development of natural resources have been the shared responsibility of a multitude of actors since the passing of the Banjul Declaration in 1977. The main players include governmental and non-governmental organizations, along with numerous projects and programmes supported by external donors and financing agencies. The National Environmental Management Council has overall responsibility for environmental policy-making and coordination at national level. The Agriculture and Natural Resources Working Group is responsible for coordination and harmonization of all cross-sectoral natural resources development issues.

3.1.3 Needs and priorities

Many of the needs and priorities reported by countries with regard to policies, programmes and institutions governing biodiversity for food and agriculture relate to resource constraints (human, physical and financial) of the type that affect many areas of biodiversity management. Many countries also express the need for sensitization and assessment activities specific to associated biodiversity. As described above (Sections 2.1.5, 2.2.3 and 2.3.2), reported needs and priorities in specific areas of management such as sustainable use, conservation, and access and benefit-sharing often include the development of relevant policies and programmes. Major needs and priorities identified by reporting countries in terms of policies, programmes and institutions targeting biodiversity for food and agriculture, associated biodiversity and wild foods include the following:

- building human-resource capacity to implement national policies, including through training and sensitization;
- respecting existing legal frameworks on biodiversity;
- implementing sustainable national biodiversity coordination mechanisms;
- mainstreaming biodiversity issues in the government, business, scientific and education sectors to ensure that they are not ignored in development processes or in government and industry decisions;
- establishing baseline datasets and long-term monitoring mechanisms to inform decision-making and information exchange;
- inventorying the resource base to inform stakeholders, and systematizing and computerizing data collected on associated biodiversity; and
- increasing research efforts on the various dimensions of associated biodiversity – upgrading of existing research facilities and development of a financial resources mobilization strategy are major priorities in this regard.

3.2 CAPACITY AND RESEARCH NEEDS

The main priorities in terms of training and education identified in the country reports were as follows:

- capacity development at national level to support the development of legislation and policies that comply with international laws, conventions, treaties and protocols;
- strengthening the capacity of all actors to understand and implement legal instruments;
- training of professionals and field technicians on technical and legal aspects of biodiversity management;
- training of farmers on the sustainable use of biodiversity, particularly associated biodiversity; and

- training of communicators to support the implementation of awareness-raising programmes targeting the public.

Priorities reported by a smaller number of countries include the following:

- training on scientific methodology, including on taxonomy and the implementation of biodiversity censuses;
- training on the development of improved biocontrol methods for established invasive alien species, pest and diseases;
- capacity development for relevant organizations on climate change impacts, use of the latest climate change-related technologies, identification of vulnerable areas and mitigation analysis;
- capacity development in climate change science; and
- capacity development with regard to strategies for controlling and/or mitigating land degradation.

The country reports also mention the need to support targeted research and to develop new models of partnership and cooperation that strengthen capacity building in scientific research and development. Support for information collection and dissemination is regarded as an essential basis for bridging knowledge gaps and ensuring sound implementation of relevant measures and activities. Some reports note an urgent need to strengthen core activities such as education and training, awareness raising, data management, access to information and networking (data collection, quality control and archiving).

As indicated above in the various needs and priorities subsections of this report, many countries mentioned the need to strengthen research on associated biodiversity and wild foods. The following major priorities were identified in this regard:

- further strengthening research capacities in universities and research centres in the fields of biodiversity management and monitoring (countries noted the lack of sufficient funding to address this need);
- raising awareness among stakeholders, including through the establishment of accessible information systems; and
- reviewing and harmonizing relevant policies.

Most country reports that identify capacity and research needs emphasize needs related to crop genetic resources. A number of countries also refer to research needs related to particular practical aspects of management such as restoring soil fertility, identifying crops suitable for specific agroecological zones and identifying and utilizing crop species that are resistant to climatic hazards. The report from the Gambia refers to the key role that combining traditional knowledge with scientific knowledge can play in the conservation and sustainable use of biodiversity for food and agriculture. Strengthening research that involves local knowledge is identified as a priority. The report particularly highlights an initiative that brings together women´s traditional knowledge and scientific research on oysters and cockles in the Niumi National Park on the country's coast. The report from Senegal highlights the need for integrated, multisectoral and multidisciplinary approaches to research on biodiversity for food and agriculture.

IV. Regional and international cooperation

4.1 MAJOR REGIONAL AND INTERNATIONAL INITIATIVES ADDRESSING THE CONSERVATION AND USE OF BIODIVERSITY FOR FOOD AND AGRICULTURE

Several types of regional and international cooperation initiatives are mentioned in the country reports. However, aside from initiatives targeting the management of crop and livestock genetic resources, none of these specifically target the conservation or sustainable use of biodiversity for food and agriculture as such. They target instead the management of relevant ecosystems (e.g. forests, seas and costal zones), particular resources (e.g. soils), landscapes or biodiversity in general. Regional initiatives (initiatives involving more than one country) reported in the country reports are listed in Table 15. Reported initiatives include those at global, continental and subcontinental levels. They can be grouped into the following three major categories:

1. initiatives that provide platforms for common regulations or actions relevant to the management of a common resource or to a common challenge: examples include the Niger River Basin Authority, the Lake Chad Basin Commission and the Pan-African Agency for the Great Green Wall; these initiatives are generally very broad and biodiversity-management activities may be a relatively small component of their work;
2. initiatives dealing with policy, scientific and management issues (most of the initiatives listed in Table 16 fall in this category); depending on the context, biodiversity management may be a major or minor component of such initiatives; and
3. initiatives focusing exclusively on biodiversity management and dealing with scientific, technical and practical issues (conservation, capacity building, regional exchange and commerce, etc.); regional networks for management of plant genetic resources fall in this category.

Funding sources for these three types of initiatives vary substantially. The majority receive funds from external sources. Some are funded by contributions from member countries. Some receive funds from multiple donors. The country reports indicate that the effectiveness and functionality of the various reported initiatives depend heavily on the nature of their funding sources. None of the initiatives is self-sufficient or autonomous in terms of funding.

The country reports indicate that participation in the reported cooperation initiatives varies from one initiative to the other. Generally, the countries that host the headquarters of the respective initiatives are the most active in day-to-day management. Countries appear generally to be more active in the initiatives in the second and third categories than in those in the first category. The benefits of cooperative initiatives tend to accrue to countries that are able to ensure the availability of the minimum human, physical and financial resources needed to implement recommendations. Countries that are in a weaker position in this regard benefit more from financial resources made available via the initiatives to support the development of local institutions and research or development facilities.

4.2 NEEDS AND PRIORITIES

Full and effective participation in regional and international initiatives requires that countries adopt or develop local legislation and institutions and train human resources to implement regional and international guidelines. For various reasons, most countries adhere to regional and international initiatives but fail to take appropriate measures to implement the recommendations arising from these initiatives. Reported reasons for this generally related to limited capacity and a lack of effective enforcement and follow-up mechanisms.

Table 15. Reported regional and international initiatives embedding the conservation and/or use of biodiversity for food and agriculture, and in particular of associated biodiversity, wild food species and ecosystem services

Policies and programmes	Objectives	Countries involved
Commission of Central African Forests (COMIFAC)	Sustainable utilization of the forest ecosystems of the Congo Basin	Burundi, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Rwanda, Sao Tome and Principe
East African Plant Genetic Resources Network	Capacity building on conservation of plant genetic resources	Burundi, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Uganda
Intergovernmental Authority on Development (IGAD) Biodiversity Management Program	Transboundary conservation of genetic resources	Kenya, Somalia
Permanent Interstate Committee for Drought Control in the Sahel (CILSS)	Investment in research on food security and in the struggle against the effects of drought and desertification, for a new ecological balance in the Sahel	Benin, Burkina Faso, Cabo Verde, Chad, Côte d'Ivoire, Gambia, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, Togo
Convention on Biological Diversity	"Conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources …"	Worldwide
United Nations Framework Convention on Climate Change	"Stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system …"	Worldwide
International Union for Conservation of Nature	Mission: "Influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable."	Worldwide
Lake Chad Basin Commission	Mandate: "Sustainable and equitable management of the Lake Chad waters and other transboundary water resources of the Lake Chad Basin; Preservation and protection of ecosystems of the catchment area; Promotion of integration, and preservation of peace and security peace in the Conventional Basin."	Cameroon, Central African Republic, Chad, Libya, Niger, Nigeria
Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region (the Nairobi Convention)	To ensure sound environmental management of the maritime and coastal areas of the East African Region. It provides a framework for the protection and development of marine and coastal resources. The protocols focus on the conservation of flora and fauna and on measures for combating marine and coastal pollution.	Comoros, France, Kenya Madagascar, Mauritius, Mozambique, Seychelles, Somalia, South Africa, United Republic of Tanzania
Pan-African Agency for the Great Green Wall	Creation of a "green wall" through an afforestation belt south of the Sahara	All NEPAD (New Partnership for Africa's Development) member countries
Niger Basin Authority	Protection of the Niger Basin ecosystem	Benin, Burkina Faso, Cameroon, Chad, Cote d'Ivoire, Guinea, Mali, Niger, Nigeria
Economic Commission on Cattle, Meat and Fish Resources (CEBEVIRHA)	Sustainable, harmonized and balanced development of the livestock and fishing sectors in member countries to achieve food security and reduce poverty in the subregion	Cameroon, Chad, Congo, Central African Republic, Equatorial Guinea, Gabon

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

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