Food and Agriculture Organization of the United Nations

COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

REGIONAL SYNTHESIS REPORTS

# NEAR EAST AND NORTH AFRICA REGIONAL SYNTHESIS FOR

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

# NEAR EAST AND NORTH AFRICA REGIONAL SYNTHESIS FOR

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

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ROME, 2019

Required citation:
FAO. 2019. *Near East and North Africa Regional Synthesis for The State of the World's Biodiversity for Food and Agriculture*. Rome.



ISBN 978-92-5-131823-2


# Contents

TABLES

# Foreword

The production systems of the Near East and North Africa are home to a wealth of biodiversity and include the centres of origin of a number of the world's major domesticated plant and animal species. Many of the region's native species, breeds and varieties have unique characteristics that help them to cope with its hot, dry climate and harsh terrain. These populations, along with those used in forestry, fisheries and aquaculture and a wide range of "associated" species such as pollinators, underpin the region's agriculture and food production and are a vital resource for the future, particularly given the need to adapt to the threats posed by climate change. The importance of managing these resources sustainably can hardly be overstated.

The process that led to the publication of *The State of the World's Biodiversity for Food and Agriculture* was an opportunity for countries and for regional groups of countries to review the status and trends of all components of biodiversity that contribute to agriculture and food production, along with the state of efforts to manage them sustainably. At national level, the preparation of country reports provided a framework for consultations involving multiple stakeholders from across the food and agriculture and environment sectors. The informal regional consultation held in 2016 allowed countries to share experiences and discuss priorities for action.

It is clear that the biodiversity of the region's production systems faces many threats, including destructive land- and water-use practices, climate change, pollution of various kinds, invasive species and the impacts of military conflicts. It is also clear that in many cases policies, programmes, legislation and institutional frameworks for the management of biodiversity for food and agriculture need to be strengthened. Many knowledge gaps need to be addressed: inventories are incomplete, monitoring inadequate and the roles and functions of particular components of biodiversity often poorly understood. Nonetheless, the country reports from the region provide numerous examples of projects, programmes and policies that are having a positive impact on the management of biodiversity in crop, livestock, forest or aquatic production systems.

This regional synthesis report provides a valuable summary of the findings of the country reports. However, its publication should be viewed as a staging post within an ongoing process. There is an urgent need for the countries of the region, and those of the world as a whole, to build on the information that has been gathered and intensify their individual and collective efforts to promote the sustainable use and conservation of biodiversity for food and agriculture.

Abdessalam Ould Ahmed
*Assistant Director-General and Regional Representative*
*FAO Regional Office for Near East and North Africa*

# Acknowledgements

Lead authors: Farid Waliyar and Kim-Anh Tempelman Mezzera

Contributors: Julie Bélanger, Agnès Bernis Fonteneau, Muhammad Dost, Irene Hoffmann, Ladina Knapp, Dafydd Pilling, Manuel Pomar, Vladimir Shlevkov Pronskiy, Miriam Widmer

Authors and contributors of country reports included in the Near East and North Africa regional synthesis are listed below.

Logistical support to the organization of an informal regional consultation on the state of the Near East and North Africa's biodiversity for food and agriculture held in Rome, Italy, 5 to 7 April 2016, was provided by FAO's Regional Office for Near East and North Africa. Financial support for both the organization of the informal regional consultation and the preparation of the regional synthesis report was provided by the Governments of Germany, Spain and Switzerland.

**Authors and contributors of country reports included in the Near East and North Africa regional synthesis**

| Country | National Focal Point[1]/lead author | Institution(s) | Contributor(s) |
|---|---|---|---|
| **Egypt** | Neveen A. Hassan | National Gene Bank<br>Ain Shams University | |
| **Iraq** | Sahar Ahmed Al-Bayati<br>Abdul Amir Abdullah Issa | Ministry of Agriculture | |
| **Jordan** | Maha Qasim Al Syouf<br>Hothaifa Ababneh | National Center for Agricultural Research & Extension | Fawzi Al Sheyab, Iyad Musalam, Khaled Abulaila, Nasab Al Rawashdeh, Sobhia Saifan, Abeer Abu Shirbi, Ahmad Al Edwan, AmaL Al Khateeb, Jameel Sarirah, Khalil Jamjoum, Mohamad Al Rifaee, Mohamed Jitan, Nuha Al Zakarneh, Rabab Kabariti, Sarab Sharaf, Zain Khraisat, Ziad Tahabsem, Shareef Rawashdeh, Ahmad Khraisat, Amani Al-Daoud, Faisal Awawdeh, Fawzi Al Sheyab, Moath Al Garaibeh, Nadira Al-Jawhari, Nazmi Abu Zaid, Nizar Hadad, Rana Muhaisen, Samia Akroush |
| | | Deutsche Gesellschaft für Internationale Zusammenarbeit | Farid Musmar, Oliver Schlein, Soenke Marahrens |
| | | University of Jordan | Mahmud Duwayri, Bashir Qaderi, Mamoon Ershidat, Said Damhouriya, Mahfouz Abu, Jafar Meqdady, Tareq Al Najjar |
| | | Jordan University of Science and Technology | Mohamad Ababneh, Saeb Khraisat, Zuhair Amer, Khaleel Jawasreh, Mohammad Ababneh, Mohammad Obeidat |
| | | Ministry of Environment | Raed Bani Hani, Bilal Qtaishat, Bilal Shagarin, Tareq Abualhawa |
| | | Mutah University | Adel Abed Al Gani, Reda Khawaldeh |
| | | Yarmouk University | Ahmad El Oqla, Wesam Al Khateeb |
| | | Royal Society for Conservation of Nature | Anas Abuyahia, Belal Ayasreh, Sameh Katatbeh, Husam Al Awidat |
| | | Ministry of Agriculture | Basma Manaseer, Eman Al Zabin, Husam Al Karapsh, Belal Al Habees, Mohamad Al Nsoor, Ahmad Wahbeh, Mohamood Faris Al Soub, Nader Habahbeh |
| | | European Neighbourhood Partnership Instrument | Esmat Al Karadsheh Eu |

[1] National Focal Points at the time of preparation and submission of the country reports. For an up-to-date list of National Focal Points for Biodiversity for Food and Agriculture, please consult: http://www.fao.org/cgrfa/overview/nfp/nfp-bfa/en/

| Country | National Focal Point[1]/lead author | Institution(s) | Contributor(s) |
|---|---|---|---|
| | | Balqa Applied University | Ezz Al Din Al Ramamneh |
| | | Royal Botanic Garden | Hatem Taifour, Mustafa Shdeifat |
| | | Al Hussein Bin Talal University | Ibrahim Rawashdeh |
| | | Jarash University | Mohamed Break |
| | | Mideast Aviation Academy | Mwafaq Fraiwan |
| | | American University Madaba | Faris Khouri |
| | | Jordanian Poultry Producers Union | Fares Hamoudeh |
| | | Royal Marine Conservation Society | Ehab Eid |
| | | Private Sector | Ahmad Wahbeh, Ashraf Al Dairi, Haithem Shaheen |
| | | United Nations Development Programme | Majed Hasanat |
| | | FAO | Talal Al Fayez |
| **Lebanon** | Lamis Chalak | Ministry of Agriculture | Dina Saleh, Mona Siblini, Mohamad Soukarie, Elias Ibrahim, Bassel Bazzal, Abeer Seyrawan, Samir Majdalani, Imad Lahoud, Michel Bassil, Ramzi Moughrabi |
| | | Ministry of Environment | Lara Samaha, Nizar Hani |
| | | Lebanese Agricultural Research Institute | Ali Chehade, Joelle Breidy, Zinette Moussa |
| | | National Council for Scientific Research | Carla Khater, Sherif Joumaa |
| | | Lebanese University | Jihad Noun, Therese Atallah, Ghassan Jaradi, Ghassan El Zein, Kamal Khazaal, Reda El Mais, Jean Stephan |
| | | American University of Beirut | Salma Talhouk, Rabih Talhouk |
| | | Saint Joseph University | Magda Bou Dagher Kharrat, Mireille Kalassi |
| | | Holy Spirit of Kaslik University | Marc Beiruty |
| | | Beirut Arab University | Safaa Baydoun |
| | | Notre Dame University | Pauline Aad |
| **Oman** | Khair Tuwair Al-Busaidi | Ministry of Agriculture and Fisheries<br>Ministry of Environment and Climate Affairs<br>Ministry of Heritage and Culture<br>Diwan of Royal Court<br>Royal Court Affairs<br>The Sultan Qaboos University Oman Animal & Plant Genetic Resources Center | |
| **Sudan** | Afaf Elgozouli | Ministry of Agriculture and Forestry | Ali Gadoom El Ghali Osman, Bahaeldin Mohmmed Khamis, Nawal Sidahmed, Yassian Nimir |
| | | Agricultural Research Corporation | El Tahir Ibrahim Mohamed, Mashaer Obeid Yosif Goda, Maha Zeinelabdeen, Yasir Ahmed Hassan, El Tahir Ibrahim Mohamed |
| | | Fisheries Research and Aquatic Center | Hend Elshiek Idris, Amar Osman Alobeid |
| | | Forests National Corporation | Elsadig Elamin Bakheit, Sara Mohmmed Elmubarak |
| | | Ministry of Animal Resources, Fisheries and Range Land | Asma Mohamed Sadig, Hawaa Omer Hasabelnbi |
| | | University of Bahri | Talaat Daffalla Abdel Magid, Elniema Abdelkhalig Mustafa, Talaat Dafalla Abdel Magid |
| | | University of Khartoum | Abdelazim Mirghani Ibrahim, Adil Ali Elhussein |
| | | Higher Council for Environment | EL Khitma Awad Mohmmed |

| Country | National Focal Point[1]/lead author | Institution(s) | Contributor(s) |
|---|---|---|---|
| | | Freelance Experts | Mamoun Gasim Musa, Gaafar Ibrahim Mohamed Ali |
| | | National Centre for Research | Abu Obieda Osman Ibrahim |
| | | Plant Protection Directorate | Ishraga Mohamed Elhassan |
| | | Ministry of Environment, Natural Resources And Physical Development | |
| **United Arab Emirates** | Fatima Obaid Al Kalbani | Ministry of Climate Change and Environment | Munir Husain, Hassinah Ali, Rumaitha Alshuhi, Muna Alshamsi |
| **Yemen** | Maeen Ali Ahmed Aljarmouzi | Agricultural Research and Extension Authority | Khalil M. Alsharjabi, Hameed Alkhader, Mohamed Mukbel Merai, Abed Albeil |
| | | Ministry of Agriculture and Irrigation – General Directorate for Forestry, Rangelands and Desertification Control | Jameel Abdulsamad Alemad, Omar Jazem |
| | | Marine Sciences and Biological Research Authority | Jamal Bawazir, Aref Hamoud |
| | | Dhamar University | Majed Aljaradi, Mohamed Alsharhi, Fath Badi |
| | | Aden University | Fadhl Albalam |
| | | Hadhramout University | Khaled Bawahedi |
| | | The Natural Resources Research Center | Mohamed Hezam Almashreki |

# About this report

## BACKGROUND

This report summarizes the state of biodiversity for food and agriculture in the Near East and North Africa, based largely on information provided in country reports submitted to FAO as part of the reporting process for the report on *The State of the World's Biodiversity for Food and Agriculture*. A first draft, based on nine country reports, was prepared as supporting documentation for an informal regional consultation on the state of the Near East and North Africa's biodiversity for food and agriculture, held in Rome, Italy, 5 to 7 April 2016. The document was later revised based on feedback received from the participants of the informal consultation. 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 (2019a).

### 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 the wild foods of plant, animal and other origin.

### Associated biodiversity

Associated biodiversity comprises those 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;
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,

[1] See Annex 2 of *Report of the Informal Regional Consultation on the State of the Near East's and North Africa's Biodiversity for Food and Agriculture* (CGRFA-16/17/Inf.11.5) (FAO, 2016).

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 and 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, 2019a).

## ABOUT THIS REPORT

This report summarizes the state of biodiversity for food and agriculture in the Near East and North 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 the Near East and North Africa's biodiversity for food and agriculture, held in Rome, Italy, 5 to 7 April 2016.

## SUMMARY

This report provides an overview of the state of biodiversity for food and agriculture in the Near East and North Africa, based on reports received from nine of the region's countries and on the outcomes of an informal regional consultation organized by FAO in Rome as part of the process leading to the preparation of *The State of the World's Biodiversity for Food and Agriculture*. The country reports cover the state of biodiversity for food and agriculture and associated ecosystem services in and around plant, animal, aquatic and forest production systems. Specifically, they address four main issues: the state of knowledge of biodiversity for food and agriculture; sustainable use and conservation of biodiversity for food and agriculture; policies, institutions and capacity; and regional and international cooperation.

The Near East and North Africa region is one of the world's main centres of origin of cultivated crops. It is the cradle of a broad range of cereals, grasses, legumes, forage crops, oil- and fibre-producing plants, vegetables, herbs, spices and fruit trees. Some of the region's countries are secondary centres of origin of cultivated plants.

Several countries reported that changes in land and water use and management, invasive plant species, climate change and pollution are among the main threats to plant, animal, forest and aquatic genetic resources. In several of the region's countries, war and armed conflicts have also seriously affected biodiversity for food and agriculture.

Countries reported a number of associated biodiversity species that are actively managed for the provision of ecosystem services related to food production, nutrition, water and sanitation. For example, honey bees and wild pollinators, such as butterflies, bumble bees and birds, are reported to be crucial components of the region's agricultural ecosystems.

Some countries reported using biological control agents. Jordan for example mentioned the use of the Mexican marigold (*Tagetes erecta*) to control plant-parasitic nematodes and the parasitic wasp *Bracon concolorans* to manage the tomato borer *Tuta absoluta*. The Sudan reported using two weevil species – *Neochetina eichhorniae* and *N. bruchi* – to control the spread of water hyacinth (*Eichhornia crassipes*). Some countries referred to a number of crop varieties that are resistant to or tolerant of pest and diseases.

Wild food species reported in the region include a substantial number of wild plants and a few

game species. Some wild plant species are traditionally used as sources of food, fodder, fibre or oil, or for medicinal purposes. However, many of these species are neglected and underutilized.

Countries reported a range of measures that contribute to the sustainable use and conservation of biodiversity for food and agriculture, including breeding activities, water- and land-management initiatives and laws addressing the conservation and exchange of animal and plant genetic resources and their associated traditional knowledge. A large number of management practices that support the maintenance and use of biodiversity for food and agriculture were reported.

Several countries reported the use of biodiversity for food and agriculture in climate change adaption and mitigation, in the control of invasive alien species, in the prevention of natural or human-made disasters and/or in reducing the effects of disasters on livelihoods, food security and nutrition.

Water scarcity and high temperatures are reported to be major constraints in the region. Several countries reported that climate change adaptation and mitigation efforts include the development and use of improved crop varieties that are adapted to environmental stresses of this kind. A number of farming practices that can improve crop production in climate change-affected production systems were reported.

The importance of maintaining and using traditional knowledge of associated biodiversity and wild foods was mentioned by a number of countries. This knowledge is, however, reported to be threatened by a number of factors, including drought, climate change, land-use change and overexploitation of wild foods. Several countries reported the implementation of countermeasures, such as the documentation and diffusion of traditional knowledge.

Countries reported a number of ongoing *in situ* and *ex situ* conservation initiatives, including several pilot projects addressing the sustainable use, conservation and restoration of wildlife populations, their ecosystems and other components of biodiversity, including plant, mammal, bird, reptile, invertebrate, fish and amphibian species. The United Arab Emirates reported that the number of nature reserves and protected areas in the country increased from 22 in 2013 to 43 in 2017. It indicated that it has a national network consisting of all the competent authorities concerned with nature reserves. Several needs and priorities in this field were reported, including strengthening relevant national policy and legal frameworks, improving capacity building and establishing national networks of protected areas that, as appropriate, represent all ecosystems and species of environmental and socio-economic importance.

Reporting countries referred to several national policies and programmes that support the conservation and sustainable use of biodiversity for food and agriculture. Several mentioned the need to strengthen their seed-sector policies, particularly in the field of farmers' rights. Some examples of regional policies and programmes that embed the conservation and sustainable use of biodiversity for food and agriculture were also reported. Countries noted the need for more explicit policy, legal and strategic frameworks and the need to increase the availability of skilled personnel and financial resources.

The region's countries are actively involved in several international conventions and treaties that have the potential to contribute to improving the conservation and sustainable use of biodiversity for food and agriculture at national level. For example, the International Treaty on Plant Genetic Resources for Food and Agriculture has created opportunities for its contracting parties to make significant progress in sustainable crop production, provided their national legislation and policies are aligned with those of the Treaty.

Countries also reported major regional initiatives targeting the conservation and use of biodiversity for food and agriculture, including the Plant Genetic Resources Network operating within the framework of the Arab Organization for Agricultural Development.

Countries highlighted the need to strengthen regional cooperation and establish transboundary initiatives for the conservation and sustainable use of biodiversity for food and agriculture. Priorities in this respect include network building, improving regional coordination, policy development, awareness raising, capacity building and improving the monitoring of biodiversity for food and agriculture.

# I. Assessment and monitoring of biodiversity for food and agriculture

## 1.1 REGIONAL CONTEXT

As of November 2017, 9 of the 19 countries in the Near East and North Africa region had submitted a country report as a contribution to the preparation of *The State of the World's Biodiversity for Food and Agriculture*.[1] Combined, these countries cover an area of approximately 4 333 690 km$^2$, including land and water, which is about 30.5 percent of the region's total territory (Table 1).

**Table 1. Percentage of land, water, agricultural and forest areas in the Near East and North Africa located in countries that provided country reports**

| | Total area | Land area | Water area | Agricultural area | Forest area |
|---|---|---|---|---|---|
| % covered by country reports | 30.5 | 30.7 | 5.7 | 29.2 | 50.0 |

*Source*: Calculated from FAOSTAT data for 2014 (data for the Sudan taken from the World Bank databank http://data.worldbank.org/indicator).

**Box 1. Facts and figures for the Near East and North Africa**

- Meadows and pastures account for 85 percent of the region's agricultural land,[1] which is much higher than the global average and indicates the dominance of livestock production in the region's agriculture.
- Arable land represents about 13.7 percent of the region's total agricultural land area, covering about 52 million hectares. However, this percentage varies significantly from country to country.[2]
- Egypt and Tunisia are the only two countries with significant areas of agricultural land under permanent crops (approximately 22 percent and 24 percent, respectively).
- The region's production systems include irrigated and rainfed crop and mixed systems and pastoral livestock production. Agroecological zones include highland, semi-arid and arid. Urban and peri-urban agriculture is significant. Artisanal fishing is practised in coastal areas.
- Because of low levels of precipitation, the region's agriculture relies heavily on irrigation.
- In several countries, sedentary mechanized farming is gradually replacing traditional nomadic pastoralism.
- On-farm food production is becoming less important in the livelihoods of poor rural households.
- Urban and peri-urban agriculture is gaining importance in terms of feeding the urban poor.
- Livestock are important to the livelihoods of landless and marginalized farmers in arid and semi-arid areas and the urban poor. For example, livestock play a major role in safeguarding food security and nutrition, serve as an alternative form of savings and insurance, and supply draught power and transport services. A downside of the livestock sector is that it increasingly relies on imported feed.
- The region's marine and freshwater ecosystems and fisheries are diverse and have a range of different complexities. The productivity of fisheries and aquaculture systems often depends on ecosystems and natural resources that are shared by several countries.

*Sources*: FAO, 2010a, 2014a.

[1] Up to 97.5 percent in Yemen and in Member Countries of the Gulf Cooperation Council (GCC) and nearly 100 percent in Mauritania.

[2] In the GCC countries and Yemen only 2.2 percent of agricultural land is arable, compared to nearly 79 percent and 4 percent in, respectively, Egypt and Iraq.

[1] The FAO Member States in the Near East and North Africa are Algeria, Bahrain, Egypt, Iran (Islamic Republic of), Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, the Sudan, Syrian Arab Republic, Tunisia, the United Arab Emirates, Yemen (see http://www.fao.org/neareast/countries/en/).

**Table 2. Production systems reported in the Near East and North Africa**

| Production system | Countries reporting |
|---|---|
| Grassland-based livestock systems | Iraq, Jordan, Lebanon, Oman, Sudan, United Arab Emirates, Yemen |
| Landless livestock systems | Egypt, Iraq, Jordan, Lebanon, Oman, Sudan, United Arab Emirates, Yemen |
| Naturally regenerated forests | Iraq, Jordan, Lebanon, Oman, Sudan, United Arab Emirates, Yemen |
| Planted forests | Egypt, Jordan, Lebanon, Sudan, United Arab Emirates |
| Self-recruiting capture fisheries | Egypt, Iraq, Jordan, Lebanon, Oman, Sudan, United Arab Emirates, Yemen |
| Culture-based fisheries | Egypt, Iraq, Oman, United Arab Emirates |
| Fed aquaculture | Egypt, Jordan, Lebanon, Oman, Sudan, United Arab Emirates, Yemen |
| Irrigated rice | Egypt, Iraq |
| Irrigated crops (non-rice) | Egypt, Iraq, Jordan, Lebanon, Oman, Sudan, United Arab Emirates, Yemen |
| Rainfed crops | Egypt, Iraq, Jordan, Lebanon, Sudan, Yemen |
| Mixed systems | Iraq, Lebanon, Sudan, United Arab Emirates, Yemen |
| Other production systems | |
| Beekeeping | Jordan, Lebanon, Yemen |
| Soilless crop production system | Jordan |
| Organic farming production systems[1] | Jordan |
| Poultry (layers and broilers)[2] | Lebanon, Yemen |

[1] Several reporting countries grow organic crops. These are usually reported on under the various crop-production categories proposed by FAO in the country-reporting guidelines.
[2] Most countries in the region have poultry production systems. These tend to be reported on under the landless livestock category proposed by FAO in the country-reporting guidelines.
*Note*: For a description of the production-system classification used in the reporting process, see Table 1.1 in FAO (2019a).
*Source*: Country reports prepared for *The State of the World's Biodiversity for Food and Agriculture* (FAO, 2019a).

The following countries provided reports: Egypt, Iraq, Jordan, Lebanon, Oman, Saudi Arabia, the Sudan, the United Arab Emirates and Yemen. The west side of the Gulf and the Arabian Peninsula are well represented. However, several countries[2] that host large shares of woodlands and forests and/or are located in North Africa are missing.

Limited inland water availability is an important constraint in the region, where only 609 $m^3$ of internal renewable water resources are available per capita per year, compared to a world average of 6 080 $m^3$. The FAO Regional Initiative on Water Scarcity for the Near East and North Africa indicates that "agriculture, which consumes already more than 85% of available fresh water resources, will face strong challenges in keeping the same water allocation while sustaining food security and rural economy" (FAO, 2012).

The region is one of the world's main centres of origin of cultivated crops. It is the cradle of a broad variety of cereals, forage plants, grasses and legumes (e.g. barley, oat,[3] wheat,[4] canary grass, grass pea, lentil, lupin, pea, clover[5] and serradella), oil and fibre plants (e.g. black mustard, olive, rape, safflower and flax), vegetable crops (e.g. *Allium* spp.,[6] asparagus, garden beet, cabbage, celery, chicory, lettuce, parsnip, rhubarb and turnip), herb, spice and essential-oil plants (e.g. peppermint, sage, thyme, anise, caraway and hop) and fruit trees (e.g. pistachio [*Pistacia vera*]). Crops such as wheat, barley and lentil that were domesticated about ten thousand years ago are still grown today (Zeven and Zhukowsky, 1975).

Some countries, such as the Islamic Republic of Iran, Lebanon and the Syrian Arab Republic, are second centres of origin of cultivated plants, including of a variety of grains and legumes (e.g. wheat,[7]

[2] Including Algeria, Libya, Mauritania, Morocco, the Syrian Arab Republic and Tunisia.
[3] Including Mediterranean and sand oat.
[4] Including durum, emmer, Polish wheat and spelt.
[5] Including Egyptian, white and crimson clover.
[6] Including sweet leek.
[7] Including einkorn, common, durum, oriental, Persian and poulard wheat.

two-row barley, rye, oat,[8] lentil and lupin), forage species (e.g. alfalfa, Persian clover, fenugreek and hairy vetch) and fruit-tree species (e.g. apple, cherry, fig, hawthorn, pear, pomegranate and quince).

Archaeological findings suggest that the first forms of agriculture (i.e. domestication of animals and transition from a nomadic to a sedentary lifestyle) originated in Mesopotamia, a region lying largely within modern-day Iraq. Iraq's particular richness in biodiversity, including genetic diversity, corresponds to scientific observations that genetic diversity is richer in areas that are close to centres of domestication (Tapio *et al.*, 2010; Peter *et al.*, 2007; Loftus *et al.*, 1999). This diversity is important for the livelihoods of small-scale livestock keepers, farmers and fishers and for breeding programmes in Iraq and in other countries of the region.

The country-reporting guidelines provided by FAO invited countries to list their production systems in accordance with the categories shown in Table 2.

Some constraints were encountered in the preparation of the country reports. For example:

1. countries faced difficulties in providing information according to the production system classification categories proposed in the country-reporting guidelines;
2. countries exposed to long periods of political unrest and ongoing conflicts were not in a position to provide extensive information, having undertaken little work in the area of biodiversity for food and agriculture over the past 25 years; and
3. in the absence of adequate monitoring, most countries struggled to provide information on the status and trends of associated biodiversity.

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

Over the past decades, FAO has conducted a series of global assessments of genetic resources for food and agriculture, presenting detailed information on the status and trends of these resources and the main drivers of change affecting them (Table 3). To date, two reports on the state of the world's genetic resources have been prepared for the plant sector, two for the animal sector and one for the forest sector. Table 3 lists the countries from the region that submitted reports to FAO as contributions to these assessments.

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

An overview of drivers of changes affecting plant, animal, forest and aquatic genetic resources reported by countries is provided in Table 4.

**Land and water use and management**: Several countries considered changes in land and water use and management to be among the main threats to plant, animal, forest and aquatic genetic resources. Oil drilling, gold mining and urban expansion were given as examples of human activities that have contributed to a reduction in arable land area, crop production and crop productivity. The areas available for grazing in the savannah belt are also shrinking. Shazali and Ahmed (1999) ascribe this to the uncontrolled expansion of both traditional and mechanized rainfed agriculture. Yemen noted that urban expansion into fertile agricultural lands has led to soil sealing, which in turn causes seasonal flooding. The Sudan mentioned that the importation of contaminated seeds had introduced diseases such as downy mildew, which had resulted in millet crop failures over several seasons. It also reported that the privatization of irrigation water management (the storage and distribution of water, including the maintenance of canals and drainage systems) has led to poor efficiency in irrigation systems in crop production. Some countries mentioned that the construction of dams and use of water-harvest schemes have had a particularly positive effect in terms of water availability in rainfed crop production systems.

**Invasive species** were noted in the country reports as one of the most serious threats to both aquatic and terrestrial biodiversity for food and agriculture. For example, the United Arab Emirates report on the tree *Prosopis juliflora* that was introduced into Abu Dhabi in the 1970s for

[8] Including Mediterranean and common oat.

**Table 3. Country participation in FAO's global assessments on plant, animal and forest genetic resources in the Near East and North Africa**

| Countries | Plant genetic resources | | Animal genetic resources | | Forest genetic resources | Aquatic genetic resources |
|---|---|---|---|---|---|---|
| | SoWPGR I | SoWPGR II | SoWAnGR I | SoWAnGR II | SoWFGR | SoWAqGR |
| Algeria | x | ✓ | ✓ | ✓ | ✓ | ✓ |
| Bahrain | x | x | x | ✓ | x | x |
| Egypt | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Iran (Islamic Republic of) | ✓ | x | ✓ | ✓ | ✓ | ✓ |
| Iraq | ✓ | ✓ | ✓ | ✓ | x | ✓ |
| Jordan | ✓ | ✓ | ✓ | ✓ | x | x |
| Kuwait | ✓ | x | x | ✓ | x | x |
| Lebanon | ✓ | ✓ | x | x | ✓ | x |
| Libya | ✓ | x | ✓ | x | x | x |
| Mauritania | ✓ | x | ✓ | ✓ | ✓ | x |
| Morocco | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Oman | ✓ | ✓ | ✓ | ✓ | x | x |
| Qatar | ✓ | x | x | x | x | x |
| Saudi Arabia | x | x | x | x | x | x |
| Sudan | ✓ | x | ✓ | ✓ | ✓ | ✓ |
| Syrian Arab Republic | ✓ | x | ✓ | x | x | x |
| Tunisia | ✓ | x | ✓ | x | ✓ | ✓ |
| United Arab Emirates | x | x | x | x | x | x |
| Yemen | ✓ | ✓ | ✓ | x | ✓ | x |
| Total | 15 | 8 | 14 | 12 | 8 | 7 |

*Note*: SoWPGR = *The State of the World's Plant Genetic Resources for Food and Agriculture*; SoWAnGR = *The State of the World's Animal Genetic Resources for Food and Agriculture*; SoWFGR = *The State of the World's Forest Genetic Resources*; SoWAqGR = *The State of the World's Aquatic Genetic Resources for Food and Agriculture*.
*Sources*: FAO, 1997, 2007a, 2010b, 2014b, 2015, 2019b.

its fast growth and its salt- and drought-tolerant properties, and subsequently spread rapidly into the valleys of the northern United Arab Emirates, where it outcompeted native flora for nutrients, water and space. *Prosopis juliflora*, along with *Opuntia* spp., is also reported to be invasive in Yemen.

**Pollution**: With a considerable increase in the amount of waste being produced, waste collection and treatment have become a serious concern in the United Arab Emirates. Inappropriate waste management is considered a threat to soil and groundwater biodiversity in particular. Addressing the problem is listed as a priority area in the country's National Strategy and Action Plan for Environmental Health (Government of the United Arab Emirates, 2010).

**Climate change** was mentioned as a severe threat to biodiversity for food and agriculture by Jordan, Oman, the Sudan, the United Arab Emirates and Yemen. More erratic weather conditions, higher temperatures, periods of extreme rainfall and longer drought spells are considered to adversely affect the richness and distribution of species of relevance to food and agriculture and to contribute to the loss of relevant traditional knowledge.

The Sudan's nomadic pastoralists have had to shift their herding activities southwards as a result of climate change.[9] This has led, *inter alia*, to conflicts between camel herders and farmers (Harir,

[9] Between 1941 and 2000, the Sudan's rainfall decreased by an average of 0.5 percent per year (RPA, 2009). As a result of increasing droughts and erratic rainfall patterns, pasture and water availability have become unpredictable.

**Table 4. Drivers of change reported to affect plant, animal, forest and aquatic genetic resources in the Near East and North Africa**

| Drivers of change | Countries reporting | Examples or description |
|---|---|---|
| Changes in land and water use and management | Jordan, Lebanon, Sudan, United Arab Emirates, Yemen | Oil drilling, gold mining and unsustainable water-management practices have led to a reduction in arable land area, crop production and productivity.<br>Increased mechanization and the expansion of traditional rainfed agriculture have led to a decrease in rangeland area.<br>Human population growth and the expansion of the agriculture sector have increased demand for water. |
| Changing economic, socio-political and cultural factors | Iraq, Jordan, Sudan, United Arab Emirates, Yemen | Open market policies and changing food consumption patterns are a threat to the conservation and use of the region's biodiversity for food and agriculture.<br>Local conflicts and an increase in infrastructure projects are putting pressure on arable land area, as well as on the sustainable use of natural resources.<br>Tourism has contributed, inter alia, to the introduction of invasive alien species that are posing a threat to the region's native biodiversity for food and agriculture. |
| Overexploitation and overharvesting | Iraq, Jordan, Oman, Sudan, United Arab Emirates, Yemen | Overgrazing has resulted in land degradation, soil erosion and the loss of grass species.<br>Overfishing is a serious threat to marine biodiversity and ecosystem functioning. |
| Climate change and natural disasters | Egypt, Jordan, Lebanon, Oman, Sudan, United Arab Emirates, Yemen | Changing climatic conditions, predicted to include rising temperatures, greater fluctuation in rainfall patterns and longer droughts, will contribute to increasing the frequency and severity of natural disasters such as floods and fires. Events of this kind can lead to land-use conflicts and negatively affect the region's genetic resources for food and agriculture (e.g. livestock breeds and endemic crop and wild plant varieties). |
| Pests, diseases, invasive alien species | Jordan, Oman, Sudan, United Arab Emirates, Yemen | The spread of transboundary animal diseases as a result of the uncontrolled movement of livestock and wild animals across borders has affected native livestock breed populations.<br>Commercial activities (e.g. tourism), illegal trade and an increase in frequency of red tides[1] have contributed to the introduction and spread of invasive alien species. |
| Advances and innovations in science and technology | Iraq, Jordan, United Arab Emirates | Artificial insemination has played an important role in the genetic improvement of cattle and sheep populations, including through cross-breeding. The latter has, however, also led to a loss of genetic variation.<br>Despite the many benefits of desalination, concerns about potential negative impacts on the environment are increasing (Lattemann and Höpner, 2008). Key issues include discharges into the marine environment, the emissions of air pollutants and the energy demand of the process. |
| Policies | Jordan, Sudan | A lack of clear policies is a threat to the conservation and sustainable use of biodiversity for food and agriculture. |
| Population growth and urbanization | Jordan, Oman, United Arab Emirates | Human population growth and urbanization put pressure on the availability of arable land and on sanitation infrastructures. When the latter are outdated and/or overloaded, waste is discharged directly into the environment and finds its way into surface or groundwater. |
| Pollution | Jordan, United Arab Emirates | Increased use of pesticides is negatively affecting biodiversity in and around production systems.<br>Energy consumption growth has led to increased greenhouse-gas emissions. |
| Other | United Arab Emirates | Illicit trade |

[1] Eutrophication may be responsible for the blooming of invasive phytoplankton species (Pertola, Kuosa and Olsonen, 2005).
*Source*: Country reports prepared for *The State of the World's Biodiversity for Food and Agriculture* (FAO, 2019a).

1994). According to Osman-Elasha and El Sanjak (2009), climate change could further increase competition for land and water between pastoralists and farmers.

In Jordan, predicted temperature increases and declines in rainfall[10] could negatively affect genetic resources for food and agriculture, in particular local livestock breeds, endemic wild plant varieties and local honey bees (*Apis mellifera*). With respect to the latter, Jordan reported that the mortality rate among honey bees had already reached worrying levels.

[10] Studies mentioned in the report of Jordan estimate that temperatures will increase by about 2 to 3 °C by 2050 and 3 to 4 °C by 2100 and that rainfall will decrease by 10 to 15 percent by 2050 and 15 to 20 percent by 2100.

Several countries mentioned that **tourism** is causing serious damage to biodiversity for food and agriculture in the region. Tourists are reported, *inter alia*, to have contributed to the introduction of exotic species. In a few countries, tourist intrusion and disturbance are also reported to have severely affected wildlife, bringing about changes, for example, in the feeding and reproduction habits of some wild animal species.

In several of the region's countries, **war and armed conflicts** have seriously affected biodiversity for food and agriculture. In Iraq, for example, a country that has suffered from war and sanctions for more than 25 years, very little work has been done to document and protect biological diversity and large knowledge gaps remain to be filled (Ministry of Environment, 2010). In its country report, Iraq highlighted the urgent need to raise awareness of the importance of biodiversity. The four main threats to biodiversity in Iraq according to UN Environment (UNEP, 2003) are: (i) lack of institutional/legal frameworks for the conservation of biodiversity; (ii) lack of a protected areas network; (iii) lack of a national biodiversity strategy and action plan;[11] and (iv) ecosystem degradation caused by the loss of the Mesopotamian marshlands and oil spills.

### 1.2.2 Associated biodiversity species actively managed for the provision of ecosystem services

Countries identified a number of associated biodiversity species that are actively managed for the provision of ecosystem services related to food production, nutrition, water and sanitation (Table 5).

**Pollination**: Honey bees, including the Syrian (*Apis mellifera syriaca*), Italian (*A. mellifera ligustica*), Carniolan (*A. mellifera carnica*), African (*A. mellifera intermissa*) and European (*A. mellifera*) honey bee, as well as wild pollinators, such as butterflies, bumble bees and birds, are reported to be crucial providers of pollination services in the region's agricultural ecosystems.

**Pests and diseases regulation**: Several practices that help control weeds, pests and diseases in crops, forest trees and aquatic organisms, including the use of pesticides, are harmful to biodiversity for food and agriculture, as well as to human, animal and environmental health. Biological control is considered to be a particularly promising means of controlling exotic pests. Some countries reported using associated biodiversity species as biological control agents. Examples from Jordan include use of the Mexican marigold (*Tagetes erecta*) to control plant-parasitic nematodes and the use of the parasitic wasp *Bracon concolorans* to manage the tomato borer *Tuta absoluta*.[12] The Sudan reported using two weevils – *Neochetina eichhorniae* and *N. bruchi* – to control the spread of water hyacinth (*Eichhornia crassipes*), a highly invasive plant species that covers major waterways and lakes and can negatively affect native aquatic plants and fish (Abdelmoti, 2012). The use of fungi belonging to the genus Trichoderma to control important plant pathogens such as Fusarium spp. was also mentioned. In the Sudan, Yousif and Suliman (2010) conducted a study on the control of the soil-borne wilt disease of chickpeas (*Cicer arietinum*) caused by *Fusarium oxysporum* f.sp. *ciceris*, using antagonistic properties of soil micro-organisms. Qatar indicated that migratory birds play an important role in keeping rodent and insect populations under control.

Some countries referred to a number of crop varieties that are resistant or tolerant to pest and diseases. In Jordan, for example, the *Lycopersicon esculentum* tomato has been found to be resistant to, *inter alia*, tomato yellow leaf curl virus, tomato spotted wilt virus and zucchini mosaic virus, and some cultivars of chickpea (*Cicer arietinum*) have been reported to be resistant to Ascochyta blight, a disease caused by the fungal pathogen *Ascochyta rabiei*. The utilization of products derived from the neem tree (*Azadirachta indica*) for their natural insect-repellent properties was also mentioned.

**Water purification and waste treatment**: Lebanon, Yemen and Jordan reported the use of a few wetland plant species for water purification (Table 4), including common reed (*Phragmites australis*), Johnson grass (*Sorghum halepensis*), moringa (*Moringa* spp.), simplestem bur-reed (*Sparganium erectum*) and the European aspen (*Populus tremula*).

[11] This refers to the situation as of 2003. Iraq published a national biodiversity strategy and action plan in 2015 (Government of Iraq, 2015).

[12] The tomato borer was first detected in Jordan in October 2009. It quickly spread to all tomato-growing areas in the country, entirely destroying open field and greenhouse tomatoes (Al-Jboory, Katbeh-Bader and Al-Zaidi, 2012).

**Natural-hazard regulation**: A number of plant species are grown in the region to regulate natural hazards. Examples include saltbush (*Atriplex* spp.), *Salsola* spp. and cover crops (e.g. barley) that can help retain moisture, reduce soil erosion and improve salinity tolerance. Fire-retardant tree species, such as the Mediterranean cypress (*Cupressus sempervirens*) and the carob tree (*Ceratonia siliqua*), are planted around forests for fire control. Other species such as the grey mangrove (*Avicennia marina*), date palm (*Phoenix dactylifera*), Mediterranean saltbush (*Atriplex halimus*) and common juniper (*Juniperus communis*) are also mentioned in the country reports.

**Nutrient cycling**: Several countries reported growing legume cover crops to improve nutrient cycling, including vetch (e.g. *Vicia ervilia* and *V. sativa*), lentil (*Lens culinaris*), chickpea (*Cicer arietinum*), alfalfa (*Medicago sativa*) and pea (*Pisum sativum*).

**Soil formation and protection**: Biological diversity helps the formation and maintenance of soil structure and the retention of moisture and nutrient levels. The loss of biological diversity through the clearing of vegetation has contributed to the salinization of soils, leaching of nutrients, lateralization of minerals and accelerated erosion of topsoil, which has reduced the land's productivity (Attiwill and Leeper, 1987). Maintaining biological diversity can help preserve the productive capacity of the soil, prevent landslides, safeguard coastlines and riverbanks and prevent the degradation of coral reefs and coastal fisheries as a result of siltation (ibid).

The following species were reported to be managed for soil formation and protection in the region: shrubby orache (*Atriplex halimus*); white saxaul (*Haloxylon persicum*); bulbous bluegrass (*Poa bulbosa*); acacia (*Acacia* spp.); bridal broom (*Retama monosperma*); mesquite (*Prosopis juliflora*); cactus (*Opuntia* spp.); Arabian tamarisk (*Tamarix arabica*); bunchgrass (*Panicum turgidum*); mangrove grass (*Aeluropus lagopoides*) and kadhab (*Cadaba rotundifolia*). According to Manousaki and Kalogerakis (2009), shrubby orache (*Atriplex halimus*), a C4 perennial native shrub of the Mediterranean basin with excellent drought and salinity tolerance, has the potential for phytoremediation of soils contaminated with lead and cadmium.

**Water cycling**: Jordan reported using shrubby orache (*Atriplex halimus*), bulbous bluegrass (*Poa bulbosa*) and *Salsola* species for water cycling. However, no information was provided on how these plants are being used in this context or on their distribution.

**Production of oxygen, gas regulation**: The reporting countries listed over plant and tree species and genera that contribute to the production of oxygen and gas regulation (Table 5).

**Table 5. Associated biodiversity species most frequently reported to be actively managed for the provision of ecosystem services in production systems in the Near East and North Africa**

| Ecosystem services | List of species |
|---|---|
| Pollination | Honey bees:<br>• European honey bee (*Apis mellifera*)<br>• Local honey bees<br>Bumble bees<br>Wild birds<br>Wild butterflies |
| Pest and disease regulation | **Biological control organisms**<br><u>Fungi</u><br>Arbuscular mycorrhizal fungi<br><u>Invertebrates</u><br>Insects:<br>• Eulophid wasp (*Aphelinus mali*)<br>• Chalcid wasp (*Aphytis melinus*)<br>• Encyrtid wasp (*Copidosoma koehleri*)<br>• Mealybug ladybird (*Cryptolaemus* spp.)<br>• Water hyacinth weevil (*Neochetina eichhorniae*)<br>• Tomato mirid (*Nesidiocoris tenuis*)<br>Parasitic wasps:<br>• *Anagyrus dactylopii*<br>• *Anagyrus indicus*<br>• *Bracon concoloran* |

**Table 5** *Cont'd*

| Ecosystem services | List of species |
|---|---|
| | Arachnids:<br>• Phytoseiid mite (*Amblyseius idaeus*)<br>Plants<br>Cabbage (*Brassica oleracea*)<br>Sunflower (*Helianthus annuus*)<br>Mexican marigold (*Tagetes erecta*)<br>Trees<br>Acacia nilotica<br>Neem (*Azadirachta indica)*<br>Desert date (*Balanites aegyptiaca*)<br>Messmate (*Eucalyptus obliqua*)<br>*Senegalia senegal*<br>**Planting disease-resistant crop varieties**<br>Chickpea (*Cicer arietinum*)<br>Pumpkin (*Cucurbita pepo*)<br>Tomato (*Lycopersicon esculentum*)<br>**Function not specified:**<br>Plants<br>Cedar (*Cedrus libani*)<br>Barley (*Hordeum spontaneum*, *H. vulgare*)<br>Silverleaf nightshade (*Solanum elaegnifolium*)<br>**Pests and pathogens**<br>Olive fruit fly (*Bactrocera oleae*)<br>Mediterranean fruit fly (*Ceratitis capitata*)<br>Codling moth (*Cydia pomonella*)<br>Shield bug (*Eurygaster integriceps*)<br>European tortoise bug (*Eurygaster maura*)<br>European grapevine moth (*Lobesia botrana*)<br>Moth (*Prays citri*)<br>Red palm weevil (*Rhynchophorus ferrugineus*)<br>Fungal plant pathogen (*Spilocaea oleaginea*)<br>Ticks<br>Moth (*Tuta absoluta*)<br>Leopard moth (*Zeuzera pyrina*) |
| Water purification and waste treatment | Trees<br>Moringa (*Moringa* spp.)<br>Olive (*Olea* spp.)<br>Poplar (*Populus* spp.)<br>Aspen (*Populus tremula*)<br>Other plants<br>Field crops<br>Forage legumes<br>Common reed (*Phragmites australis*)<br>Johnson grass (*Sorghum halepense*)<br>Simplestem bur-reed (*Sparganium erectum*) |
| Natural hazard regulation | Planting crops and trees<br>Saltbush (*Atriplex* spp.), saltwort (*Salsola* spp.) and cover crops such as barley (for soil-erosion control and salinity tolerance)<br>Mediterranean cypress (*Cupressus sempervirens*) and carob tree (*Ceratonia siliqua*) around forests for fire control<br>Mediterranean saltbush (*Atriplex halimus*)<br>Grey mangrove (*Avicennia marina*)<br>Common juniper (*Juniperus communis*)<br>Date palm (*Phoenix dactylifera*) |
| Nutrient cycling | Planting crops and cover crops<br>Chickpea (*Cicer arietinum*)<br>Lentil (*Lens culinaris*)<br>Alfalfa (*Medicago sativa*)<br>Pea (*Pisum sativum*)<br>Ervil (*Vicia ervilia*)<br>Vetch (*Vicia sativa*) |

**Table 5** *Cont'd*

| Ecosystem services | List of species |
|---|---|
| Soil formation and protection | Acacia (*Acacia* spp.)<br>Mangrove grass (*Aeluropus lagopoides*)<br>Mediterranean saltbush (*Atriplex halimus*)<br>*Cadaba rotundifolia*<br>*Ceratonia* spp.<br>White saxaul (*Haloxylon persicum*)<br>*Odyssea mucronata*<br>Cactus (*Opuntia* spp.)<br>Desert bunchgrass (*Panicum turgidum*)<br>Bulbous bluegrass (*Poa bulbosa*)<br>Mesquite (*Prosopis juliflora*)<br>Bridal broom (*Retama monosperma*)<br>Saltwort (*Salsola* spp.)<br>Arabian tamarisk (*Tamarix arabica*) |
| Water cycling | Mediterranean saltbush (*Atriplex halimus*)<br>Bulbous bluegrass (*Poa bulbosa*)<br>Saltwort (*Salsola* spp.) |
| Habitat provisioning | Acacia (*Acacia* spp.)<br>Chickpea (*Cicer* spp.)<br>Carob tree (*Ceratonia siliqua*)<br>*Dipterygium glaucum*<br>Lentil (*Lens* spp.)<br>Alfalfa (*Medicago sativa*)<br>Persea (*Mimusops laurifolia*)<br>Pistachio (*Pistacia* spp.)<br>Mistletoe (*Plicosepalus curviflorus*)<br>Tamarind (*Tamarindus indica*)<br>White clover (*Trifolium repens*)<br>Star fenugreek (*Trigonella stellata*)<br>Christ's thorn jujube (*Ziziphus spina-christi*) |
| Production of oxygen, gas regulation | Acacia (*Acacia* sp.)<br>Mangrove grass (*Aeluropus lagopoides*)<br>Garlic (*Allium* spp.)<br>Mediterranean saltbush (*Atriplex halimus*)<br>Grey mangrove (*Avicennia marina*)<br>Neem tree (*Azadirachta indica*)<br>Cabbage (*Brassica oleracea*)<br>*Cadaba rotundifolia*<br>Carob tree (*Ceratonia siliqua*)<br>*Ceratonia* spp.<br>Chickpea (*Cicer arietinum*)<br>*Cicer* spp.<br>Pumpkin (*Cucurbita pepo*)<br>Alqa (*Dipterygium glaucum*)<br>White saxaul (*Haloxylon persicum*)<br>Sunflower (*Helianthus annuus*)<br>Barley (*Hordeum spontaneum, H. vulgare*)<br>Common juniper (*Juniperus communis*)<br>Lentil (*Lens culinaris*)<br>Tomato (*Lycopersicon esculentum*)<br>Alfalfa (*Medicago sativa*)<br>Persea (*Mimusops laurifolia*)<br>Moringa (*Moringa* spp.)<br>*Odyssea mucronata*<br>Cactus (*Opuntia* spp.)<br>Desert bunchgrass (*Panicum turgidum*)<br>Date palm (*Phoenix dactylifera*)<br>Common reed (*Phragmites australis*)<br>Pistachio (*Pistacia* spp.)<br>Pea (*Pisum sativum*)<br>Mistletoe (*Plicosepalus curviflorus*) |

**Table 5** *Cont'd*

| Ecosystem services | List of species |
|---|---|
| | Bulbous bluegrass (*Poa bulbosa*)<br>Poplar (*Populus* spp.)<br>Mesquite (*Prosopis juliflora*)<br>Bridal broom (*Retama monosperma*)<br>Saltwort (*Salsola* spp.)<br>Silverleaf nightshade (*Solanum elaegnifolium*)<br>Johnson grass (*Sorghum halepense*)<br>Marigold (*Tagetes erecta*)<br>Tamarind (*Tamarindus indica*)<br>Arabian tamarisk (*Tamarix arabica*)<br>White clover (*Trifolium repens*)<br>Star fenugreek (*Trigonella stellata*)<br>Ervil (*Vicia ervilia*)<br>Vetch (*Vicia sativa*)<br>Christ's thorn jujube (*Ziziphus spina-christi*) |
| Not specified | Blackthorn (*Acacia mellifera*)<br>White stern thorn (*Acacia polycantha*)<br>Red acacia (*Acacia seyal*)<br>Paperback thorn (*Acacia sieberiana*)<br>Baobab (*Adansonia digitata*)<br>Silk tree (*Albizia aylmeri*)<br>Grey mangrove (*Avicennia marina*)<br>African fan palm (*Borassus aethiopum*)<br>Large-leaved saucer-berry (*Cordia africana*)<br>African ebony (*Diospyros mespiliformis*)<br>Winter thorn (*Faidherbia albida*)<br>Phalsa cherry (*Grewia tenax*)<br>Sea cucumber (*Holothuria scabra*)<br>Doum palm (*Hyphaene thebaica*)<br>African mahogany (*Khaya senegalensis*)<br>African bamboo (*Oxytenanthera abyssinca*)<br>Dry zone cedar (*Pseudocedrela kotschyi*)<br>Small-leaved bloodwood (*Pterocarpus lucens*)<br>Tamarind (*Tamarindus indica*) |

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

**Box 2. Monitoring micro-organisms: an example from Algeria**

With funding provided by the Ministry of Land Planning and Environment, Algeria identified and taxonomically classified about 150 different taxa of micro-organisms:

- rhizobia and their use in their natural habitats;
- bacteria and fungi of Oubeira Lake;
- bacteria of hot salt springs; and
- antagonists of plant pathogens for crop protection.

Under this initiative, 230 isolates of *Actinomycetes* spp., including 29 original isolates suitable for use in biological control measures, and the *Azospirillum brasilense* bacteria, a rhizosphere inhabitant that can improve the growth of wheat under salt stress conditions, were identified in the Saharan zone.

*Source*: Ministère de l'aménagement du territoire et de l'environnement, 2014.

### 1.2.3 Wild food species

The wild food species most frequently reported by countries in the region are listed in Table 6. Countries reported mainly wild plants. A few game species were reported. No aquatic species were mentioned.

**Table 6. Wild food species reported by two or more countries in the Near East and North Africa**

| Wild food species | Countries reporting |
|---|---|
| **Plant** | |
| Okra (Abelmoschus esculentus) | Oman, Sudan |
| Baobab (*Adansonia digitate*) | Oman, Sudan |
| Amaranth (*Amaranthus* spp.) | Oman, Sudan |
| Desert date (*Balanites aegyptiaca*) | Sudan, Yemen |
| Hanza (*Boscia* spp.) | Oman, Sudan |
| Karira (*Capparis decidua*) | Sudan, Yemen |
| Mallow-leaves (*Corchorus* spp.), Jew's mallow (*C. olitorius*), threelocule cochrus (*C. trilocularis*) | Lebanon, Sudan, Yemen |
| Wild endive (*Cichorium pumilum*) | Jordan, Lebanon |
| Key lime (*Citrus aurantifolia*) | Oman, Yemen |
| Karsatta (*Dobera glabra*) | Sudan, Yemen |
| Fig tree (*Ficus* spp., *F. vasta*), Punjab fig (*F. palmata*), shortleaf fig (*F. populifolia*), sycamore fig (*F. sycomorus*) | Lebanon, Oman, Sudan, Yemen |
| Fennel (*Foeniculum vulgare*) | Lebanon, Sudan, Yemen, |
| Sandpaper raisin (*Grewia flavescens*), *G. mollis*, phalsa cherry (*G. tenax*), mallow-leaved cross-berry (*G. villosa*) | Oman, Sudan, Yemen |
| Tumble thistle (*Gundelia tourneforti*) | Jordan, Lebanon |
| Doum palm (*Hyphaene thebaica*) | Sudan, Yemen |
| Common purslane (*Portulaca oleracea*) | Jordan, Lebanon, Oman, Yemen |
| *Premna resinosa* | Oman, Yemen |
| Sicilian sumac (*Rhus coriaria*) | Jordan, Lebanon |
| Docks (*Rumex* spp., *R. chalepensis, R. cyprius, R. nervosus*), clustered dock (*R. conglomeratus*), fiddle dock (*R. pulcher*), bladder dock (*R. vesicarius*) | Jordan, Lebanon, Oman |
| Sage (*Salvia* spp.), Greek sage (*S. fruticosa*), Jerusalem sage (*S. hierosolymitana*) | Jordan, Lebanon |
| White mustard (*Sinapis alba*) | Jordan, Lebanon |
| Tamarind (*Tamarindus indica*) | Oman, Sudan |
| Thyme (*Thymus* spp., *T. roegneri*), Breckland thyme (*T. laevigatus*), common thyme (*T. vulgaris*) | Jordan, Lebanon, Oman, Yemen |
| Jujube (*Ziziphus* spp., *Z. leucodermis*), buffalo thorn (*Z. mucronata*), Christ's thorn jujube (*Z. spina-christi*) | Lebanon, Oman, Sudan, Yemen |
| **Game species** | |
| Goat (*Capra* spp.) | Iraq, Jordan, Sudan |
| Gazelle (*Gazella* spp.) | Iraq, Sudan, Yemen |
| Partridge (*Ammoperdix* spp.) | Iraq, Jordan |

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

The region has a large number of wild food species. The Sudan reported that some wild plant species are traditionally used for food, fodder, fibre, oil and/or medicinal purposes. However, many of these species are often neglected and underutilized because their yields are low and they are not easily accessible. Some countries reported that there is a lack of appropriate legislation related to the conservation and promotion of wild food species.

Wild foods in the region are essentially used as substitutes when food shortages occur. Wild foods used in this way can include annual and perennial woody trees, herbs, shrubs and weeds, as well as other wild plants, such as wild okra (*Abelmoschus* spp.) and wild Jew's mallow (*Corchorus olitorius*). The Sudan mentioned that forest fruit species such as the doum palm (*Hyphaene thebaica*), *kirkir* (*Randia geipaeflora*), *karmadoda* (*Naucleae latifolia*) and *godeim* (*Grewia tenax*) are particularly important to the food security and nutrition of local communities during agricultural off-seasons or crop failures (for further information, see Abdel-Rahman, Awad and Babiker, 2014).

Iraq mentioned that information on wild foods is not readily available. However, it did indicate that a small proportion of the population inhabiting the marshlands of the southern part of the country depend on fishing and hunting (ducks and geese) for food.

### 1.2.4 Drivers of change

The main drivers of change affecting associated biodiversity, ecosystem services and wild food resources in the region, as reported by countries, are summarized in Table 7.

The Sudan mentioned that, in the absence of systematic data gathering on the various components of associated biodiversity, no conclusions could be drawn on the status of these components or on the drivers of change that affect them. It did, however, indicate that the use of broad-spectrum insecticides had resulted in a reduction in beneficial insect populations (predators, parasitoids and pollinators).

In Yemen, wild foods are essential to many rural subsistence households. However, population growth, invasive alien species, drought, floods and grazing pose a threat to many wild food species, particularly in the country's woodlands and rangelands. The extent to which these drivers have affected wild food species is undocumented. A lack of reliable data and a lack of formally trained foresters mean that the conservation and restoration of wild food species is challenging.

In Jordan, rising poverty levels have increased pressure on the country's natural resources, leading, *inter alia*, to the overexploitation of wild food species such as thyme (*Thymus* spp.).

Lebanon reported that demographic changes (including the influx of Syrian refugees), urbanization and sociopolitical, economic and cultural factors such as changing lifestyles were among the main threats to the country's associated biodiversity, ecosystem services and wild foods.

Oman mentioned that the production of a number of wild forest trees (e.g. wild fig trees) and berry bushes had steadily decreased as a result of a decline in pollinator populations. The main causes of this decline are believed to be (i) extreme heatwaves caused by climate change and (ii) pests and diseases.

### 1.2.5 National information systems on associated biodiversity

Most of the reporting countries indicated that they have national information systems in place to assess sectoral genetic resources (i.e. crop, livestock, forest or aquatic genetic resources), some of which also include data of relevance to associated biodiversity. A few countries reported having information systems to monitor specific components of associated biodiversity. Most of these systems were, however, developed for environmental rather than agricultural purposes.

The Sudan mentioned having a research programme on plant genetic resources that was established in the 1980s to collect, conserve, evaluate and document local crop varieties.[13] It also has a forest herbarium that contributes to the conservation of forest tree species. Oman established a National Information Sharing Mechanism on Plant Genetic Resources for Food and Agriculture[14] and a Genetic Resources Modelling System (GeRMS) to document and manage plant genetic resources.

Jordan mentioned that its National Center for Agriculture Research and Extension collaborates with Bioversity International to evaluate change in the genetic makeup of barley (*Hordeum spontaneum*). It noted that its monitoring activities for associated biodiversity were dispersed across a number of institutes and initiatives. For example, the Royal Society for the Conservation of Nature monitors various associated-biodiversity species in nature reserves. Jordan also reported small-scale surveys monitoring flora and fauna, but noted that crop wild relatives and wild foods at *in situ* conservation sites were not systematically monitored.

In Egypt, the National Gene Bank is responsible for managing the country's programmes on plant genetic resources. The genebank is organized into four major departments, one of which

[13] http://arcsudan.sd/agricultural-plant-genetic-resources-conservation-and-research-center/
[14] http://www.pgrfa.org/gpa/omn

**Table 7. Drivers of change reported to affect associated biodiversity, ecosystem services and wild food resources in the Near East and North Africa**

| Drivers of change | Countries reporting | Examples or description |
|---|---|---|
| Changes in land and water use and management | Sudan, Yemen | Land fragmentation, expansion of mechanized farming, dam construction, degradation of downstream habitats. |
| Changing economic, socio-political and cultural factors | Sudan, Yemen | The ecological and social friction caused by large-scale mechanized agriculture is well documented in the literature and can be blamed for three types of conflict:<br>- conflict between traditional farmers and owners of the large schemes;<br>-conflict among local people in the vicinity of the schemes; and<br>-conflict involving the state, as a major backer of the scheme owners, and small farmers and pastoralists. |
| Overexploitation and overharvesting | Sudan, United Arab Emirates, Yemen | Natural forest vegetation has been subjected to heavy overexploitation.<br>Overgrazing occurs to such an extent that large areas of forest land lie bare of vegetation.<br>Aquatic systems are affected by use of destructive fishing gear and overfishing. |
| Climate change | Sudan, United Arab Emirates, Yemen | Higher temperatures and water stress, desertification. |
| Natural disasters | Sudan, Yemen | Droughts, floods and seasonal wildfire outbreaks. |
| Pests, diseases, invasive alien species | Sudan, Yemen | Spread of invasive alien species such as mesquite (*Prosopis juliflora*).<br>Increase in the planting of the toxic shrub Jatropha curcas.<br>Spread of various invasive insects. |
| Advances and innovations in science and technology | Sudan, Yemen | Threats to indigenous genetic resources. |
| Policies | Sudan, Yemen | Weaknesses in institutional capacity and law enforcement. |
| Population growth and urbanization | Sudan, Yemen | Pressure on land and over use of wild foods. |
| Pollution | Sudan, Yemen | Pollution from the petroleum, mining, cement and other industries and from artificial fertilizers. |
| Other | Qatar, Yemen | International trade. |

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

exclusively focuses on activities related to micro-organisms of relevance to agriculture. Iraq reported not having any national information systems to monitor associated biodiversity. However, efforts are being made to evaluate biodiversity according to the targets and indicators of the Convention on Biological Diversity and to develop a national biodiversity strategy and action plan.

## 1.3 NEEDS AND PRIORITIES

The main needs and priorities in the region in terms of the assessment and monitoring of biodiversity for food and agriculture, and in particular of associated biodiversity, wild foods and ecosystem services are to develop:

1. national biodiversity strategy and action plans addressing biodiversity across all sectors and communities;
2. regional coordination to support the implementation of targeted policies;
3. information systems and databases for biodiversity for food and agriculture; and
4. tools and methodologies to monitor, assess and economically valuate the components of biodiversity for food and agriculture.

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

## 2.1 SUSTAINABLE USE

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

Egypt, Lebanon, Jordan, the Sudan, the United Arab Emirates and Yemen reported applying a range of management practices to support the maintenance and use of biodiversity for food and agriculture (Table 8).

Jordan reported that organic farming contributes to protecting and maintaining both soil micro-organisms and local cultivars of crops such as tomato, wheat and legumes. It also mentioned that soil-management practices and water-harvesting techniques favour the retention of soil moisture and the maintenance of vegetation cover, both of which are important to the conservation of biodiversity in crop fields.

The Sudan mentioned that the use of both local and exotic plant genetic resources in plant breeding programmes had led to the development of improved crop cultivars. This had resulted in the production and release of, *inter alia*, improved cereal, oil-crop, food-legume, vegetable and fruit varieties. It also reported that the increased application of integrated pest management practices in vegetable, wheat and cotton production, through the so-called Gazira Scheme, had had a positive effect on biodiversity for food and agriculture.

Jordan indicated that pollination-management practices are increasingly being applied in livestock landless systems and naturally regenerated forests. The United Arab Emirates and Yemen reported an upward trend in pollination management in irrigated cropping systems.

With water becoming increasingly scarce, the region's agriculture sector, which consumes over 83 percent of the water in the region, is under severe pressure to use water more efficiently (IFAD, 2009). In Jordan, efforts have been undertaken to improve water-management practices in agriculture (Van Tuijl, 1993). Jordan reported that 50 percent of the country's cultivated area is

**Box 3. Projects that have promoted sustainable management practices for biodiversity for food and agriculture: examples from Jordan**

The Bani Hashem Village project was established through a partnership between the Ministry of Agriculture and the International Union for Conservation of Nature. It engages the local community in the protection and restoration of the area's biodiversity, including medicinal and aromatic herbs and other indigenous plant species. Effective participation on the part of the local community has strongly contributed to the project's success.

The International Fund for Agricultural Development established a zero-tillage project for resource-poor farmers and livestock producers in rainfed cropping systems. The adoption of zero-tillage farming facilitated land management and enhanced crop yields, household incomes, consumption and food security. It also had positive biophysical and environmental effects.

*Source*: Adapted from the country report of Jordan.

**Table 8. Reported trends in the adoption of selected management practices and approaches in the Near East and North Africa**

| Practice or approach | Production systems | Countries reporting | Reported trends in adoption |
|---|---|---|---|
| **Agroforestry** | Livestock grassland-based systems<br>Livestock landless systems<br>Naturally regenerated forests<br>Irrigated crops<br>Rainfed crops<br>Beekeeping | Jordan<br>Lebanon<br>Yemen | Increasing trends in livestock grassland-based systems, stable trends in naturally regenerated forests and decreasing trends in livestock landless systems, rainfed crop systems and beekeeping in Jordan<br>Increasing trends in beekeeping in Lebanon |
| Conservation agriculture | Livestock grassland-based systems<br>Livestock landless systems<br>Naturally regenerated forests<br>Irrigated crops (non-rice)<br>Rainfed crops<br>Beekeeping | Jordan<br>Lebanon<br>Yemen | Decreasing trends in livestock systems and beekeeping and increasing trends in irrigated crop systems in Jordan<br>Increasing trends in beekeeping in Lebanon |
| Integrated plant nutrient management | Livestock landless systems<br>Irrigated crops<br>Rainfed crops | Jordan<br>United Arab Emirates<br>Yemen | Decreasing trends in livestock landless systems and increasing trends in rainfed and irrigated crop systems in Jordan<br>Increasing trends in irrigated crops and rainfed crops systems in Yemen |
| Integrated pest management | Livestock grassland-based systems<br>Livestock landless systems<br>Naturally regenerated forests<br>Planted forests<br>Fed aquaculture<br>Irrigated crops<br>Rainfed crops<br>Mixed systems | Jordan<br>Lebanon<br>Sudan<br>United Arab Emirates<br>Yemen | Increasing trends in grassland-based and landless livestock systems, naturally regenerated forests, planted forests and mixed systems in Lebanon<br>Increasing trends in date-palm cultivation in Sudan<br>Increasing trends in vegetable, wheat and cotton production in Sudan<br>Increasing trends in irrigated crop and rainfed crop systems in Yemen |
| Pollination management | Livestock landless systems<br>Naturally regenerated forests<br>Beekeeping<br>Irrigated crops | Jordan<br>United Arab Emirates<br>Yemen | Increasing trends in livestock landless systems, beekeeping and naturally regenerated forests in Jordan<br>Jordan notes decreasing trends in the importation of queens and packaged bee swarms<br>Increasing trends in irrigated crop systems in Yemen |
| Landscape management | Livestock landless systems<br>Livestock grassland-based systems<br>Naturally regenerated forests<br>Planted forests<br>Beekeeping | Jordan<br>Lebanon | Increasing trends in all forest systems, decreasing trends in all livestock and beekeeping systems in Jordan<br>Increasing trends in beekeeping in Lebanon |
| Sustainable soil management practices | Livestock grassland-based systems<br>Livestock landless systems<br>Naturally regenerated forests<br>Irrigated crops (non-rice)<br>Rainfed crops | Jordan<br>United Arab Emirates<br>Yemen | Decreasing trends in all livestock systems in Jordan |
| Organic agriculture | Livestock grassland-based systems<br>Livestock landless system<br>Naturally regenerated forests<br>Irrigated crops<br>Rainfed crops<br>Beekeeping | Jordan<br>Lebanon<br>United Arab Emirates<br>Yemen | Increasing trends in all production systems except livestock landless system in Jordan<br>Increasing trends in beekeeping in Lebanon |

**Table 8** *Cont'd*

| Practice or approach | Production systems | Countries reporting | Reported trends in adoption |
|---|---|---|---|
| Low external input agriculture | Livestock landless systems<br>Naturally regenerated forest<br>Irrigated crops<br>Rainfed crops<br>Beekeeping | Jordan<br>Lebanon<br>Yemen | Decreasing trends in livestock landless systems in Jordan<br>Stable trends in beekeeping in Lebanon |
| Home gardens | Livestock grassland-based systems<br>Livestock landless systems<br>Naturally regenerated forests<br>Irrigated crops<br>Rainfed crops<br>Beekeeping | Jordan<br>Lebanon<br>Sudan<br>Yemen | Increasing trends in beekeeping and naturally regenerated forests and decreasing trends in all livestock systems in Jordan<br>Increasing trends in beekeeping in Lebanon<br>Sudan reports home gardens are a common type of small-scale farming<br>Decreasing trends in irrigated crops and in rainfed crops in Yemen |
| Ecosystem approach to capture fisheries | Self-recruiting capture fisheries | Jordan | Decreasing trends in self-recruiting capture fisheries in Jordan |
| Diversification | Self-recruiting capture fisheries<br>Livestock grassland-based systems<br>Livestock landless systems<br>Naturally regenerated forests<br>Planted forests<br>Irrigated crops<br>Mixed systems<br>Rainfed crops<br>Beekeeping<br>Soilless culture production system | Jordan<br>Lebanon Sudan<br>Yemen | Increasing trends in self-recruiting capture fisheries and decreasing trends in beekeeping in Jordan<br>Increasing trends in livestock landless systems, planted forests and beekeeping in Lebanon<br>Decreasing trends in livestock grassland-based systems, increasing trends in irrigated crops and mixed systems in Yemen |
| Base broadening | Livestock grassland-based systems<br>Livestock landless systems<br>Naturally regenerated forests<br>Irrigated crops<br>Rainfed crops<br>Mixed systems<br>Beekeeping | Jordan<br>Yemen | Increasing trends in rainfed crop systems and decreasing trends in beekeeping in Jordan<br>Increasing trends in irrigated crop and mixed systems, and decreasing trends in livestock grassland-based systems in Yemen |
| Domestication | Livestock grassland-based systems<br>Naturally regenerated forests<br>Irrigated crops<br>Beekeeping | Jordan<br>United Arab Emirates<br>Yemen | Decreasing trends in domestication of wild bee species in beekeeping production systems in Jordan<br>Decreasing trends in domestication in livestock grassland-based systems in Yemen |
| Restoration practices | Livestock grassland-based systems<br>Livestock landless systems<br>Naturally regenerated forests<br>Self-recruiting capture fisheries<br>Rainfed crops<br>Mixed systems<br>Beekeeping | Jordan<br>Lebanon<br>United Arab Emirates<br>Yemen | Decreasing trends in livestock grassland-based systems and increasing trends in rainfed crop systems and naturally regenerated forests in Jordan<br>Increasing trends in livestock landless systems, naturally regenerated forests, beekeeping and mixed systems in Lebanon<br>Increasing trends in restoration practices in livestock grassland-based systems in Yemen |
| Landscape management | Livestock grassland-based systems<br>Naturally regenerated forests<br>Self-recruiting capture fisheries<br>Irrigated crops (non-rice)<br>Rainfed crops<br>Mixed systems | Jordan<br>Lebanon<br>United Arab Emirates<br>Yemen | Increasing trends in naturally regenerated forests and self-recruiting capture fisheries in Jordan<br>Increasing trends in beekeeping in Lebanon<br>Decreasing trends in livestock grassland-based systems and increasing in irrigated crop, rainfed crop and mixed systems in Yemen |
| Management of micro-organisms | Livestock grassland-based systems | Jordan<br>Sudan<br>Yemen | Increasing trends in livestock grassland-based systems in Jordan<br>Increasing trends in Sudan, production systems not specified |

**Table 8** *Cont'd*

| Practice or approach | Production systems | Countries reporting | Reported trends in adoption |
|---|---|---|---|
| Enriched forests | Livestock grassland-based systems<br>Naturally regenerated forests<br>Rainfed crops<br>Beekeeping | Jordan<br>Lebanon<br>Yemen | Increasing trends in naturally regenerated forests and in livestock grassland-based systems in Jordan<br>Increasing trends in beekeeping in Lebanon |
| Polyculture/aquaponics | Self-recruiting capture fisheries | Jordan<br>United Arab Emirates | Increasing trends in Jordan |

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

under these improved practices. Jordan also successfully implements zero-tillage and conservation agriculture and supports the implementation of the Al Hima[15] system.

Iraq reported that it is developing a law to address the conservation, maintenance and exchange of animal and plant genetic resources and their associated traditional knowledge. The endorsement of this law is expected to lead to the development of action plans and practices that promote the conservation and use of these resources and the associated biodiversity found in crop and livestock production systems.

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

In Jordan, the Bee Research Department of the country's National Center for Agricultural Research and Extension runs a programme that encourages farmers to engage in beekeeping to alleviate poverty. The Sudan referred to the importance of home gardens to food and nutrition and household income between the harvesting periods of staple crops. It noted that in order to increase the harvesting period of home gardens farmers plant a variety of tree and herbaceous species that provide products at different times of the year. The Sudan also mentioned the importance of forest products, including wild meat and wild fruits (e.g. from the flowering tree *Cordia africana* and the woody plant species *Boscia senegalensis*),[16] to food security and nutrition. Yemen noted that forest products, such as wild meat, contribute significantly to food security, nutrition and household income.

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

Countries in the region that reported using biodiversity for food and agriculture for coping with climate change, invasive alien species and natural or human-made disasters are listed in Table 9.

#### Climate change

For thousands of years, the region has had to cope with water scarcity and extreme temperatures. As a result, it has developed a valuable repository of traditional and institutional knowledge that if preserved and made accessible could make an important contribution to global efforts to address climate change (Hattam, 2009).

With regard to the use of biodiversity for food and agriculture to adapt to and mitigate climate change, a number of countries referred to the importance of developing and using improved crop varieties that can cope with the environmental stresses caused by climate change, including prolonged droughts and the increased occurrence of pest and diseases.

In Yemen, the World Bank is studying "long traditions of agrobiodiversity farming practices" to develop coping strategies that, it is hoped, will help secure the health and livelihoods of local populations in the face of a changing climate, while reducing the region's contribution to global

[15] Al Hima is a traditional rangeland management system.

[16] During periods of drought in the Sahel, wild fruits from the *Cordia africana* and the *Boscia senegalensis* are used as famine foods by local communities.

**Table 9. Reported examples of the use of biodiversity for food and agriculture to cope with climate change, invasive alien species or natural or human-made disasters in the Near East and North Africa**

| Country | Description |
|---|---|
| **Use of biodiversity for food and agriculture to adapt to and mitigate climate change** | |
| Jordan | Use of local wheat and barley varieties in participatory-evolutionary breeding[1] has encouraged farmers to select, use and conserve varieties that are better adapted to climate change.<br>The International Center for Agricultural Research in the Dry Areas and the International Fund for Agricultural Development launched a project to improve the food security and climate change adaptability of livestock producers using the rainfed barley-based system.[2] |
| Lebanon | A national strategy has been developed for the conservation and management of plant genetic resources to optimize their use in the context of climate change. |
| Oman | As part of climate change adaptation efforts, local wheat landraces are being bred to produce new varieties that have shorter growing seasons and can be managed with more flexibility, especially during years with prolonged periods of extreme heat and limited water availability.<br>Studies have been conducted with the aim of improving the use of resilient indigenous rangeland forage species in the country's grasslands (Nadaf, Al-Farsi and Al-Hinai, 2004). |
| **Use of biodiversity for food and agriculture to control invasive alien species** | |
| Sudan | The water hyacinth weevils *Neochetina eichhorniae* and *N. bruchi*, as well as an unspecified fish species, are used to biologically control water hyacinth. |
| **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** | |
| Oman | A natural wall of mangrove forest is being built to thwart tidal threats along the coastline.<br>Dunes and their associated grasses and shrubs contribute to stabilizing and resupplying marine sands, thereby controlling both the erosion of beaches and the movement of wind-blown sand towards inland areas. |

[1] "In evolutionary plant breeding, crop populations with a high level of genetic diversity are subjected to the forces of natural selection. In a cycle of sowing and re-sowing seed from the plant population year after year, those plants favoured under prevailing growing conditions are expected to contribute more seed to the next generation than plants with lower fitness. Thus, evolving crop populations have the capability of adapting to the conditions under which they are grown" (Döring *et al.*, 2011).
[2] More-detailed information on the project can be found at https://www.slideshare.net/ICARDA/improving-the-food-security-and-climate-change-adaptability-of-livestock-producers-using-the-rainfed-barley-based-system
*Source*: Country reports prepared for *The State of the World's Biodiversity for Food and Agriculture* (FAO, 2019a).

**Box 4. Rehabilitation of degraded rangelands and improvement of their carbon-sequestration capacity: an example from the Sudan**

In 1992, UNDP/GEF established the project Community-Based Rangeland Rehabilitation for Carbon Sequestration, covering 17 villages in the Sudan's Central Bara Province. The aim of the project was to implement a simple model of community-based natural-resources management to prevent overexploitation and degradation of marginal lands and rehabilitate rangelands for carbon sequestration. The following outcomes of the project significantly helped pastoralists to adapt to climate change and mitigate its effects:

- improved management of natural resources through training and other capacity-building activities;
- improved food-storage facilities, including for the storage of grain during dry periods;
- better access to local and national markets and to credit through revolving credit funds;
- increased production of marketable sheep; and
- enhanced living conditions for women, *inter alia*, through participation in community gardens.

*Source*: Adapted from the country report of the Sudan.

warming (Hattam, 2009). The farming practices documented include traditional practices and knowledge related to the conservation and utilization of biodiversity important to agriculture, including local landraces and their wild relatives.

In the Sudan, changes in climate and vegetation, including severe periods of drought in the 1980s, have led to changes in the livestock species kept, with increased use of dromedaries and goats at the expense of cattle and sheep (FAO, 2007b).

### Invasive alien species

Jordan reported that no comprehensive studies on invasive alien species with adverse impacts on food and agriculture are currently being carried out. However, it notes that research on some invasive alien species, such as the silverleaf nightshade (*Solanum elaeagnifolium*)[17] and the dwarf honey bee (*Apis florea*), is taking place on a project basis (the report cites Haddad, De Miranda and Bataeneh 2008). Jordan and other countries pointed out that invasive species need to be better monitored before management strategies to control them can be developed and implemented at national and regional levels.

Lebanon reported that in the context of a FAO technical cooperation project[18] its Ministry of Agriculture is trying to keep the invasion and spread of the tomato leaf miner (*Tuta absoluta*) under control. Similar action is being taken against fruit flies and other invasive insects.

The Sudan reported using the water hyacinth weevils *Neochetina eichhorniae* and *N. bruchi* to biologically control water hyacinth. The adult insects feed on water hyacinth leaves and petioles, while the larva tunnels into the petioles and the crown of the plant, causing biotic stress and reducing the number of flowers and seeds produced (Abdelmoti, 2012).

### Natural or human-made disasters

In the wake of tropical cyclone Gonu, environmentalists in Oman have intensified efforts to create a natural wall of mangrove forest to thwart tidal threats along the country's coastline. Dunes and their associated grasses and shrubs contribute to stabilizing and resupplying marine sands, thereby controlling both the erosion of beaches and the movement of wind-blown sand towards inland areas.

In Jordan, some villages, including those participating in the Hima Bani Hashem Villages project, are adopting the Al Hima conservation system.[19] Al Hima integrates nature conservation with human well-being, as it aims to combat overgrazing and the loss of vegetation cover, and to secure the sustainable use of renewable natural resources. The strength of the system lies in the active involvement of communities, who take responsibility for the protection and restoration of biodiversity in their local areas. This has contributed, *inter alia*, to the restoration of indigenous medicinal and aromatic plant species.

In Jordan, governmental institutions recently started working on the conservation and use of animal and fish genetic resources to enhance food security and strengthen rural and social development. A genebank for animal genetic resources will be established to preserve genetic material from superior local sheep breeds for distribution to farmers (NCARE, 2014). Several fish species, including carp and Nile tilapia, are being conserved in hatcheries for subsequent distribution and use in repopulating reservoirs and/or irrigation ponds across the country. The benefits of these conservation programmes to smallholder farmers are two-fold: (i) generation of additional income through fish sales; and (ii) provision of natural fertilizer[20] (NCARE, 2014).

From 2002 to 2005, Bioversity International and partners carried out a project in Yemen on medicinal and aromatic plants to enhance the conservation and use of neglected and underutilized crops. The main aim of the project was to raise the incomes of the participating farmers[21] through the cultivation and marketing of henna, coriander, cumin and nigella. In the context of this project, alhydwan, an ingredient in Yemen's traditional cuisine with a long history of use, regained popularity throughout the country for use in the production of porridge, desserts and savoury products. With the rising demand for this wild crop, farmers in the Hadramout valley have become increasingly interested in cultivating and selling it on domestic and regional markets.

[17] Project code: FAO-TCP/RAB/3301.
[18] Project code: FAO-TCP/RAB/3301.
[19] Al Hima is a traditional rangeland-management system.
[20] Farmers use the urea-enriched waters to irrigate their crops.
[21] Farmers from 13 communities in three different ecological zones participated in the project.

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

Countries were invited to list and describe ecosystem/landscape/seascape approaches[22] that have improved the management and use of biodiversity for food and agriculture in the region. Table 10 summarizes the information provided.

**Table 10. Reported examples of initiatives that use an ecosystem/landscape/seascape approach in the Near East and North Africa**

| Country | Ecosystem/landscape/seascape approach(es) |
|---|---|
| Iraq | There is a proposal to establish a Mesopotamian Marshlands National Park. Marshland conservation work is ongoing under the New Eden Group Project. |
| Jordan | Jordan Beekeepers' Union Forest: In 2014, land was donated to the Jordan Beekeepers' Union to be developed as an example of a honey bee forest.<br>In 2001, the National Center for Agricultural Research and Extension developed a plot of forest trees that can be used to guide beekeepers in the selection of trees whose flowering periods enable gaps in nectar flow to be covered. |
| Lebanon | Water-harvesting technologies and organic farming are being implemented in crop system.<br>Efforts are being made to develop farmers' seed-production systems and facilitate farming communities' access to seed production. |
| Sudan | Sudan has begun to shift its management strategy for marine resources towards an ecosystem approach. Commercial fishing for sea cucumber was closed in 2009 based on evidence provided to all Red Sea states by the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA). |

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

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

Several factors are reported to affect the maintenance and use of traditional knowledge of associated biodiversity and wild foods, including drought, climate change and overexploitation of wild foods. Documentation and diffusion of traditional knowledge are reported to be important, as such knowledge is often maintained orally by the older generation.

Jordan referred to research studies that have gathered information from local populations in various regions of the country on the use of medicinal plants. Through its National Center for Agricultural Research and Extension, the country has documented more than 100 species of edible wild plants that are utilized by local communities as food (e.g. salad and spices) and traditional medicine. Examples include caladium (*Arum* spp.), rocket salad (*Eruca sativa*), dwarf chicory (*Cichorium pumilum*), tumbleweed (*Gundelia tournefortii*), *Asparagus* spp., cyclamen persicum (*Cyclamen persicum*), sagebrush (*Artemisia* spp.) and thyme (*Thymus* spp.).

Iraq mentioned that it plans to enforce a law on the conservation and maintenance of traditional knowledge related to animal and plant genetic resources.

The Sudan mentioned that several projects have contributed to the maintenance and use of traditional knowledge of associated biodiversity and wild foods. It particularly referred to the Route Delineation – Darfur States project, under which various services, including water points, schools and fire grids to protect rangeland against seasonal fires, were developed along transhumance routes in response to needs that were identified by nomadic pastoralist communities.

[22] 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.

The Sudan also referred to the Dryland Husbandry Project (1995 to 2003), which taught women from the Rashaida tribe to process surplus milk and ghee and to practise handicrafts and taught women of the Beja tribe to process surplus milk into cheese.

Iraq mentioned tribal reserves such as the Barzan Tribal Reserve in Iraqi Kurdistan. In Yemen, the World Bank is assisting highland farmers that rely on rainfed agriculture to identify coping strategies for adaptation to climate change (World Bank, 2015). Actions include the conservation and use of biodiversity of importance to agriculture, including local landraces and crop wild relatives. The project also focuses on conserving the associated local traditional knowledge of these highland farmers (ibid.). Lebanon has collected information on traditional knowledge of wild food species. The information is documented and disseminated through leaflets, booklets or articles. Dieticians are involved in this project and make recommendations about consuming wild food species in fresh or cooked dishes, as they are considered to be healthy foods.

In Yemen, in 2013, under the Agricultural Biodiversity for Adaptation to Climate Change Project, a study was conducted to document traditional knowledge in four highland provinces. The researchers found that in many of the targeted areas, farmers face enormous climate-related production problems, including soil erosion due to flooding, crop deterioration due to drought, pests and diseases and low soil fertility. To mitigate and overcome these problems farmers have used the following management principles, most of which rely on traditional skills and knowledge:

- maintaining agricultural biodiversity (crops and vegetative cover);
- optimizing cropping patterns and increasing efficiency in use of natural resources;
- strengthening the foundations of production system management (plant and animal complementarity);
- conserving and sustainably using water; and
- applying farming practices that increase crop productivity, including appropriate sowing dates, plant-protection measures and measures related to land preparation and soil fertility.

### 2.1.6 Needs and priorities

Countries were invited to report on needs and priorities for the sustainable use of biodiversity for food and agriculture. Priorities mentioned included the following:

- strengthening human capacity;
- developing policies and legislation on biodiversity, including national biodiversity strategy and action plans;
- enhancing and promoting local traditional knowledge and practices that contribute to the sustainable management of the environment and natural resources;
- improving data collection and statistics;
- increasing awareness among stakeholders;
- promoting revenue-generating activities from local natural resources;
- conducting impact assessments of ecosystem services;
- harmonizing different sectors with respect to the sustainable use of biodiversity for food and agriculture; and
- making the necessary funds available for agrobiodiversity-related activities.

## 2.2 CONSERVATION

The region has a long tradition of applying biodiversity-friendly farming practices. In Yemen, the World Bank is tapping into the knowledge and expertise of local farmers on the conservation and utilization of biodiversity important to agriculture (particularly local landraces and their wild relatives) and associated local traditional knowledge to create coping strategies for adaptation to climate change.

### 2.2.1 *In situ* conservation

The examples provided by countries that reported on *in situ* conservation measures did not always directly relate to associated biodiversity or wild food species. Most countries reported having

natural reserves (e.g. marine and forest reserves) and/or botanic gardens. The objectives of the reported conservation initiatives varied. In Oman, for example, conservation efforts in natural reserves target the maintenance of ecosystems. In Jordan the focus is on the conservation of biodiversity, including as a source of genes, and on utilization, awareness raising and research. In Lebanon, the focus is on raising awareness and fostering ecotourism.

In the United Arab Emirates many pilot projects on the sustainable use and conservation of wildlife populations and other components of biodiversity are being implemented. The country report notes that the number of natural reserves increased from 22 in 2013 to 43 in 2017 and the number of reserves recorded as being of international importance within the framework of the Ramsar Convention increased from five in 2013 to seven in 2017.[23]

The Sudan referred, *inter alia*, to the conservation of date-palm genetic resources by generations of local farmers, on-farm conservation of plant genetic resources in home gardens and the *ex situ* conservation of a limited number of indigenous and exotic plants in the country's National Botanical Garden.

Oman mentioned that various fruit-tree species (e.g. date palm, banana, mango, guava and citrus), as well as pasture and medicinal plant species, are being conserved in field genebanks. Jordan reported that its conservation programmes include restrictions on the hunting of game species such as ostriches, goitered gazelles (*Gazella subgutturosa*) and Persian onagers (*Equus hemionus onager*). It also mentioned that its National Center for Agricultural Research and Extension monitors the oriental hornet (*Vespa orientalis*) and the dwarf honey bee (*Apis florea*) with the objective of protecting local honey bees.

Iraq mentioned that a gazelle-breeding project is being undertaken under the umbrella of its Ministry of Agriculture. It also referred to the implementation of fishing moratoria in certain lakes.

### 2.2.2 *Ex situ* conservation

Most of the reporting countries mentioned having established *ex situ* conservation facilities for agricultural research and breeding purposes, particularly for crops and their wild relatives. A few countries described *ex situ* conservation activities that specifically target components of associated biodiversity and/or wild food species. Jordan, for example, reported conserving native bee species *ex situ*, including the honey bee subspecies *Apis mellifera syriaca*,[24] to protect them from going extinct and ensure the sustainability of beekeeping activities for poverty alleviation and food security. Jordan also mentioned conserving 265 wild medicinal plant species *ex situ*. Lebanon reported that the National Seed Bank of the Lebanese Agricultural Research Institute contains seed collections of wild edible, medicinal and aromatic plant species, as well as wild forage and wild fruit tree species, endemic species and landraces and crop wild relatives. In the Sudan, *ex situ* conservation activities are essentially undertaken in genebanks and protected areas. The country referred to the Forestry National Corporation and the Agricultural Plant Genetic Resources and Research Center, which are responsible for the conservation of 7 000 forest specimens and more than 11 000 accessions of more than 60 crops,[25] respectively. Iraq mentioned that some of the country's plant genetic resources had been sent to the International Center for Agricultural Research in the Dry Areas for long-term conservation.

Regarding the *ex situ in vivo* conservation of animal species, Iraq mentioned activities targetting several local poultry and other livestock breeds. Yemen reported that sheep and goat breeds are maintained *ex situ* at its Central Highland Research Station. In the United Arab Emirates, breeding centres have been established for the conservation of some endangered species, including the Arabian tahr, the Arabian oryx and the gazelle.

[23] Figures from the country report of the United Arab Emirates have been updated here to reflect recent changes.

[24] Bees are conserved in isolated areas at the NCARE Research Station (2 000 queen cells per year).

[25] A number of these crops are included in Multilateral System of Access and Benefit Sharing established by the International Treaty on Plant Genetic Resources for Food and Agriculture.

**Table 11. Reported needs and priorities for the conservation of biodiversity for food and agriculture in the Near East and North Africa**

| Country | Needs and priorities |
|---|---|
| Iraq | - Develop management plans for protected areas<br>- Establish a national network of protected areas<br>- Formulate a national law for forest management and protection<br>- Develop legislation and practical control measures targeting invasive species<br>- Implement pollution remediation and control measures<br>- Review and update of all environmental legislation<br>- Create environmental impact assessment and strategic environmental assessment policies for biodiversity protection |
| Jordan | - Develop nationwide capacity to enhance, properly conserve and utilize biodiversity for food and agriculture<br>- Secure the financial support needed to implement strategies for conserving genetic resources *in situ* and *ex situ* |
| Lebanon | - Promote appropriate awareness through participatory approaches involving local communities and various stakeholders<br>- Promote development projects on sustainable use, traditional knowledge and best practices<br>- Enhance socio-economic programmes through the promotion of agro-ecotourism and product value chains<br>- Document success stories and lessons learned |
| Oman | - Undertake collection missions that cover the whole spectrum of plant genetic resources, including major crops, minor crops, underutilized species, forages, wild plants for food and agriculture and crop wild relatives<br>- Build the capacity of national scientists in the conservation and utilization of biodiversity |
| Sudan | - Conduct adequate research and surveys on plant biodiversity and its conservation, and support institutions involved in this work<br>- Develop clear national policies for the conservation of local plant genetic resources<br>- Establish *in situ* conservation activities in most plant biodiversity sectors<br>- Create a national legislative and institutional framework for agrobiodiversity<br>- Harmonize work on the sustainable use of biodiversity for food and agriculture across sectors<br>- Enact national legislation on the conservation and sustainable use of biodiversity, taking into consideration matters related to access and benefit-sharing and to the protection of local communities', farmers' and pastoralists' rights to biological resources and their indigenous knowledge, practices and technologies |
| United Arab Emirates | - Develop and implement programmes to improve the conservation status of 70 percent of the species most threatened with extinction<br>- Conserve and protect important genetic resources<br>- Establish protected areas covering 12 percent of terrestrial areas and inland water areas and 14 percent of coastal and marine areas |
| Yemen | - Conduct surveys and inventories on biodiversity components<br>- Initiate research on rare and endangered species and their habitats<br>- Undertake research on critical habitats, including methods to restore and maintain the ecological functioning of biodiversity components<br>- Initiate research to quantify and forecast the response of genotypes, species, habitats, ecosystems and landscapes under anticipated climatic changes<br>- Develop adaptation and conservation policies<br>- Provide funds and infrastructure for research institutions to develop research programmes in target areas<br>- Conduct forest, rangeland, soil and desertification surveys<br>- Support traditional and environmentally sound land-use practices<br>- Review and adjust relevant policies<br>- Set up suitable information systems for data and information collection, dissemination and monitoring |

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

### 2.2.3 Needs and priorities

The following list summarizes needs and priorities in terms of the conservation of biodiversity for food and agriculture, including associated biodiversity and wild foods.

- Establish national networks of protected areas.
- Develop management plans for protected areas.
- Formulate national laws for forest management and protection.

- Develop legislation and practical control measures for the management of invasive species.
- Implement pollution remediation and control measures.
- Review and update all environmental legislation.
- Create environmental impact assessment and strategic environmental assessment policies that contribute to the protection of biodiversity.
- Organize collection missions that cover the whole spectrum of plant genetic resources, including major crops, minor crops, underutilized species, forages, wild food plants and crop wild relatives.
- Promote cross-sectoral harmonization of efforts to strengthen the sustainable use of biodiversity for food and agriculture.
- Build capacity and provide financial support for the conservation and use of biodiversity for food and agriculture.

Table 11 provides a country by country overview of reported needs and priorities in terms of the conservation of biodiversity for food and agriculture, including associated biodiversity and wild foods.

## 2.3 ACCESS AND EXCHANGE

Table 12 presents an overview of the main measures in place in the region to regulate access to biodiversity for food and agriculture and ensure the fair and equitable sharing of benefits arising from its utilization.

Most of the reporting countries highlighted the need to strengthen national frameworks for access and benefit-sharing and conservation and sustainable use of biodiversity for food and agriculture with appropriate policies, legislation, institutional measures and action plans. Institutional capacity building was mentioned as one of the main priorities.

**Table 12. Reported measures regulating access and benefit-sharing for biodiversity for food and agriculture in the Near East and North Africa[1]**

| Description of measure | Components of biodiversity for food and agriculture | Countries |
|---|---|---|
| *The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS) to the Convention on Biological Diversity (Nagoya Protocol)*<br><br>The Nagoya Protocol, which entered into force on 12 October 2014, provides a legal framework for the effective implementation of the fair and equitable sharing of benefits arising out of the utilization of genetic resources | Genetic resources that are covered by the Convention on Biological Diversity and related traditional knowledge | Contracting parties<br><br>Egypt, Jordan, Lebanon, Mauritania, Qatar, Sudan, Syrian Arab Republic, United Arab Emirates<br><br>Only signatories<br><br>Algeria, ,Morocco, Tunisia, Yemen<br><br>Egypt: A series of laws and decrees have been issued to comply with international commitments in relation to the conservation and use of, and access to, different components of biodiversity for food and agriculture. For example, Law 53/1966 prohibits the hunting of birds and of other wild animals that are considered to be beneficial and in need of protection.<br><br>Lebanon: National laws to comply with the Nagoya Protocol and the International Treaty on Plant Genetic Resources for Food and Agriculture are being drafted. The draft national law on Access to Lebanese Genetic and Biological Resources and Sharing of Benefits Arising from their Utilization is expected to be endorsed by the country's parliament in the near future.<br><br>Jordan: The country report notes the need to modify national legislation to comply with international agreements, conventions and protocols related to the protection of genetic resources for food and agriculture and the sharing of benefits arising from their use. Access and benefit-sharing of genetic resources are subject to signed agreements.<br><br>Oman: A series of laws and decrees have been issued to comply with international commitments in relation to the conservation and use of, and access to, different components of biodiversity for food and agriculture. For example, Royal Decree No. 48/2006 deals with issues related to seed production and distribution. |

**Table 12** *Cont'd*

| Description of measure | Components of biodiversity for food and agriculture | Countries |
|---|---|---|
| | | Sudan: National legislation dealing with conservation and sustainable use of plant genetic resources, access to these resources, the sharing of benefits arising from their use, and the management of information related to them has been drafted. |
| *International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRA)*<br>Contracting Parties to the ITPGRFA make plant genetic resources for food and agriculture available within the framework of the ITPGRFA's Multilateral System.[2]<br>Parties wishing to provide and receive material under the Multilateral System use the Standard Material Transfer Agreement.[3] | Plant genetic resources for food and agriculture | Contracting parties<br>Algeria, Egypt, Iran (Islamic Republic of), Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syrian Arab Republic, Tunisia, United Arab Emirates, Yemen |
| | Genetic resources and traditional knowledge belonging to indigenous peoples and local communities | Jordan: Some work on traditional knowledge documentation has been carried out by the National Center for Agricultural Research and Extension and Royal Society for the Conservation of Nature through the Global Environment Facility project Conservation of Medicinal Herbal Plants of Jordan.<br><br>Yemen: The country has issued several decrees and laws addressing the preservation of biodiversity for food and agriculture and its associated local knowledge. This has contributed to raising awareness of the importance of traditional knowledge among local communities and of the need to document this knowledge. It has also resulted in the establishment of several projects addressing this field. |

[1] Measures facilitating access to components of biodiversity for food and agriculture usually vary according to the intended use of the resource (e.g. any use, research and development, commercial use). Examples of possible measures consist of the need to obtain prior informed consent, sharing benefits based on mutually agreed terms and having special considerations in place for access to resources held by indigenous peoples and local communities.
[2] The Multilateral System of the ITPGRFA has put 64 crops (listed in Annex 1 to the ITPGRFA) into an easily accessible global pool of genetic resources that is freely available to potential users in the ITPGRFA's ratifying nations for research, breeding and training for food and agriculture. Those who access genetic materials through the Multilateral System agree to share any benefits from their use through the four benefit-sharing mechanisms established by the ITPGRFA.
[3] The Standard Material Transfer Agreement is a private contract with standard terms and conditions that ensures that the relevant provisions of the ITPGRFA are followed by individual providers and recipients of plant genetic material.
*Source*: Websites of the CBD and ITPGRFA, and country reports prepared for *The State of the World's Biodiversity for Food and Agriculture* (FAO, 2019a).

# 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.

### 3.1.1 Policies and programmes

The countries of the Near East and North Africa are actively involved in several international conventions and treaties that potentially contribute to improving the conservation and sustainable use of biodiversity for food and agriculture at the national level. The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) has, for example, created opportunities for its contracting parties to make significant progress in sustainable crop production, provided that relevant national legislation and policies are aligned with those of the ITPGRFA (Mozafari Hashjin, 2011).

Oman reported that regional cooperation in coral-reef management has significantly improved since a regional conference on coral bleaching was held in Riyadh in 2000, followed by a workshop on Kish Island (2003) and a meeting in Tehran (2004).

Reporting countries referred to several national policies and programmes that support the conservation and sustainable use of biodiversity for food and agriculture. However, most of these instruments focus on broader issues and do not explicitly address or mention biodiversity for food and agriculture, associated biodiversity or wild foods.

Various examples were given of national policies and strategies that were originally developed for specific sectors,[26] but turned out to be beneficial to other areas of biodiversity for food and agriculture, including the delivery of ecosystem services.

A few countries referred to relevant environmental laws, projects and programmes. Egypt, for example, mentioned that its National Gene Bank runs a conservation programme for micro-organisms of relevance to agriculture. Programmes such as these positively contribute to the maintenance of ecosystem services and to the conservation of associated biodiversity, even if this is not their primary objective.

Iraq, Jordan, Oman and Sudan mentioned having policies in place that support the application of ecosystem, landscape and/or seascape approaches. Jordan specifically referred to the adoption and implementation of the integrated ecosystem approach for protected forest areas, while the Sudan reported on the application of the Code of Conduct for Responsible Fisheries. As an example of institutional support for the implementation of ecosystem approaches, the Sudan referred to its decision, taken in 2009, to abandon commercial fishing of sea cucumbers to avoid their depletion. The United Arab Emirates mentioned that its National Biodiversity Strategy refers to the need to develop and apply a seascape approach. Lebanon reported that biodiversity for food and agriculture has so far rarely been addressed in an ecosystem-approach context.

Several countries mentioned the need to strengthen their seed-sector policies, particularly in the field of farmers' rights. A few countries reported on initiatives taken to protect and preserve seeds of important crop species. Under the Millennium Seed Bank initiative, for example, 1 380 seed collections are stored under long-term conditions at the National Seed Bank of the Lebanon Agricultural Research Institute, with duplications held at the Millennium Seed Bank of the Royal Botanic Gardens, Kew (United Kingdom). These collections include seeds from wild, edible, medicinal and aromatic plant species, as well as wild forage and fruit-tree species, endemic species and landraces, and crop wild relatives.

[26] For example, the United Arab Emirate's fisheries decrees, Iraq's law on the protection of rangelands (Law No. 106) and Qatar's hunting and fishing regulation (Law 4 – 2002).

Some examples of regional policies and programmes that embed the conservation and sustainable use of biodiversity for food and agriculture were also provided. However, most of these policies and programmes are reported to be difficult to implement due to, *inter alia*, a lack of financial and political support, and contradictory national legislation.

Table 13 lists a few examples of policies and programmes embedding the conservation and/or use of biodiversity for food and agriculture, as provided by countries.

**Table 13. Reported examples of policies and programmes promoting the sustainable use and conservation of biodiversity for food and agriculture in the Near East and North Africa**

| Domain | Policy/programme | Description | Country |
|---|---|---|---|
| **Coordinated use and conservation of plant, animal, forest and aquatic genetic resources** | Establishment of a national gene bank | In 2003, the National Gene Bank of Egypt was established by Ministerial Decree for the conservation and maintenance of plant, animal and micro-organism genetic resources in the agricultural sector. | Egypt |
| | Rangelands Rationalization, Conservation and Fodder Resources Development Act | This law, effective as of February 2015, addresses the utilization and protection of grazing resources through local administration. | Sudan |
| | Millennium Seed Bank Project | 1 380 seed accessions (including wild, edible, medicinal and aromatic plant species, as well as of wild forage and wild fruit-tree species, endemic species and landraces, and crop wild relatives) are stored under long-term conditions at the National Seed Bank of the Lebanon Agricultural Research Institute, with duplications held at the Millennium Seed Bank of the Royal Botanic Gardens, Kew (United Kingdom). | Lebanon |
| | Forestry Law (2009) | In 2005, the Ministry of Agriculture stopped renting out forest land to local contractors for tree removal. It developed the Forest Law, which entered into force in 2009. | Iraq |
| **Food security and nutrition** | Establishment of the National Gene Bank | One of the genebank's main objectives is to achieve food security by maintaining biodiversity and providing the agricultural system with outstanding genetic resources that tolerate various biotic and abiotic environmental stresses. | Egypt |
| | Ministry of Agriculture and Fisheries and the Sultan Qaboos University's collecting mission for indigenous legumes germplasm | From 2008 to 2010, germplasm of indigenous legumes was collected to protect these species from extinction in the face of emerging biotic (diseases and insect pests) and abiotic (temperature, salinity and drought) stresses and to ensure the country's food security. | Oman |
| **Sustainable use and conservation of associated biodiversity** | Ministerial Decree 500 of the year 2014 | Ministerial Decree 500 of the year 2014 regulates shark fishing and trade. | United Arab Emirates |
| | Ministerial Decree 501 of the year 2015 | Ministerial Decree 501 of the year 2015 imposes a seasonal ban on the fishing and trade of safi and sheri during the spawning season. | |
| | Ministerial Decree 174 of the year 2016 | Ministerial Decree 174 of the year 2016 imposes a seasonal ban on the fishing and trade of *alibdh* fish during the spawning season in the Emirate of Abu Dhabi. | |
| **Maintenance of ecosystem services** | Updated National Biodiversity Strategy and Action Plan (2015–2020) | The plan addresses the maintenance of ecosystem services and explicitly refers to the importance of biodiversity for food and agriculture, including associated biodiversity and/or wild foods, in this context. | Saudi Arabia |
| | Coral-reef farming | The Marine Environmental Research department of the Ministry of Climate Change and Environment has cultivated corals for restoration purposes. | Sudan |
| **Improving resilience and sustainability of production systems** | Sustainable aquaculture | There is a plan formulated by national authorities for the overall sustainable development of aquaculture and marine fisheries and the aquatic environment. | Oman |
| | Enhancing Resilience of Local Communities in the Butana Area of Gedarif State | The main goal of the project is to enhance the resilience of local communities in the Butana area to current and future rainfall variability through rangeland rehabilitation and the widespread introduction of water-harvesting and storage techniques. | Jordan |

**Table 13** *Cont'd*

| Domain | Policy/programme | Description | Country |
|---|---|---|---|
| **The application of an ecosystem/ landscape/seascape approach** | Ecosystem approach for protected forest areas | Conservation of accessions of forest tree species seeds and reforestation, and establishment of about 35 rangeland reserves in different ecosystems. | Jordan |
| | Commercial fishing for sea cucumber | In 2009, change from a traditional resource-management approach towards an ecosystem approach. | Sudan |
| | Second National Biodiversity Strategy and Action Plan (NBSAP2) | The NBSAP2 aims to mainstream biodiversity into decision-making processes across all sectors by promoting an ecosystem approach. With regard to the connectivity and resilience of protected areas, the framework prioritizes the development of an integrated approach to infrastructure and the creation of green corridors. | Yemen |

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

**Box 5. Contributions of stakeholder groups to the management of biodiversity for food and agriculture: examples from Iraq, Jordan and Lebanon**

The non-governmental organization (NGO) Nature Iraq successfully surveyed the north of the country to find and conserve the indigenous wild goat (*Capra aegagrus*). The organization is also effectively raising public awareness on the importance of conserving biological diversity. Small-scale livestock keepers also play an important role in the maintenance of indigenous livestock breeds and the traditional knowledge associated with them.

In Jordan, the Beekeepers' Union, in collaboration with the National Center for Agricultural Research and Extension, the Royal Botanic Garden and Honey Bee Online Studies,[1] succeeded in setting up an educational programme to teach school and university students about the value of honey bees as bio-indicators, ecosystem service providers and a source of healthy products.

In Lebanon, several NGOs are actively working to conserve and maintain the country's natural and cultural heritage, as well as its nature reserves. Among other activities, these organizations document and publish data on traditional knowledge concerning wild food species and promote the use of wild and healthy foods.

*Source*: Adapted from the country reports of Iraq, Jordan and Lebanon.

[1] See http://www.hobos.de/en/

### 3.1.2 Interministerial cooperation and collaboration mechanisms

Overall, countries reported that interministerial cooperation and related collaboration mechanisms in the area of conservation and sustainable use of biodiversity for food and agriculture need to be strengthened. This is considered a priority by Jordan, Oman and the Sudan.

In Iraq, the Ministry of Health coordinates a multiministerial committee for biosafety in the context of the Cartagena Protocol.

Lebanon mentioned that its Ministries of Agriculture and Environment jointly established and jointly manage nature reserves and protected areas (covering a total area of 3 500 ha) for the conservation of, *inter alia*, forest tree species and soil and water biodiversity.

The United Arab Emirates' National Biodiversity Strategies and Action Plan was prepared by the Ministry of Climate Change and Environment in collaboration with representatives of various other ministries. One of the Plan's objectives is to strengthen synergies between the different actors involved in the implementation of environmental conventions.

The Sudan created the Higher Council for Environment and Natural Resources to coordinate the biodiversity for food and agriculture-related activities undertaken by the Range and Pasture

**Table 14. Reported needs and priorities related to policies and programmes for the conservation and sustainable use of biodiversity for food and agriculture in the Near East and North Africa**

| Country | Needs and priorities |
|---|---|
| Iraq | - Review and update environmental legislation<br>- Enhance and promote local and traditional knowledge and practices<br>- Promote income-generating activities based on the sustainable use of natural resources |
| Lebanon | - Develop a national strategy for the conservation and management of biodiversity for food and agriculture |
| Oman | - Collaborate with the private sector to develop a national project and plan of action for breeding and seed production<br>- Monitor the implementation of laws and regulations related to the conservation and use of biodiversity and assess their impact on the conservation and use of biodiversity for food and agriculture |
| Sudan | - Develop and implement explicit national policies and legislation for the management of invasive alien species<br>- Strengthen legal frameworks to prevent indiscriminate cross-breeding of livestock breeds<br>- Develop a strategy and action plan for fisheries development and integrated coastal management |
| United Arab Emirates | - Ensure adoption of the National Biodiversity Strategy and Action Plan (NBSAP) by the federal government to guarantee its implementation<br>- Allocate financial, human and technical resources for the implementation of the NBSAP at federal and local levels<br>- Integrate the value of biodiversity in planning and decision-making processes<br>- Increase the number of governmental and non-governmental institutions that monitor and implement policies and programmes promoting sustainable food production<br>- Take into account traditional practices and knowledge, as well as innovations, in the development of local and national policies and legislation related to conservation and sustainable use of biodiversity for food and agriculture |
| Yemen | - Formulate specific policies, strategies and action plans<br>- Mobilize resources and adequate funds for implementation<br>- Build institutional capacity in the fields of monitoring, evaluation and human resources development<br>- Set up operational information management systems<br>- Invest in research and technology development |

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

Administration of the Ministry of Agriculture and Forests, the Horticultural Sector Administration of the Ministry of Agriculture, and the Agricultural Plant Genetic Resources Conservation and Research Centre of the Agricultural Research Corporation. However, the council is not fully operational due to infrastructural and financial constraints.

### 3.1.3 Needs and priorities

Overall, the region's countries are in need of: (i) more explicit policy, legal and strategic frameworks; (ii) skilled human resources; and (iii) financial resources to support the development and implementation of programmes for the conservation and sustainable use of biodiversity for food and agriculture (Table 14). More specifically, countries referred to the need to strengthen national stakeholder networks, improve coordination between relevant institutions and actors and promote traditional knowledge.

## 3.2 CAPACITY AND RESEARCH NEEDS

All reporting countries stressed the importance of national capacity building for the conservation, management and sustainable use of associated biodiversity. Some countries provided examples of capacity-building programmes related to biodiversity for food and agriculture, but very few of these specifically addressed associated biodiversity. Moreover, most of these programmes were reported to be facing financial, human-resource and infrastructural constraints.

All of the reporting countries referred to the need to raise public awareness about biodiversity for food and agriculture-related issues and environmental conservation. The Sudan mentioned the need to raise awareness about the value of micro-organism diversity and ecosystems and to strengthen capacity in relevant institutions. Iraq reported that there is a shortage of appropriate facilities and trained personnel for long-term plant seed and livestock germplasm conservation.

**Table 15. Reported training and education needs related to the conservation and sustainable use of biodiversity for food and agriculture in the Near East and North Africa**

| Training and education needs | Countries reporting |
|---|---|
| Better public awareness raising measures | Egypt, Iraq, Jordan, Lebanon, Oman, Sudan, United Arab Emirates, Yemen |
| Extension programmes that improve the capacities of local stakeholders | Jordan, Lebanon, Oman, Sudan, Yemen |
| More effective knowledge and technology transfer | Iraq, Sudan, Yemen |
| Better training on characterization and conservation of biodiversity for food and agriculture | Iraq, Jordan, Lebanon, Oman, Yemen |
| Better training on genetic-improvement techniques | Lebanon, Oman, Yemen |
| Inclusion of issues related to the conservation and sustainable use of biodiversity for food and agriculture in academic curricula and institutional agendas | Jordan, Lebanon, Sudan, Yemen |

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

Jordan mentioned that while the country's National Center for Agricultural Research and Extension has competent and well-trained extension personnel, there is a lack of well-developed extension programmes addressing biodiversity conservation and the utilization of genetic resources for food and agriculture.

Table 15 summarizes the main training and education needs reported by countries in the region related to the conservation and sustainable use of biodiversity for food and agriculture.

All of the reporting countries in the region acknowledged the need to improve national research programmes and facilities for the conservation and sustainable use of associated biodiversity, wild foods and ecosystem services. More specifically, several countries expressed the need to: (i) improve the identification, monitoring and characterization of genetic resources; (ii) strengthen existing research programmes and where necessary develop new ones; (iii) improve institutional support; and (iv) strengthen cooperation between decision-makers and the scientific research community, as well as among research institutions. Constraints to addressing these needs include shortages of financial, human and material resources.

The Sudan explicitly mentioned the need to transfer new technologies to producers and to involve them in multidisciplinary research activities. Iraq mentioned a need to strengthen whole genome sequencing and phylogenetic studies. Jordan highlighted the need to (i) strengthen cooperation between decision-makers, researchers and institutions responsible for environmental monitoring and (ii) monitor and address the impacts of climate change on biodiversity as part of the country's protected areas planning

# IV. Regional and international cooperation

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

Countries in the region described several regional and global initiatives that embed the conservation and sustainable use of biodiversity for food and agriculture. These initiatives are compiled in Table 16.

**Table 16. Reported regional and international initiatives addressing the conservation and/or use of biodiversity for food and agriculture in the Near East and North Africa**

| Policy or programme | Description | Countries reporting |
|---|---|---|
| *Sectoral genetic resources for food and agriculture* | | |
| **Global Plans of Action for Genetic Resources for Food and Agriculture** | The Global Plan of Action for Animal Genetic Resources (GPA for AnGR) provides a framework that supports and increases the effectiveness of national, regional and global efforts to sustainably use, develop and conserve animal genetic resources, to facilitate the mobilization of resources, including adequate financial resources, and to promote a pragmatic, systematic and efficient approach that harmoniously addresses the development of institutions, human resources and cooperative frameworks in animal genetic resources management.<br><br>To facilitate the implementation of the GPA for AnGR, a regional project was established to strengthen the capacity of countries and regional economic communities in Africa to sustainably use and conserve animal genetic resources through the institutionalization of national and regional policies, legislation and technical instruments. | Sudan |
| | The Second Global Plan of Action for Plant Genetic Resources for Food and Agriculture (Second GPA for PGRFA) is a strategic framework for the conservation and sustainable use of plant genetic diversity. It was adopted by the FAO Council in November 2011 and reaffirms the commitment of governments to the promotion of plant genetic resources as an essential component of food security through sustainable agriculture in the face of climate change. | Jordan, Lebanon, Yemen |
| **Plant Genetic Resources Network within the framework of the Arab Organization for Agricultural Development** | This regional initiative was established at the end of 2015 to facilitate the storage and exchange of plant genetic resources data among Arab countries. Iraq's Seed Testing and Certification Directorate has begun to enter the country's seed data collection into this regional database. | Iraq |
| *Conventions and agreements* | | |
| **Convention on the Conservation of Wildlife and their Natural Habitats in the Countries of the Gulf Cooperation Council** | This convention, which entered into force in 2003, is the first legal instrument binding the six member States of the Gulf Cooperation Council to coordinate their activities on the conservation of wildlife and natural habitats. | United Arab Emirates |
| **Kuwait Regional Convention for Cooperation in the Protection of the Marine Environment from Pollution** | Adopted in 1978, the Kuwait Regional Convention is an umbrella agreement for the protection of the marine environment in the region shared by Bahrain, Iran (Islamic Republic of), Iraq, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates. It aims to identify and keep the sources of pollution in the area under control and to deal with environmental management issues (e.g. environmental impact assessments). | United Arab Emirates |
| **Convention on International Trade in Endangered Species of Wild Fauna and Flora** | This intergovernmental agreement was adopted in 1974 to ensure that international trade in specimens of wild animals and plants does not threaten their survival. | United Arab Emirates |
| **"Rio Conventions"** | United Nations Framework Convention on Climatic Change (UNFCCC) entered into force on 21 March 1994. Its ultimate objective is to stabilize greenhouse-gas concentrations at a level that would prevent dangerous anthropogenic (human-induced) interference with the climate system. It states that "such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner." | Jordan, United Arab Emirates, Yemen |

**Table 16** *Cont'd*

| Policy or programme | Description | Countries reporting |
|---|---|---|
| | United Nations Convention to Combat Desertification (UNCCD) established in 1994, is the sole legally binding international agreement linking environment and development to sustainable land management. The Convention specifically addresses the arid, semi-arid and dry subhumid areas, known as the drylands, where some of the most vulnerable ecosystems and peoples can be found.<br>The Convention on Biological Diversity (CBD) entered into force in 1993. The Convention's three main objectives are:<br>- the conservation of biological diversity;<br>- the sustainable use of the components of biological diversity; and<br>- the fair and equitable sharing of the benefits arising out of the utilization of genetic resources | |
| **Convention on Wetlands of International Importance (Ramsar Convention)** | The Ramsar Convention, which came into force in 1975, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. | Lebanon, United Arab Emirates, Yemen |
| **Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia** | Adopted in 2007, this intergovernmental agreement aims to protect, conserve, replenish and recover sea turtles and their habitats in the Indian Ocean and Southeast Asian region, working in partnership with other relevant actors and organizations. | United Arab Emirates |
| **Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia (Raptors MoU)** | Adopted in 2008, the Raptors MoU is an international, legally non-binding agreement addressing the protection of migratory birds of prey. | United Arab Emirates |
| **Memorandum of Understanding on the Conservation of Migratory Sharks** | This international instrument for the conservation of migratory species of sharks was founded in 2014 under the auspices of the Convention on the Conservation of Migratory Species of Wild Animals (also known as the Bonn Convention). | United Arab Emirates |
| *Projects, initiatives and networks* | | |
| **Eastern Nile Watershed Management Project** | This regional project focuses on:<br>- community watershed management;<br>- knowledge for cooperative action; and<br>- project management. | Sudan |
| **Abu Dhabi Global Environmental Data Initiative** | At the end of 2013, the Abu Dhabi Environmental Data initiative, with support from the Abu Dhabi Environment Agency and in cooperation with UN Environment, launched an Atlas of the Arab Region featuring "before and after" images of selected sites. The atlas also shows the pace of "metamorphosis" based on the factors contributing to change, including land-use changes, urban growth, degradation of marine and coastal areas, hydrological changes and shrinking water areas and quantity, loss of habitat and the impact of climatic change. | United Arab Emirates |
| **Nile Basin Initiative (NBI)** | The NBI is a nine-nation intergovernmental organization dedicated to equitable and sustainable management and development of the shared water resources of the Nile Basin. | Sudan |
| **Indian Ocean Tuna Commission (IOTC)** | The IOTC is an intergovernmental organization responsible for the management of tuna and tuna-like species in the Indian Ocean. | Sudan |
| **Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA)** | PERSGA is an intergovernmental organization dedicated to the conservation of the coastal and marine environments in the region. The organization's initiative on coral reefs has been a significant influence on the preservation of coral communities in the Persian Gulf, the Gulf of Oman and the Arabian Sea. | Sudan, Yemen |

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

## 4.2 NEEDS AND PRIORITIES

Most of the reporting countries highlighted the need to strengthen regional cooperation and establish transboundary initiatives for the conservation and sustainable use of biodiversity for food and agriculture. Countries' priorities in this respect include network building and improving regional coordination, policy development, awareness raising, capacity building and monitoring of biodiversity for food and agriculture.

Egypt specifically expressed the need to strengthen technical cooperation in taxonomy and in advanced molecular and cytogenetic techniques, as well as in the management of collections of various functional and taxonomic groups, including the collection and analysis of data. Jordan

highlighted the importance of studying and managing alien and invasive species at the regional level and also called for a regional approach to the conservation of the honey-bee subspecies *Apis mellifera syriaca*.

Finally, a few countries mentioned the importance of strengthening activities at the regional level targeting the conservation and sustainable use of neglected and underutilized crops. Even though these crop species can be very important locally and/or regionally, *inter alia* because of their nutritional qualities and their ability to grow in environments where other crops fail, research on them is still very limited compared to major food crops.

# References


**Abdelmoti, M.A.** 2012. *Report on plant protection in Sudan*. Regional Workshop on Strengthening Regional Cooperation and Knowledge Sharing in Plant Protection between the Near East Countries, 2–4 December 2012, Cairo, Egypt. (available at http://www.slideserve.com/aretha/report-on-plant-protection-in-sudan).

**Abdel-Rahman, N.A., Awad, I.I. & Babiker, E.B.** 2014. Nutritional value of some edible forest fruits. *Journal of Agri-Food and Applied Sciences*, 2(3): 72–76.

**Al-Jboory, I.J., Katbeh-Bader, A. & Al-Zaidi, S.** 2012. First observation and identification of some natural enemies collected from heavily infested tomato by *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae). *Jordan Middle-East Journal of Scientific Research*, 11(4): 435–438.

**Attiwill, P.M. & Leeper, G.W.** 1987. *Forest soils and nutrient cycles*. Melbourne, Australia, Melbourne University Press.

**Döring, T.F., Knapp, S., Kovacs, G., Murphy, K. & Wolfe, M.S.** 2011. Evolutionary plant breeding in cereals—into a new era. *Sustainability*, 3: 1944–1971.

**FAO.** 1997. *The State of the World's Plant Genetic Resources for Food and Agriculture*. Rome. (available at http://www.fao.org/3/a-w7324e.pdf)

**FAO.** 2007a. *The State of the World's Animal Genetic Resources for Food and Agriculture*. B. Rischkowsky & D. Pilling, eds. Rome. (available at http://www.fao. org/3/a-a1260e.pdf).

**FAO.** 2007b. *Adaptation to climate change in agriculture, forestry, and fisheries: perspective, framework and priorities*. Rome. (available at http://www.fao.org/nr/climpag/pub/adaptation_to_climate_change_2007.pdf).

**FAO.** 2010a. *Regional priority framework for the Near East*. Cairo. (available at http://www.fao.org/fileadmin/user_upload/rne/docs/RPF-EN.pdf).

**FAO.** 2010b. *The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture*. Rome. (available at http://www.fao.org/ docrep/013/i1500e/i1500e.pdf).

**FAO.** 2012. *Regional Initiative on Water Scarcity for the Near East and North Africa (WSI).* Cairo. (available at http://www.fao.org/fileadmin/user_upload/rne/docs/WSI-Pamphlet-en.pdf).

**FAO.** 2014a. *FAO Statistical Yearbook 2014. Near East and North Africa food and agriculture*. Cairo. (available at http://www.fao.org/docrep/019/i3591e/i3591e.pdf).

**FAO.** 2014b. *The State of the World's Forest Genetic Resources*. Rome. (available at http://www.fao. org/3/a-i3825e.pdf).

**FAO.** 2015. *The Second Report on the State of World's Animal Genetic Resources for Food and Agriculture*. B.D. Scherf & D. Pilling, eds. Rome. (available at http://www.fao.org/3/a-i4787e.pdf).

**FAO.** 2016. *Report of the Informal Regional Consultation on the State of the Near East's and North Africa's Biodiversity for Food and Agriculture*. Information Document. Sixteenth Regular Session of the Commission on Genetic Resources for Food and Agriculture, Rome, 30 January to 3 February 2017. CGRFA-16/17/Inf.11.5. Rome. (available at http://www.fao.org/3/a-mr770e.pdf).

**FAO.** 2019a. *The State of the World's Biodiversity for Food and Agriculture*. J. Bélanger & D. Pilling (eds.). FAO Commission on Genetic Resources for Food and Agriculture Assessments. Rome. 572 pp. (available at http://www.fao.org/3/CA3129EN/CA3129EN.pdf).

**FAO.** 2019b. *The State of the World's Aquatic Genetic Resources for Food and Agriculture*. FAO Commission on Genetic Resources for Food and Agriculture assessments. Rome. (available at http://www.fao.org/3/CA5256EN/CA5256EN.pdf).

**Government of Iraq.** 2015. *Iraq's National Biodiversity Strategy and Action Plan (2015–2020)*. Baghdad. (available at https://www.cbd.int/doc/world/iq/iq-nbsap-01-en.pdf).

**Government of the United Arab Emirates.** 2010. *National Strategy and Action Plan for Environmental Health. United Arab Emirates 2010*. Abu Dhabi. (available at https://sph.unc.edu/files/2013/07/report.pdf).

**Haddad, N.J., De Miranda, J. & Bataeneh, A.** 2008. The discovery of *Apis florea* in Jordan. *Journal of Apicultural Research*, 47: 172–173.

**Harir, S.** 1994. "Arab belt" versus "African Belt" ethno-political conflict in Dar Fur and the regional cultural factors. *In* S. Harir & T. Tvedt, eds. *Short-cut to decay. The case of Sudan*, pp. 10–68. Uppsala, Sweden, Nordiska Afrikainstitutet.

**Hattam, J.** 2009. *Adapting to climate change in the arid Middle East.* (available at http://www.treehugger.com/corporate-responsibility/adapting-to-climate-change-in-the-arid-middle-east.html).

**IFAD (International Fund for Agricultural Development).** 2009. *Fighting water scarcity in the Arab countries*. Rome. (available at https://www.ifad.org/documents/10180/7f193193-023f-4ede-8e33-038aa1b53aa3).

**Lattemann, S. & Höpner, T.** 2008. Environmental impact and impact assessment of seawater desalination Presented at the Conference on Desalination and the Environment. *Desalination*, 220 (1–3): 1–15.

**Loftus, R.T., Ertugul, O., Harba, A.H., El-Barody M.A., MacHugh, D.E. & Bradley, D.G.** 1999. A microsatellite survey of cattle from a centre of origin: the Near East. *Molecular Ecology*, 8: 2015–2022.

**Manousaki, E. & Kalogerakis, N.** 2009. Phytoextraction of Pb and Cd by the Mediterranean saltbush (*Atriplex halimus* L.): metal uptake in relation to salinity. *Environmental Science and Pollution Research*, 16(7): 844–854.

**Ministère de l'aménagement du territoire et de l'environnement.** 2014. *5ème Rapport National de la République Algérienne Démocratique et Populaire sur la mise en œuvre de la convention sur la diversité biologique au niveau national*. Algiers. (available at https://www.cbd.int/doc/world/dz/dz-nr-05-fr.pdf).

**Ministry of Environment.** 2010. *Iraqi Fourth National Report to the Convention on Biological Diversity*. Baghdad. (available at https://www.cbd.int/doc/world/iq/iq-nr-04-en.pdf).

**Mozafari Hashjin, J.** 2011. The Near East Regional Group. Centring the diversity for unlocking the genetic potential. In C. Frison, F. López & J.T. Esquinas-Alcázar, eds. *Plant genetic resources and food security: Stakeholder Perspectives on the International Treaty on Plant Genetic Resources for Food and Agriculture*, pp. 93–108. Abingdon, UK & New York, USA, FAO, Bioversity International and Earthscan.

**NCARE (National Center for Agricultural Research and Extension).** 2014. *Annual report.* Amman. (available at http://www.ncare.gov.jo/).

**Nadaf, S.K., Al-Farsi, S.M. & Al-Hinai, S.A.** 2004. Seed production of indigenous rangeland forage species in Oman. *Seed Info,* (27): 12–14.

**Osman-Elasha, B. & El Sanjak, A.** 2009. Global climate changes: impacts on water resources and human security in Africa. *In* M. Leroy, ed. *Environment and conflict in Africa: reflections on Darfur*. Addis Ababa, University for Peace, Africa Programme.

**Pertola, S., Kuosa, H. & Olsonen, R.** 2005. Is the invasion of *Prorocentrum minimum* (Dinophyceae) related to the nitrogen enrichment of the Baltic Sea? *Harmful Algae*, 4(3): 481–492.

**Peter, C., Buford, M., Perez, T., Dalamitra, S., Hewitt, G. & Erhart, G.** 2007. Genetic diversity and subdivision of 57 European and Middle- Eastern sheep breeds. *Animal Genetics*, 38: 37–44.

**RPA (Range and Pasture Administration).** 2009. F*eed gap report*. Khartoum.

**Shazali, S. & Ahmed. A.G.M.** 1999. *Pastoral land tenure and agricultural expansion: Sudan and the Horn of Africa*. IIED Issue Paper No. 85. London, International Institute for Environment and Development.

**Tapio, M., Ozerov, M., Tapio, I., Toro M., Marzanov, N., Cinkulov, M., Goncharenko, G., Kiselyova, T., Murawski, M. & Kantanen, J.** 2010. Microsatellite-based genetic diversity and population structure of domestic sheep in northern Eurasia. *BMC Genetics*, 11: 76.

**UNEP (United Nations Environment Programme).** 2003. Desk study on the environment in Iraq. Nairobi.

**Van Tuijl, W.** 1993. *Improving water use in agriculture: experiences in the Middle East and North Africa*. Washington, DC, IBRD.

**World Bank.** 2015. *Adaptation to climate change in the Middle East and North Africa Region*. Washington, DC. (available at http://go.worldbank.org/B0G53VPB00).

**Yousif, F. & Suliman, W.S.** 2010. Biological control of chickpea wilt caused by *Fusarium oxysporum* f.sp. *ciceris*. *University of Khartoum Journal of Agricultural Sciences*, 18(2): 237–249.

**Zeven, A.C. & Zhukovsky, P.M.** 1975. *Dictionary of cultivated plants and their centres of diversity excluding ornamentals, forest trees and lower plants*. Wageningen, Netherlands, Pudoc.

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

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

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

ISBN 978-92-5-131823-2

9 789251 318232

CA6146EN/1/10.19