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Organization of the
United Nations



FOOD POLICY MONITORING

in the Near East and North Africa region

1st Quarter 2023 | Bulletin

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Layout design by Angham Abdelmageed (FAO RNE).

ACRONYMS AND ABBREVIATIONS

ADF	Agricultural Development Fund
AFOLU	Agriculture, Forestry and Other Land Use
Agrico	Qatari Agricultural Development Company
AICS	Italian Agency for Development Cooperation
AIM4C	Agriculture Innovation Mission for Climate
C3S	Copernicus Climate Change Service
CARI	Consolidated Approach for Reporting Indicators
CHC	Climate Hazards Center (University of California, Santa Barbara)
CHIRPS	Climate Hazards Group Infrared Precipitation with Stations
COP	Conference of Parties
DAC	Development Assistance Committee (OECD)
EBRD	European Bank for Reconstruction and Development
eCDI	Enhanced Composite Drought Index
EIB	European Investment Bank
eMISK	Electronic Environmental Monitoring Information System of Kuwait
EPA	Kuwait Environmental Public Authority
ERRY III	Supporting Resilient Livelihoods, Food Security, and Climate Adaptation in Yemen
ESCWA	United Nations Economic and Social Commission for Western Asia
EU	European Union
FAOSTAT	Food and Agriculture Organization Statistics Database
FAST	Food and Agriculture for a Sustainable Transformation Initiative
FPMA	FAO Food Price Monitoring and Analysis Tool

GAPAs	Gum Arabic Producer Associations
GCC	Gulf Cooperation Council
GCF	Green Climate Fund
GEF	Global Environment Facility
GEFS	Global Ensemble Forecast System
GHG	Greenhouse Gas
GIS	Kuwaiti Geographic Information System
I-CAN	Initiative on Climate Action and Nutrition
ICARDA	International Center for Agricultural Research in Dry Areas
ICRC	International Committee of the Red Cross
IFAD	International Fund for Agricultural Development
IGC	International Grains Council
IKI	German International Climate Initiative
IMF	International Monetary Fund
INDCs	Intended Nationally Determined Contributions
IPC	Integrated Food Security Phase Classification
IPCC	Intergovernmental Panel on Climate Change
IsDB	Islamic Development Bank
IUCN	International Union for Conservation of Nature
IWMI	International Water Management Institute
KISR	Kuwait Institute for Science and Research
LULUCF	Land Use, Land-Use Change and Forestry
MAFWR	Omani Ministry of Agriculture, Fisheries and Water Resources
MENA	Middle East and North Africa
MERWAT	Libyan National Water Platform
MEWA	Saudi Ministry of Environment, Water and Agriculture

MODON	Saudi Authority for Industrial Cities and Technology Zones
MUFPP	Milan Urban Food Policy Pact
NAMAs	Nationally Appropriate Mitigation Actions
NAP	National Adaptation Plan
NENA	Near East and North Africa
NCCS	Egypt's National Climate Change Strategy 2050
NCP	Jordanian National Conveyance Project
NDC	Nationally Determined Contribution
ND-GAIN	Notre Dame Global Adaptation Initiative
NENA	Near East North Africa
NIAD	Bahrain National Initiative for Agricultural Development
NRW	Non-Revenue Water
OAIC	Algerian Interprofessional Cereals Agency
OECD	Organization for Economic Co-operation and Development
OPEC	The Organization of the Petroleum Exporting Countries
PADCRC	co's Competitive and Resilient Cereal Development Support Programme
MorocPNEEI	Morocco's National Irrigation Water Saving Programme
RCP	Representative Concentration Pathway
RDI	Responsive Drip Irrigation
REDD-plus	Reducing Emissions from Deforestation and Degradation (UNFCCC)
RICCAR	Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region
RLDP	Rural Livelihood Development Project (FAO)
RROEC	Regional Research Observatory on the Environment and Climate
SALMA	Smart Adaptation of Forest Landscapes in Mountain Areas
SCALA	Scaling up Climate Ambition on Land Use and Agriculture through Nationally Determined Contributions and National Adaptation Plans

SIDA	Swedish International Development Cooperation Agency
SMS	Short Message Service
SSP	Shared Socioeconomic Pathway
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
UNHCR	United Nations High Commissioner for Refugees
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VAT	Value Added Tax
WB	World Bank
WaPOR	FAO Water Productivity Open-Access Portal
WFP	World Food Programme
WMO	World Meteorological Organization
WRDM	Kuwaiti Water Resources Development and Management Program

SUMMARY

While global food and fertilizer prices have continued to withdraw from their March 2022 peaks, they remain high compared to their 2019–2021 levels. International grain quotations also remain well above their value in preceding years. Tight international grain markets, the ongoing war in Ukraine, uncertainties about the Black Sea Grain Initiative's renewal, and currency depreciations pose risks to global food security and nutrition, especially in net food-importing Arab countries. Food prices are expected to remain high in 2023 as a result of geopolitical tensions, high energy costs, supply shortages, and weather events.

Consequently, high food inflation persists in the NENA region.¹ Egypt and Lebanon are experiencing increases of above 30 percent in food prices. However, the inflation rate will soften from 8.8 percent in 2022, to 6.6 percent in 2023, to 4.3 percent in 2024. Currency depreciation and increasing public debt, especially in non-oil exporting countries, are adding further challenges to the region's food security situation. Import-dependent economies across the region – Egypt, Jordan, and Tunisia in particular – are struggling to stay solvent as they continue to tackle last year's commodity price shock and capital outflows.

Cereal production across the Maghreb region is under serious threat this season as extensive drought conditions negatively impact crop yields. Crops are unlikely to recover from persistent dryness in northern Iraq, northeastern and southwestern Morocco, the northeast of the Syrian Arab Republic, central-northern Tunisia, and parts of Algeria. The expected fall in production will further increase the demand for cereal imports in the Maghreb region. The Horn of Africa is facing the worst drought in over a decade, and depressed rainfall and high temperatures are forecast for the March–May season in 2023; crops in Somalia were unable to recover from the effects of drought.

In addition to drought, the Syrian Arab Republic was devastated by the 6 February earthquake, where the number of deaths reached 1 414, and 2 357 were injured; more than 100 000 households were displaced. FAO's priority in the Syrian Arab Republic is to ensure that rural communities can recover basic food production and resume their agricultural livelihoods. In this light, FAO will supply farming input, veterinary care, and unconditional cash transfers. FAO is currently assisting 17 880 rural families (107 280 people) through providing fodder to livestock keepers, fertilizers to farmers, and support for the rehabilitation of canal irrigation.

Food insecurity also remains critical in other conflict-affected countries, such as Somalia, the Sudan, and Yemen. In Mauritania, besides high food prices, flooding in 2022 and refugee populations continue to aggravate food insecurity.

Countries in the region continue to support their vulnerable communities and those most in need with social safety net measures (Bahrain). However, in some instances (Egypt), the Government was forced to increase the price of subsidized basic foodstuff (sugar, rice, oil, and

¹ This Bulletin is intended to capture the countries of the Near East and North Africa (NENA): Algeria, Bahrain, the Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Somalia, the Sudan, the Syrian Arab Republic, Tunisia, the United Arab Emirates and Yemen. The terms NENA region and Arab region are used interchangeably.

flour) for ration card holders due to increased international food prices and domestic currency depreciation.

Trade liberalizing measures included lifting export bans (Egypt: wheat) and export restrictions (Saudi Arabia: on more than 1 481 customs items), scrapping import taxes (Tunisia: milk powder and butter), introducing trade facilitation measures (Egypt: expediting the clearance of goods, lifting requirements for importers to use letters of credit, and allowing the transfer of imported goods awaiting customs clearance to reducing storage costs), and investment in logistics to ease importing and exporting (Oman). Countries have continued to diversify their agricultural trade relations to improve food security (Egypt with African countries), and open free trade agreement negotiations (United Arab Emirates with Ukraine and Uzbekistan). Increasing storage capacities of grain silos has improved food security, especially at the crossroads of global trade between Europe and Asia (Oman).

Trade restricting measures included maintaining export bans (Egypt: rice), introducing new export bans (Kuwait: eggs; Morocco: tomatoes, onions, and potatoes), and restricting imports to protect the domestic market (Jordan: olive oil). In addition, Lebanon tripled its tariffs on imports in local currency amid a worsening economic crisis one month after the country devalued its national currency by 90 percent.

Specific policies aimed to enhance agricultural tourism (Kuwait) and to support domestic production to substitute imports (Kuwait, Saudi Arabia, and United Arab Emirates). Production-increasing policies included the introduction of subsidies for seeds (Morocco). To expand domestic grain supply, some countries increased the direct government purchase of wheat from abroad (Iraq), and from domestic production (Oman), or granted exclusive rights to specific agencies to import wheat (Algeria). In addition, bilateral and multilateral donors continued to provide substantial support to enhance regional food security.

Certain measures such as the exoneration of dietary sugar from customs duties and VAT in Algeria, eased the affordability of certain basic foodstuffs. However, such steps are problematic for maintaining healthy diets as they favor the consumption of unhealthy sugar which may increase the already high rate of obesity in the Arab region. In contrast, Oman introduced a food fortification programme to improve nutrition and combat health diseases resulting from nutrient deficiency.

Section II of the Bulletin focuses on the climate change related agricultural policies and innovations introduced by Arab countries to mitigate and adapt to climate change. These policies aim to increase production in harsh climatic conditions and improve food security while transforming food systems to be resilient against shocks induced by climate change. For example, in recent years, controlled-environment agriculture has become more critical in delivering locally produced fresh, safe, healthy fruits and vegetables, especially in the Gulf region (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, Yemen). Many other measures aim to increase water efficiency in the region (Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Saudi Arabia, Tunisia, United Arab Emirates). Examples of these measures include investing in desalination plants, dams, water harvesting, and advanced smart or drop irrigation technologies. Countries have introduced policies to enhance the cultivation of drought-resistant varieties (Lebanon, Tunisia), reforest with mangroves and other native trees (Bahrain, Jordan, Saudi Arabia), restore rangelands (Sudan), setup effective early warning systems (Comoros), monitor drought (Tunisia), introduce climate-resilient practices and technologies (Djibouti), and digitalize agricultural services (Egypt, Morocco).

Section II also presents projects that FAO and other international organizations are undertaking in the region to help countries with climate change adaptation and mitigation. Some FAO programmes are focused on the whole NENA region, such as the FAO Regional Initiative on Water Scarcity.

Although NENA countries are among the most vulnerable, most water-stressed, and least climate-resilient regions, these countries are among the lowest receiving regions in the world in climate finance directed towards agriculture and land use. To increase the resilience of agrifood systems against climate change, the quantity and quality of climate finance towards adaptation and agrifood sectors in the Arab region need to be improved. Due to scarce water resources, the water and sanitation sector received the most extensive climate finance inflow in 2020 in the Arab region. On the other hand, agriculture, forestry, and fishery subsectors were the sixth most financed subsector in climate finance.

Egypt, Iraq, Jordan, Morocco, and Tunisia were the primary recipients of climate change finance flows in the region between 2015 and 2020 across all sectors. Morocco was largely the most significant recipient of climate finance directed explicitly toward agriculture and land use in 2020, followed by Palestine, Egypt, Tunisia, and Iraq, respectively.

Agriculture was a significant topic at the Sharm El-Sheikh Climate Change Conference (COP27) in November 2022 where the Egyptian Presidency dedicated one of its thematic days to climate change adaptation and agriculture. The COP27 Presidency and FAO also launched the Food and Agriculture for a Sustainable Transformation (FAST) initiative to improve the quality and quantity of climate finance for agriculture and food systems by 2030.

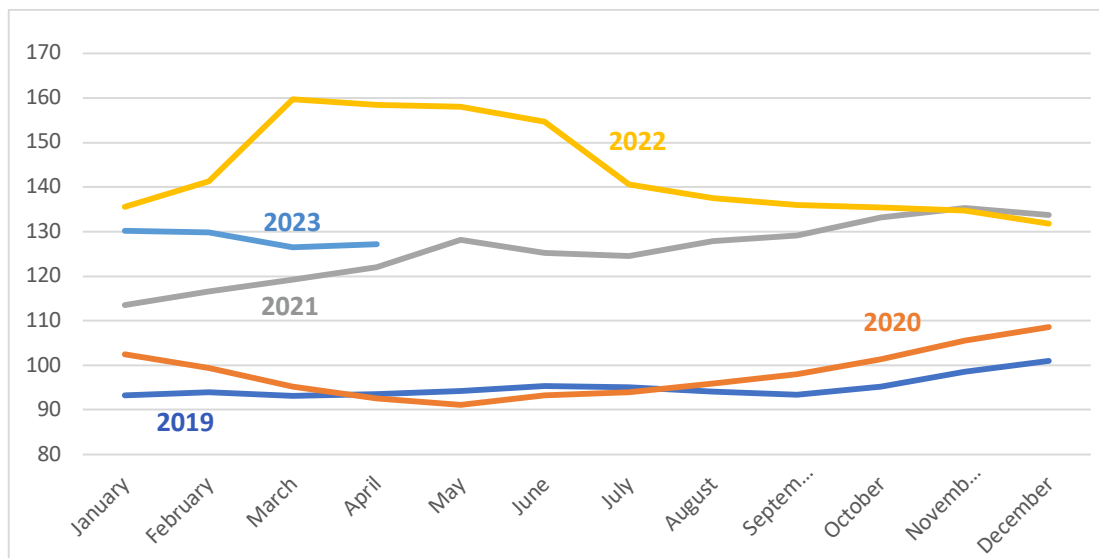


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Section I: Food markets and food security situation²

Global food markets

Figure 1. FAO Food Price Index

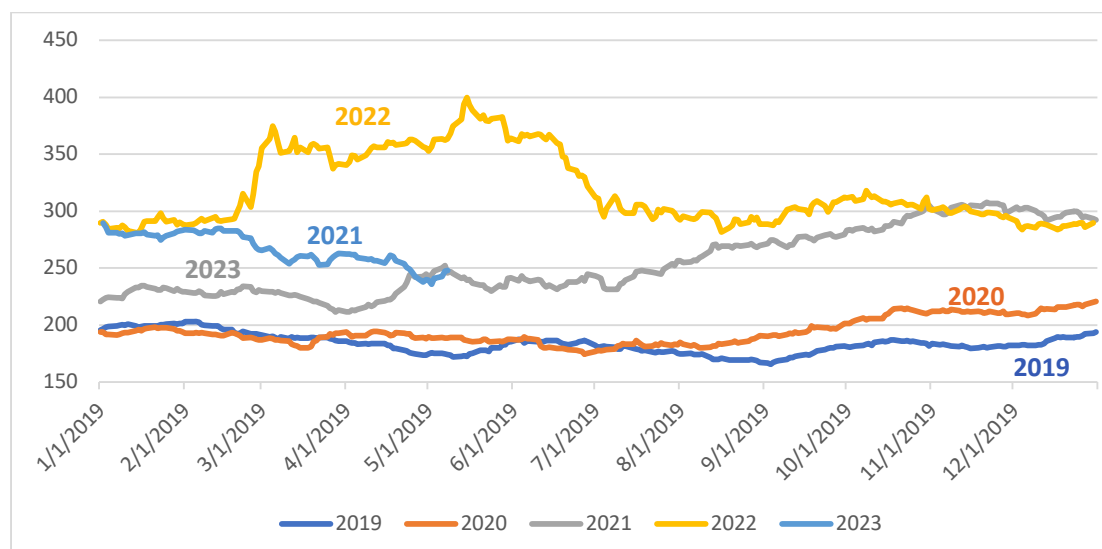


Source: FAO. 2023. FAOSTAT: World Food Situation. In: FAO. Rome. Cited February 2023. <https://www.fao.org/worldfoodsituation/foodpricesindex/en/>

² The maps presented in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of FAO concerning the legal status of any country, territory, or the delimitation of its frontiers or boundaries.

The [FAO Food Price Index](#) averaged 127.2 points in April 2023, marking a 20.4 percent decline from its peak in March 2022. However, global food prices remain high compared to the 2019–2021 Food Price Index values (Figure 1).

Figure 2. Wheat subindex of the Grains and Oilseeds Index by the International Grains Council (IGC)



Source: International Grains Council (IGC). 2023. Grains and Oilseeds Index. In: IGC. London. Cited February 2023. <https://www.igc.int/en/markets/marketinfo-goi.aspx>

The Wheat subindex of the [Grains and Oilseeds Index](#) by the International Grains Council (IGC), which tracks the price movement across seven essential commodities, was 32.4 percent lower at the end of April 2023 than a year before (Figure 2). On the other hand, wheat prices are still well above price levels of 2019–2021.

The World Bank natural gas index peaked in August 2022; however, until March 2023, it fell back to July 2021 levels (Figure A1, Annex). The **prices of fertilizers** reached a peak in April 2022 but have fallen back since then.³ In April 2023, diammonium phosphate (DAP) prices were 33.2 percent, the urea and potassium chloride prices 66.1 percent lower than a year before (Figure A2). However, the prices of all fertilizers are still **above their level in 2020**. For many producers, especially in low-income countries, high fertilizer prices render input purchases less affordable, potentially decreasing yields.

According to FAO, [global cereal supplies are forecast to tighten in 2022/23](#) (Figure A3). **Global cereal production** is anticipated to be 2 785 million tonnes in 2022, a **1.0 percent decline from the previous year**. Wheat production in 2023 is estimated at 800.4 million tonnes, which would be 3.0 percent higher than the 2022 level. Total coarse grain production is expected

³ Prices of fertilizers, particularly nitrogen fertilizers, are significantly affected by natural gas prices, as their production requires massive energy.

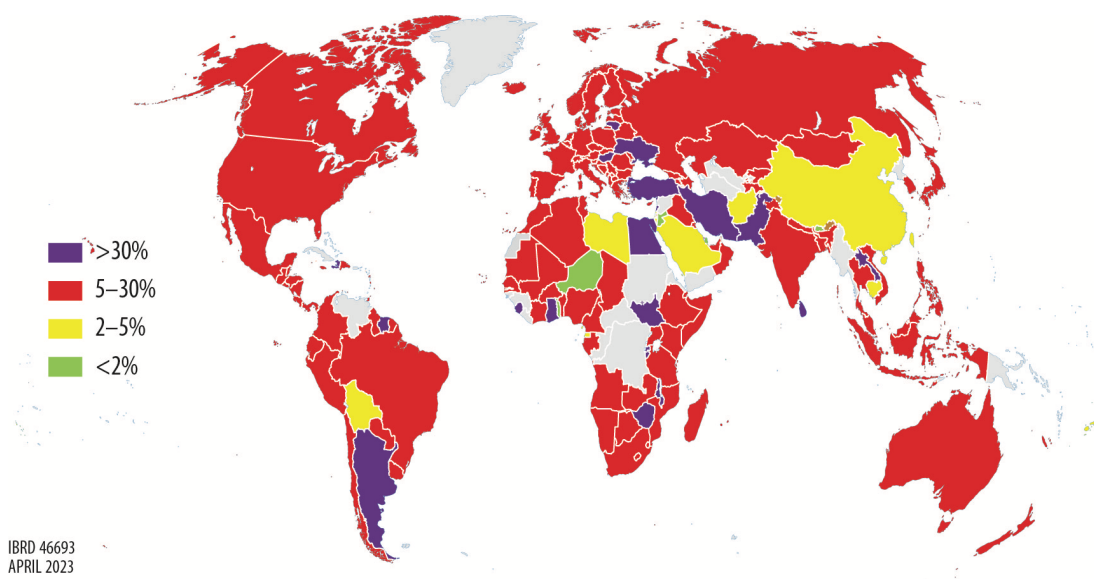
to decline 2.8 percent from the previous year. Estimated ending stocks for 2022/23 are 5.2 percent higher for wheat and 3.9 percent lower for coarse grain than last year. If China is excluded from global total wheat stocks, [projected wheat stocks for 2022/23](#) are 58 days of use, the lowest level since 2007/08 (53 days). Similarly, considering only stocks that major exporting countries hold, ending stocks for 2022/23 are estimated at 26.3 days of use, also the lowest level since 2007/08 (25.4 days).

The [Black Sea Grain Initiative](#), an UN-brokered deal in July 2022 aiming to supply markets with food and fertilizer amid global shortages and high prices, stabilized global commodity markets and brought down food costs. The agreement was extended on 18 March 2023 though a notable change to the agreement was made, shortening the period of renewal from 120 to 60 days, a change that Russia supported and Ukraine opposed. Russia warned that the deal's extension beyond 18 May would depend on removing non-food or fertilizer-related sanctions that still affect shipments, such as payment restrictions, logistics, and insurance industries. The effect of a shorter period of validity is significant in that there is often a slowdown of shipments in the leadup to the renewal date out of concern that the deal may collapse. The shorter period may also dissuade ship owners from chartering their vessels, given the insurance costs involved and the possibility of becoming stuck. [Many other bottlenecks hinder the full potential of the deal](#), including a slowdown of ship inspections.

These market trends, the ongoing war in Ukraine, uncertainties about the Black Sea Grain Initiative's renewal, and currency depreciations in developing countries pose risks to **global food security and nutrition**, especially in net food-importing Arab countries. Furthermore, tight stocks make commodity markets volatile, particularly with extreme weather events. For example, in North Africa, rainfall deficits in Algeria, Tunisia, and, albeit to a lesser degree, in Morocco are resulting in below-average wheat harvest expectations for 2023 following the already low outturns in 2022. Furthermore, relatively high fertilizer costs may affect application rates with adverse implications for yields.

Consumer prices for food and other essentials have increased sharply in most parts of the world. Food price inflation remains high in most countries (Figure 3), with Egypt and Lebanon experiencing an increase of above 30 percent in food prices. According to the IMF, [food prices are expected to remain high in 2023](#) due to the war in Ukraine, high energy costs, supply shortages, and weather events.

Figure 3. Food price inflation heat map (World Bank)



Source: World Bank. 2023. Food Security Update, 6 April 2023. <https://thedocs.worldbank.org/en/doc/40ebbf38f5a6b68bfc11e5273e1405d4-0090012022/related/Food-Security-Update-LXXXII-April-06-2023.pdf>

Note: The final boundary between the Sudan and South Sudan has not yet been determined. The final status of the Abyei area is not yet determined. The final status of Jammu and Kashmir has not yet been agreed upon by India and Pakistan.

Food price inflation persists in the Arab region

High food inflation persists in the region, albeit at a slower pace, due to increased international commodity prices and local currency depreciation; its rate is **expected to soften in 2023 and 2024**. During her speech at the Seventh Public Finance Forum in February 2023, IMF Managing Director Kristalina Georgieva affirmed that Arab countries are currently experiencing a **decline in inflation** from 8.8 percent in 2022, to 6.6 percent in 2023, and 4.3 percent in 2024. Countries of the Gulf Cooperation Council continue to contain inflation due to their increased revenues and international reserves from high oil prices. However, Georgieva said that **public debt in some states is of concern** and that governments must build resilience through fiscal policies to protect against shocks in uncertain times. **Import-dependent economies** across the region – Egypt, Jordan, and Tunisia in particular – are **struggling to stay solvent** as they continue to tackle last year's commodity price shock and capital outflows. According to the IMF, **combating inflation will remain a priority in the region in 2023**.

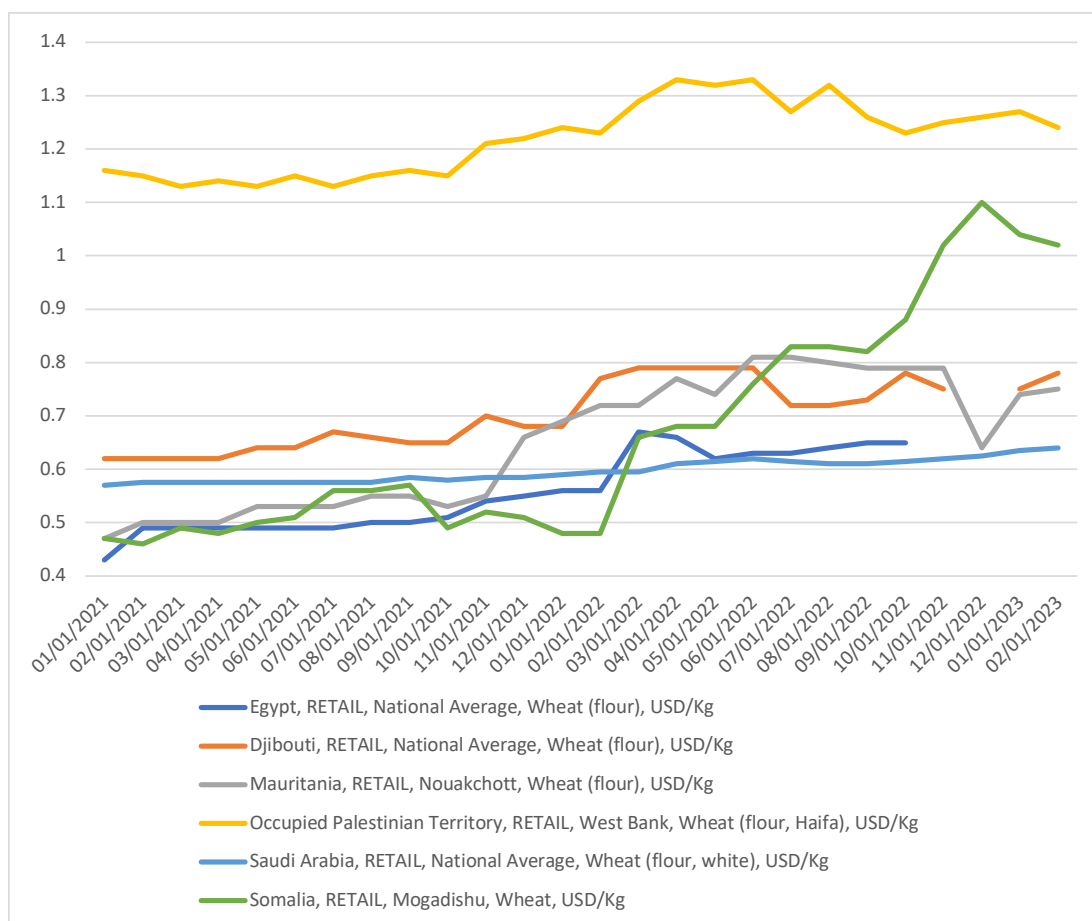
The **Egyptian pound** has lost half of its value vis-à-vis the US dollar since the beginning of the Ukraine war. **Egypt's annual inflation surged to 32.7 percent** in March 2023. Egypt's surging inflation rate follows a series of currency devaluations starting in March 2022, a prolonged shortage of foreign currency, and continuing delays in allowing imports into the country.

In neighboring **Libya**, the **national cost of the food basket in November 2022 was 18 percent higher** compared to its pre-Ukraine conflict level.

The **Lebanese pound continued its depreciation** in early 2023, having **lost some 97 percent of its value against the US dollar since 2019** by the end of January 2023. On 1 February 2023, Lebanon adopted the new official exchange rate (Sayrafa rate) of 15 000 LBP/USD, marking a 90 percent devaluation, a value still far below the parallel market rate. The Lebanese **food inflation** rate reached 171.2 percent in November 2022 and is projected to increase due to further currency depreciation. To ease food insecurity, the Lebanese Minister of Economy stated that 70 percent of food products would not be subject to higher customs duties.

In **Somalia**, due to severe dryness and four consecutive below-average harvests, **prices of maize and sorghum** in December 2022 were around the already elevated year-earlier values. Cereal production is estimated to be 40 to 60 percent below-average in the last cropping season. In the **Sudan**, **prices of coarse grains** in January 2023 remained between two and three times their already elevated year-earlier values. In some markets, prices of locally grown sorghum began to increase seasonally in January 2023 by 3 to 9 percent. In the **Syrian Arab Republic**, in December 2022, the cost of the standard reference food basket **almost doubled in 12 months**. The **Yemeni rial lost 28 percent of its value** against the US dollar in 2022, leading the cost of the minimum food basket to rise by 17 percent in 2022.

Figure 4. Wheat (flour) retail prices in selected Arab countries



Source: FAO. 2023. FPMA Tool. In: FAO. Rome. Cited February 2023. <https://fpma.fao.org/gIEWS/fpmat4/#/dashboard/tool/domestic>

Figure 4 shows some examples of wheat price developments in the region since January 2021. The graph shows an increasing trend in domestic wheat prices, especially since the beginning of 2022. In 2022, the cost of wheat flour increased by 10.3 percent in Djibouti, 7.2 percent in Mauritania, 7.6 percent in Saudi Arabia, 116.7 percent in Somalia, and 51.6 percent in the Syrian Arab Republic. Wheat flour prices increased by 16 percent in Egypt between January and October 2022. There are some countries, more the exception than the rule, where wheat prices decreased in 2022. For example, in February 2023, prices of imported wheat in the [Sudan](#) (Khartoum) were about 10 percent below their elevated year-earlier values.

[Feed prices have also increased due to high grain and soybean prices.](#) For example, the increase in corn and soybeans prices coincided with the rise in the foreign exchange rate in Egypt, causing poultry feed prices to double and, consequently, the cost of poultry production increased by more than 50 percent, placing a heavy burden on small-sized breeders. In addition, high commodity prices and the depreciation of the Egyptian pound increased the foreign currency needed for the release of corn and soybeans shipments, which were stuck for many weeks in Egyptian ports last autumn, causing feed prices to skyrocket. As a result, Egypt has begun acting to reduce the severity of these negative repercussions by seeking to provide hard currency, especially with regards to the provision of food, fuel, and raw materials for production requirements.

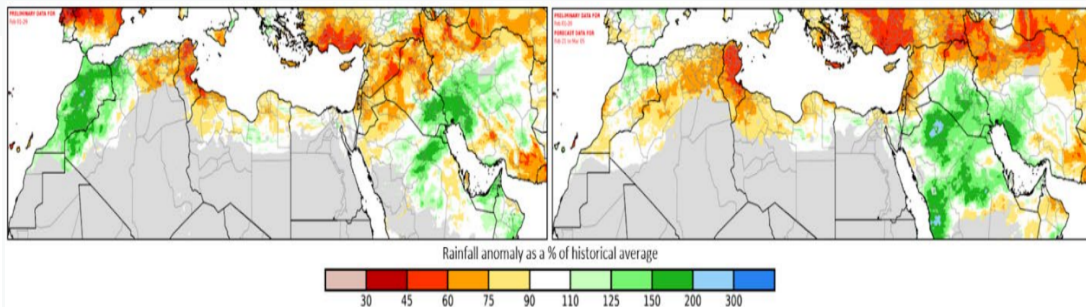
Drought threatens crop production in the Maghreb region

[Cereal production](#) across the Maghreb region of northern Africa is under serious threat this season as extensive drought conditions negatively impact crop yield potential in a band stretching from Mauritania in the west to the western reaches of Libya in the east⁴ (Figure 5). Substantial rainfall deficits (<75 percent of average) are present in many areas due to drier-than-average conditions during most of the rainfall season that were punctuated with higher rainfall events. Despite the recent improvements in Algeria, most northern areas still have below-average November to mid-February totals. In Tunisia, rainfall in late January likely provided some relief; however, season-to-date rainfall totals are still far below-average (< 60 percent). Data indicate these as being [among the driest](#) on record. Above-average rainfall in early February in the northwest of the Syrian Arab Republic punctuated otherwise below-average rainfall conditions during the past two months. The area also experienced extensive flooding after a dam collapsed due to damage caused by the devastating February 6th earthquake.

4

Weather conditions from late February to April are the most important for crop production in Northern Africa.

Figure 5. Seasonal rainfall anomaly (left, 21 January 2023–20 February 2023) and a seasonal rainfall anomaly outlook (right, 1 November 2022–5 March 2023)



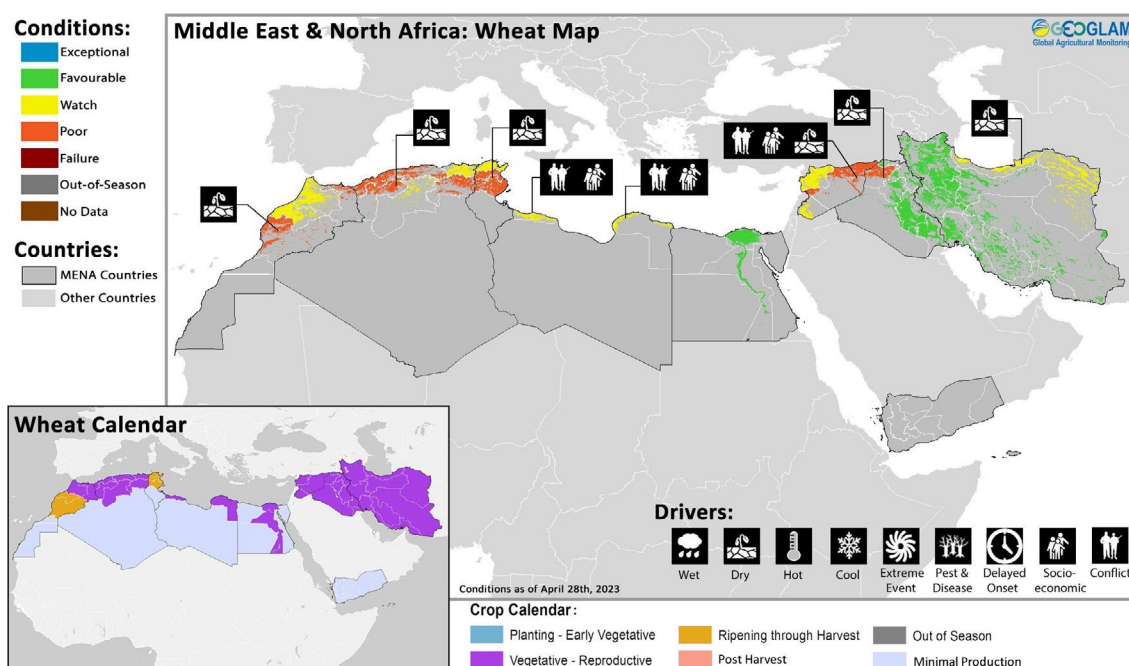
Source: Crop Monitor Early Warning, No. 80 issue, March 2023. Cited April 2023. <https://cropmonitor.org/index.php/cmreports/reports-archive/>

Note: Both panels are [Climate Hazards Centre \(CHC\) Early Estimates](#), which compare current precipitation totals to the 1981–2021 Climate Hazards Group Infrared Precipitation with Stations (CHIRPS) average for respective accumulation periods. CHIRPS are rainfall estimates from rain gauges and satellite observations. The figures show the percent of average precipitation for 21 January 2023 to 20 February 2023 (left) and for 1 November 2022 to 5 March 2023 (right). Both panels use CHIRPS Prelim for 1 to 20 February 2023. The right panel also includes a CHIRPS-GEFS forecast for 21 February to 5 March 2023.

Note: The final boundary between the Sudan and South Sudan has not yet been determined. The final status of the Abyei area is not yet determined.

Figure 5-right shows an outlook for 1 November to 5 March rainfall, based on preliminary data for 1 to 20 February and a two-week forecast. Most areas with below-average season-to-date rainfall are unlikely to improve during this time due to forecast average to below-average rainfall. However, there may be an expansion in locations with overall poor rainfall performance. Climate models forecast increased chances for warmer-than-normal temperatures through May and overall weak indicators for rainfall during the next several months. There are slightly elevated chances of above-normal March-to-May rainfall in Iraq and the Syrian Arab Republic, according to WMO, Copernicus Climate Change Service (C3S), and North American Multi-Model Ensemble (NMME) ensemble forecasts.

Figure 6. The situation of wheat crops and the wheat calendar



Source: Crop Monitor Early Warning. Issue No. 82. April 2023. Cited April 2023. <https://cropmonitor.org/index.php/cmreports/earlywarning-report/>

Note: The final boundary between the Sudan and South Sudan has not yet been determined. The final status of the Abyei area is not yet determined.

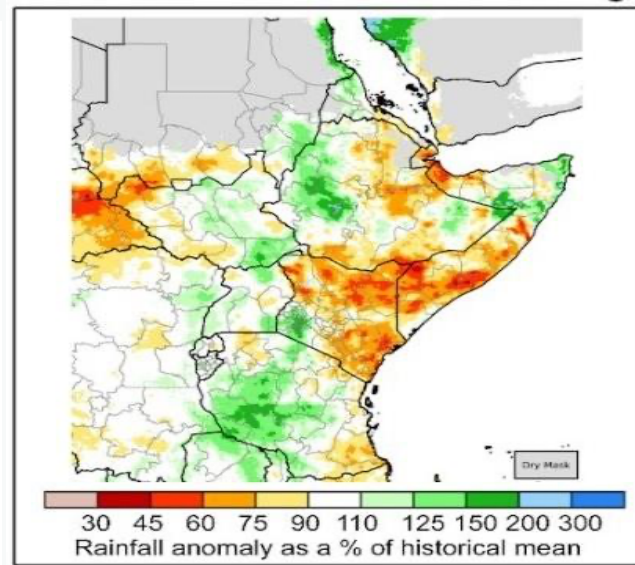
Crops are unlikely to recover from persistent dryness in northern Iraq, northeastern and southwestern Morocco, the northeast of the Syrian Arab Republic, central-northern Tunisia, and parts of Algeria. However, forecast above-average rainfall for April and May in northern Iraq and the Syrian Arab Republic may lead to some crop improvement. In **Morocco**, large portions of the country have experienced below-average rainfall during the early part of the season, particularly in January. While February brought some relief in the northwestern region, rainfall was significantly below-average again in March. The generally low and sporadically distributed rainfall combined with above-average winter temperatures are expected to result in below-average yields, except in some western and central areas such as Chaouia, Gharb, Tanger-Tetouan, and parts of Doukkala-Abda. In **Algeria**, conditions were mostly dry in March throughout the country, following irregular and below-average rainfall earlier in the season. Consequently, winter cereal growth has been delayed since the start of the season, and crop biomass is considerably below-average in most regions, except in parts of the northeastern coast. In **Tunisia**, the current season's rainfall deficit since October has resulted in most regions experiencing their lowest total rainfall since 2001/02. The dry conditions combined with above-average temperatures in the last month have severely impacted crop conditions, especially in the central-northern regions of the country, except for Bizerte. The national-level crop yield is expected to be significantly below the five-year average. While agroclimatic conditions remain favourable in **Libya**, persistent socioeconomic challenges continue to impact agricultural activities. In **Egypt**, conditions remain favourable for irrigated crops. In the **Syrian Arab Republic**, despite good rainfall in the north and south of the country in March,

the biomass of winter cereals is below-average in most of Hassakeh in the northeast, parts of Aleppo, Hama, and Idleb in the northwest, and in the south, particularly in As-Suweida and Dara, though winter cereals may benefit from the above-average rainfall forecast for April and May. Furthermore, following the 6 February earthquake, among other infrastructure damages, a dam collapsed in the northwest, leading to the overflow of the Orontes River. Then, on 16 March, heavy rainstorms led to severe flooding in the northwest, causing more damage to infrastructure and agricultural land, affecting livelihoods. In **Iraq**, conditions are favourable in the central and southern areas of the country as good rainfall resulted in average to above-average biomass. However, in the north, particularly in the main cereal producing governorate of Ninewa in the northwest, as well as parts of Dahuk and Erbil in the northeast, crop biomass is below-average due to generally poor rainfall performance despite some improvement in March. Only 50 to 60 percent of the average rainfall amount was received from December to February. However, forecast above-average rainfall for April and May could lead to some recovery in the north.

Morocco's planted wheat area is 11 percent lower than the five-year average this season. With a lower yield forecast, production is expected to be 3.56 million tonnes, 34 percent lower than the five-year average of 5.36 million tonnes in 2023. The country's expected barley crop production is 1.04 million tonnes against the five-year average of 1.86 million tonnes. In **Algeria**, ongoing drought conditions severely hampered the autumn planting programme, and vegetative crop growth has been well below-average. Algeria's planted area is 1.39 million hectares, a 23 percent deficit against the five-year average. The current yield forecast is 24 percent lower than the five-year average, which leads to a production outlook of 1.8 million tonnes, 45 percent lower than the five-year average. The barley crop forecast production currently stands at 1.19 million tonnes compared to the five-year average of 1.47 million tonnes. Warm and dry conditions have dogged plant growth since planting in late autumn in **Tunisia**. Very little rain fell from early December to mid-January. As a result, wheat production is forecast to be at 0.99 million tonnes, 14 percent lower than the five-year average. Barley output is expected to go down 29 percent against the five-year average at 0.37 million tonnes. Drought conditions and the expected fall in production **will increase the demand for cereal imports in the Maghreb region**.

In **Egypt**, the Nili season (Nile Flood) rice crop harvest was finalized in January under favorable conditions. As a result, Egypt's wheat production is likely to remain unchanged from the previous marketing year. **USDA forecasts Egypt's wheat imports** in the marketing year 2022/23 (July/June) at 11.0 million tonnes, down from last marketing year's estimate of 11.5 million tonnes. Egypt was able to secure a steady supply of wheat through diversification of wheat origins, whether through tenders or by directly purchasing wheat from several countries. Egypt's corn production expanded in response to high prices; similarly, rice production increased as planted areas increased. Consequently, both corn and rice imports are forecast to be lower.

Figure 7. Poor rainfall performance in East Africa (October–December 2022)

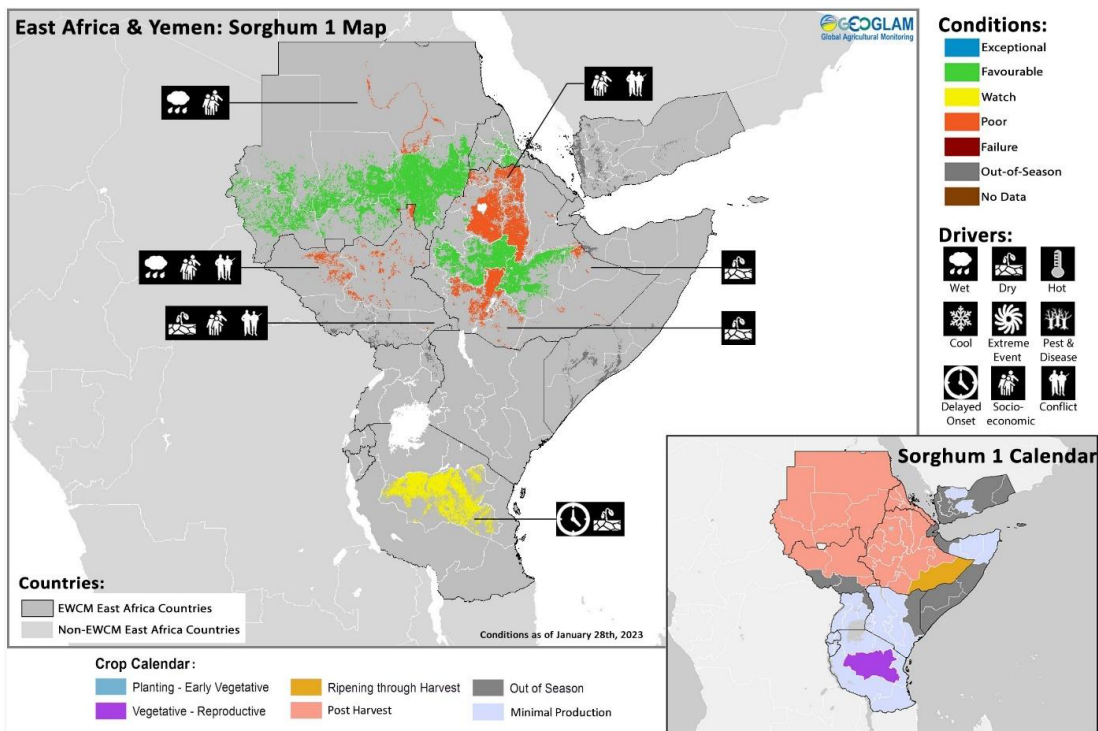


CHIRPS October–December (OND 2022) percent of average rainfall, from CHIRPS data (Climate Hazards Centre)

Source: Crop Monitor Early Warning, Issue No.78, February 2023. Cited February 2023. <http://cropmonitor.org/index.php/cmreports/reports-archive/>

The **Horn of Africa** is facing the worst drought in more than a decade, and depressed rainfall and high temperatures are forecast for the March-to-May season in 2023 (Figure 7). In Somalia, harvesting Deyr season maize and sorghum crops was finalized by February 2023 under poor conditions as crops could not recover from persistent dry and hot conditions throughout the season. Deficits were the greatest in northwestern, central, and southern areas, with the northwestern and central areas receiving 60 to 90 percent, and the southern areas receiving only 30 to 75 percent of the long-term average cumulative rainfall. The poor 2022 Deyr rainfall season is expected to result in a harsher dry season from January to March 2023. As of late December, water levels along the Juba and Shabelle rivers remained below the long-term average, and levels are expected to continue to decline until the beginning of the April to June 2023 Gu rains. Many socioeconomic challenges resulting from several consecutive dry seasons contributed to below-average plantings and yields, including limited financing at the household level that lowered access to agricultural inputs, and internal displacement that decreased agricultural labour availability. In Yemen, total crop production is expected to be less than the previous year due to irregular rainfall in the highlands where the primary cereal harvest season ended in November.

Figure 8. Sorghum production conditions in East Africa



Source: Crop Monitor Early Warning. Issue No.78. February 2023. Cited February 2023. <http://cropmonitor.org/index.php/cmreports/earlywarning-report/>

Note: Crop condition map synthesizing Sorghum 1 conditions as of 28 January. Crop conditions over the main growing areas are based on a combination of inputs, including remotely sensed data, ground observations, field reports, and national and regional experts. Conditions other than favourable are labeled on the map with their driver. Note: The final boundary between the Sudan and South Sudan has not yet been determined. The final status of the Abyei area is not yet determined.

In **East Africa**, the harvesting of main season cereals was finalized under mixed conditions as crops could not recover from widespread flooding over the Nile River Basin in the **Sudan**. In the Sudan, the harvesting of main season millet and sorghum crops was finalized in February 2023 under generally favorable conditions, except in the northern Nile River Basin where crops were impacted by the flooding (Figure 8). The high cost of harvesting equipment delayed harvesting activities and caused some farmers to use cheaper labor, resulting in increased post-harvest losses. However, overall crop outcomes for the 2022/23 cropping season are higher than the previous year and near-average. This is due to a shift towards less resource intensive crops like sorghum and millet, high production costs for cash crops and wheat, limited access to agricultural finance and high input costs, and better weather conditions leading to improved yields. However, winter wheat crops are now in the vegetative to reproductive stage for harvest from March and will be completed by April. While agroclimatic conditions are generally favourable, wheat production is forecast to be about 476 000 tonnes, about 30 percent below its year-earlier average due to reduced plantings in favour of legumes and spices.

Earthquake in the Syrian Arab Republic

In the **Syrian Arab Republic**, the earthquake of 6 February directly affected Aleppo, Hama, Idlib, Latakia, and Tartous governorates. The **number of deaths reached 1 414, while 2 357 were injured and more than 100 000 households were displaced.** **FAO's initial assessment** of the areas affected by the earthquakes shows significant loss of livestock and major damage to agricultural equipment and infrastructure, including greenhouses, irrigation, storage facilities, as well as food and feed production facilities, among others. All these factors are disrupting crop and livestock production and threatening people's immediate and long-term food security.

FAO's priority in the **Syrian Arab Republic** is to ensure that rural communities can recover basic food production and resume their agricultural livelihoods. In this light, FAO will supply farming inputs (animal feed, seed, seedlings, fertilizer, fuel, tools, equipment), veterinary care (livestock treatment and vaccination), and unconditional cash transfers. The Organization is currently assisting 17 880 rural families (107 280 people) by providing fodder to livestock keepers in Aleppo, fertilizers to farmers in Latakia, and support for rehabilitating irrigation in Hama.

Food security situation in the region

In the third quarter of 2022, families across **Lebanon** continued to face diminishing purchasing power, affecting vulnerable peoples' ability to meet basic needs. Food prices increased by 37 percent from the beginning of 2022 until the third quarter of 2022, and by more than 2 000 percent since the start of the crisis in October 2019. The government continues to seek alternative methods of support (e.g. Soft loan from the World Bank to import wheat for bread) and is exploring the possibility of extending the areas cultivated with wheat suitable for bread manufacturing.

In **Libya**, the national cost of the food basket in November 2022 was 18 percent higher than pre-conflict levels. Libya is heavily dependent on imports from Russia and Ukraine for its cereal needs (88 percent). The decreased purchasing power of vulnerable households affected their ability to afford nutritious foods and food staples, raising concerns about overall food security and leading them to adopt negative coping strategies. WFP estimates that over 324 000 individuals need food assistance in Libya.

In **Mauritania**, it is projected that nearly 695 000 people will need humanitarian assistance during the June to August 2023 lean season, including over 106 000 people in IPC Phase 4 (Emergency). This would be an improvement from the previous year, mostly due to the substantial cereal production increase in 2022. However, high food prices continue to worsen the food security situation, while flooding in 2022, which affected about 54 000 people, has further aggravated the conditions of vulnerable households. In addition, as of November 2022, the country hosted over 100 000 refugees, mainly from Mali.

In [Palestine](#), 1.8 million people (34 percent) are food insecure. The [Food Consumer Price Index](#) increased by 6.8 percent in October 2022 compared to October 2021.

The food security situation remains dire in [Somalia](#). At the national level, about 6.5 million people (almost 40 percent of the total population) are projected to face acute food insecurity between April and June 2023. This figure, about 65 percent higher than a year earlier, includes about 4.4 million people in IPC Phase 3 (Crisis), 1.9 million in IPC Phase 4 (Emergency), and 223 000 in IPC Phase 5 (Catastrophe). The high prevalence and severity of food insecurity are due to prolonged drought, which began in late 2020 and caused severe crop and livestock losses. In addition, the impact of the drought on household food security has been compounded by prolonged conflicts and hikes in international prices of wheat and fuel caused by the war in Ukraine.

Food insecurity remains alarmingly high in the [Sudan](#), with significant increases in food and other commodity prices, a reduced harvest, and continued conflict. About 7.74 million people (16 percent of the analysed population) were estimated to be [acutely food insecure](#) (IPC Phase 3 [Crisis] and Phase 4 [Emergency]) between October 2022 and February 2023. This figure includes about 6.19 million people in IPC Phase 3 (Crisis) and 1.55 million in IPC Phase 4 (Emergency) levels of acute food insecurity, which is about a 30 percent increase on a yearly basis. The main drivers are macroeconomic challenges resulting in rampant food and non-food inflation and the escalation of intercommunal violence.

In the [Syrian Arab Republic](#), the December 2022 standard reference food basket facing consumers almost doubled in 12 months and increased four times compared to two years ago. The prolonged crisis in Ukraine and the weakened local currency remained critical drivers behind the price inflation. By the end of 2022, the minimum wage could only afford one-fifth of the food basket. The recent earthquake has exacerbated the situation (see the previous subsection above). Based on the World Food Programme's Consolidated Approach for Reporting Indicators (CARI), about 15 million people are in need of food and agriculture assistance (representing 68 percent of the total population), including 12.1 million people who are estimated to be acutely food insecure, primarily due to constrained livelihood opportunities and a continuously worsening economy.

[Three years of drought have dried up reservoirs in Tunisia](#), threatening harvests critical to the North African country's battered economy and pushing the Government to raise tap water prices for homes and businesses. Empty dams across the fertile northern hills and eastern plains are alarming farmers producing olives and wheat crops. The drought has also pushed up fodder prices, contributing to [Tunisia's dairy industry crisis](#) as farmers sell off herds they can no longer afford to keep, leaving supermarket shelves empty of milk and butter.

In [Yemen](#), approximately 17 million people, over half the population, experienced high levels of Acute Food Insecurity (IPC Phase 3 or above) from October to December 2022. [21.6 million people](#), nearly three-quarters of the population, will require humanitarian and protection assistance in 2023. The primary concern is the 6.1 million people classified in IPC Phase 4. Although IPC Phase 5 (Catastrophe) has been prevented, close monitoring of the food security situation is essential.

Food policy-related developments and international support to improve food security

Algeria

August 2022: Removal of all taxes on e-commerce, mobile phones, and IT equipment for personal use and startups, relying solely on regulated tariffs.

Exoneration of dietary sugar from customs duties and VAT. Locally produced white sugar was also exempt from VAT at various distribution stages.

Attribution of exclusive rights for the purchase of wheat on the domestic market to the Algerian Interprofessional Cereals Agency (Office Algérien Interprofessionnel des Céréales, OAIC). The OAIC obtained exclusive rights to wheat imports in August 2021.

Bahrain

January 2023: Suspension of the three-month industrial land fees for food storage facilities, as well as the approvals and fees required by the Ministry of Industry and Commerce for supermarkets to run promotional campaigns. The Ministry of Social Development disbursed an additional month of financial support to low-income families to account for global inflation. Officials also increased monitoring and inspection of local market prices.

Comoros

October 2022: Receipt of nearly EUR 6 million from the African Development Bank to boost food production.

February 2023: Receipt of USD 30 million from the World Bank to provide emergency cash transfers and improve the resilience of vulnerable households.

Egypt

September 2022: Ban on the export of wheat and other staples lifted after six months.

September 2022: Ministry of Finance announces waiving the fines resulting from delays in finalizing customs procedures due to paperwork delays for importers and investors, among other decisions to facilitate imports. Measures to expedite the clearance of goods through customs before the final processing were also introduced. Shipping agencies awaiting customs clearance are given approval to transfer imported goods to dry ports or warehouses outside the ports to save the USD-denominated storage costs.

September 2022: Receipt of EUR 100 million from the European Union to secure food, such as wheat shipments from Ukraine.

October 2022: Ban on the export of rice continues in order to cover local needs.

October 2022: FAD and partner organizations announce that they would provide USD 2 billion in loans until 2030 to boost food security in response to Egypt's plan to increase investment in the food, water, and energy sectors.

October 2022: Discussion of new agricultural and food security opportunities are held between Egypt and African countries as they seek to boost their bilateral cooperation due to the effects of the war in Ukraine. The spokesman for the Egyptian Ministry of Agriculture relayed that "the objectives of such projects [to establish collective farms] include enhancing cooperation in the agricultural field with African countries, as well as transferring Egyptian agricultural expertise and technology to African countries, and conducting joint agricultural research aimed at improving the productivity of various crops. In addition, these farms provide promising opportunities for opening new markets for Egyptian agricultural products and exporting Egyptian crops and fruits to African countries."

November 2022: Decree issued by Egypt's cabinet against vendors for hoarding or stocking up on rice amid soaring food prices and inflation with a penalty of at least one year in prison and a fine between EGP 100 000 and 1 million to prevent shortages of the strategic commodity on the market. The decree will remain in effect for three months.

December 2022: Import restriction is lifted and a list of economic activities the government would leave to the private sector to meet two critical conditions attached to the International Monetary Fund's USD 3 billion support package is approved. The Central Bank of Egypt also dropped the requirement for importers to use letters of credit, allowing direct payment.

December 2022: Prices of food commodities, including sugar, rice, flour, and oil were increased by the Ministry of Supply and Internal Trade with sugar to be sold to ration card holders at EGP 14 per kg instead of EGP 10.5, rice at EGP 14 per kg instead of EGP 10.5, flour at EGP 20 per kg instead of EGP 11, and oil at EGP 30 per 800 ml bottle instead of EGP 25. A source in the Chamber of Grain Industry in the Federation of Industries explained that the spike in the price of flour was due to the lack of supply on the market.

Iraq

September 2022: Ministry of Trade plans to import more wheat for local flour production, decreasing the dependence on more expensive imported flour. A decision is made to adopt 'new mechanisms' of wheat buying as well.

Jordan

August 2022: Launch of 2021–2030 National Food Security Strategy and its 2022–2024 Executive Plan at a ceremony presided by Prime Minister Bisher Al-Khasawneh. The strategy was drawn up under the directives of His Majesty King Abdullah to designate 2021 as the year of food security, with the aim of turning Jordan into a food security regional hub. During the ceremony, the Prime Minister stated that the Kingdom's food security ranking has moved up on the Global Food Security Index from 62 in 2020 to 49 in 2021.

September 2022: Agriculture Ministers of Iraq, Jordan, Lebanon, and the Syrian Arab Republic agreed to support Jordan's initiative to host the regional observatory for food security. According to the Jordan News Agency (Petra), Jordanian Agriculture Minister, Khalid Hneifat, held a meeting with his counterparts Iraqi Minister Muhammad Khafaaji, Lebanese Minister Abbas Hajj Hassan, and Syrian Minister Muhammad Qatna, in which they discussed the need to resolve issues surrounding the region's food security amid worsening global events.

October 2022: OPEC Fund for International Development for the Emergency Food Security Project provides a USD 100 million loan to increase the country's food security and help mitigate the impact of rising commodity prices. The project will support Jordan's medium-term investments to enhance food security and the country's short-term emergency response. The construction and expansion of 70-grain bunkers will increase Jordan's wheat and barley storage capacity by a total of 700 000 tonnes. The funds will also facilitate the procurement of these two vital agricultural commodities.

November 2022: Temporary halt of high-volume olive oil imports from Palestine due to the local bumper harvest. Hazem al-Samadi, Deputy Secretary-General of the Ministry of Agriculture's marketing and quality department, said the imports were "rejected at this time due to the peak of the local production season."

November 2022: Loan of USD 130 million approved by EBRD to establish a higher council for food security. In addition, Jordan's Food Security Council was established to work alongside the National Committee for Food Security to help mitigate the country's vulnerability to global food crises and climate change. Jordan has prioritized enhancing food security in line with its national food security strategy launched in September 2021, since it relies heavily on food imports and buys over 95 percent of its grain supply.

January 2023: Ministry of Industry, Trade, and Supply announced that it would receive a USD 200 million fund from the Islamic Development Bank (IsDB) to cover the costs of Jordan's Emergency Food Security Project. Part of the fund would cover the cost of purchased goods, as well as the services associated with their provision, such as transport.

Kuwait

September 2022: Ban on the export of fresh eggs from 1 October 2022 until 21 May 2023 issued by the Minister of Commerce and Industry, Fahad Al-Shariaan. Licenced national farms and chicken and egg production companies are excluded from the ban.

December 2022: Set of requirements established to enhance agricultural tourism and strengthen the country's food security system. For example, the area of agricultural holding should be not less than 100 000 m², and the owner of the licence must adhere to the specified activities. The Municipality also desires to help Kuwaiti farmers and to increase the attractiveness of Kuwaiti products as an alternative to imported ones.

Lebanon

November 2022: The United Nations World Food Programme increased food assistance to feed one-third of Lebanon's crisis-hit population.

January 2023: Long-standing official exchange rate of 15 000 Lebanese pounds against the US dollar shifted, almost a 90 percent devaluation amid a years-long economic crisis.

February 2023: The first shipment of 33 000 tonnes of wheat, financed under the Lebanon Wheat Supply Emergency Project, arrived at the Port of Beirut. The shipment, equivalent to about one month's-worth of Arabic bread consumption in the country, will help rebuild Lebanon's wheat stock and secure affordable bread for poor and vulnerable households. It will be followed by several additional shipments over the consequent months to ensure the continuity of wheat supply and access to affordable bread throughout the project's lifespan.

February 2023: Import tariffs in local currency tripled as the Government seeks to boost revenue amid a worsening economic crisis.

Morocco

September 2022: Approval of a EUR 199 million loan by the Board of Directors of the African Development Bank in Abidjan to finance Morocco's Competitive and Resilient Cereal Development Support Programme (PADCRC). This new operation forms part of the African Emergency Food Production Facility to help boost food security, nutrition, and resilience across Africa. The programme will help reduce Morocco's cereal imports, focusing on improving productivity and the resilience of cereal production to climate change. It also provides for structural reforms that will lead to more efficient and resilient production systems.

September 2022: Morocco begins to seek investors for a USD 213 million agriculture project in the Western Sahara irrigated by a wind-powered desalination plant. The project, which aims to turn 52 km² of unused land near the city of Dakhla into farms growing fruit, vegetables, and animal feed, will be 77 percent state-funded and is part of a USD 7 billion development plan launched by Morocco in 2015 to upgrade Western Sahara's infrastructure, including the construction of a USD 1 billion port in Dakhla.

October 2022: Introduction of a subsidy for certified seed for the 2022–2023 crop year, reducing the price of planting seeds to: common wheat at -210 USD/tonne, durum wheat at -290 USD/tonne, and barley at -210 USD/tonne. Bread wheat imports continue to be subsidized based on a fixed flat rate premium in response to high global wheat prices. The subsidy measures outlined are to be valid until 30 April 2023.

November 2022: Terre Verte (green earth) programme deal worth USD 115 million signed by the European Union and Morocco to support the agricultural and forestry sectors. The funds would invest in food production, agricultural development, and biodiversity protection.

December 2022: Partnership signed between Agadir Horticultural Complex (CHA) and DANA Global, a desert technology venture builder and investment platform based in Abu Dhabi, to create a regional innovation hub for resilient and environmentally friendly agriculture in Morocco.

January 2023: Ban imposed on the import of meat and cattle from the United Kingdom and Northern Ireland; a measure valid for one year due to health considerations (mad cow disease).

February 2023: Ban imposed on the export of tomatoes, onions, and potatoes to West African countries to ensure food security at home after tomato prices rose sharply due to reduced production caused by cold temperatures and elevated fertilizer prices. Traders said tomato sales to Europe, where they fetch higher prices, have also raised prices domestically.

Oman

September 2022: Sohar Logistics Hub for the inspection of agricultural, fishery, foodstuff, and livestock, and consignments inaugurated by Oman's Ministry of Agriculture, Fisheries and Water Resources (MAFWR) in partnership with the integrated logistics solution provider, Al Madina Logistics Services (AMLS). Developed with a USD 9.1 million (OMR 3.5 million) investment, Sohar Logistics Hub offers a broad range of handling and inspection services for importing, exporting, and follow-up of products from and into the Sultanate.

January 2023: Sohar Flour Mills opened 12 grain silos with a total capacity of 160 000 tonnes at Sohar Port, a crucial deep-sea port at the centre of global trade routes between Europe and Asia. The silos were constructed to make Oman better prepared to tackle food shortages and enhance food security.

February 2023: Ministry of Agriculture, Fisheries and Water Resources signed an agreement of cooperation with Oman Flour Mills Company to purchase locally produced wheat crop from farmers in the harvest season of 2022/23 for OMR 500 per tonne in a bid to strengthen the food security system and to encourage the local farmers to grow wheat.

March 2023: Implementation of food fortification regulations, making food fortification compulsory for the following products: wheat flour, table salt, milk and milk products and vegetable oils and fats. Food fortification refers to adding one or more nutrients to food to improve the product's nutritional value and protect the community from symptoms resulting from nutrient deficiency.

Saudi Arabia

October 2022: Ministry of Environment, Water and Agriculture (MEWA) announced that it aims to localize 85 percent of the country's food industry by 2030. This includes raising fish production by 500 percent, increasing exports to SAR 3 billion, and raising the volume of dates exports to SAR 2.5 billion by 2025. Food imports cost SAR 70 billion annually.

November 2022: Agricultural Development Fund (ADF) announced signing contracts worth SAR 1 540 million (approx. USD 410.7 million) with several firms for importing various agricultural products with the aim of strengthening food security and compensating for food shortages that may occur in the supply of agricultural goods.

December 2022: Export restrictions on 11 percent of the restricted items (estimated at SAR 3.5 billion) were removed, allowing their export directly without the need to obtain prior approval. Products made from locally produced potatoes using water-restricted technologies were also given approval for export.

February 2023: Saudi Authority for Industrial Cities and Technology Zones, known as MODON, revealed that it signed several agreements in 2022 worth a total value of SAR 1.69 billion (USD 285 million). These partnerships aim at localizing the food and beverage industry in line with the National Industry Strategy of Saudi Vision 2030.

Tunisia

December 2022: Loan of EUR 220 million approved by the European Investment Bank, including EUR 150 million in emergency support for food security. Agriculture Minister Mahmoud Elyess Hamza said the loan would help Tunisia to supply soft wheat regularly. The country's deep financial crisis resulted in the shortage of many food commodities.

January 2023: Taxes on powdered milk and butter imports were scrapped to enhance the supply of the commodities in the local dairy market, in order to prevent a supply shortage. The dairy subsector in Tunisia has been in an uphill battle since the start of 2022, with daily production dropping to 1.4 million litres against an average consumption rate of 1.8 million litres per day.

United Arab Emirates

October 2022: Emirate of Abu Dhabi signed the Milan Urban Food Policy Pact (MUFPP), joining over 250 cities worldwide committed to reducing food waste and developing a more sustainable food system.

December 2022: Discussions began with Ukraine over a potential free trade deal known as a Comprehensive Economic Partnership Agreement (CEPA) to liberalize trade flows. Ukraine, one of the world's largest exporters of wheat and grain, is looking for ways to support its war-damaged economy while the United Arab Emirates seeks to ensure its food security. The government also issued directives to various government agencies, including hospitals and armed forces, instructing them to prioritize the purchase of local produce to support local agritech efforts.

January 2023: Government of the United Arab Emirates highlighted efforts to boost local food security as a critical goal for transforming its food supply system in 2023 and introduced new taxation strategies to fund further innovation and development.

February 2023: The United Arab Emirates and Uzbekistan agreed to promote trade and economic cooperation in food security, renewable energy, tourism, and natural resources.

Yemen

December 2022: World Bank approved additional USD 150 million grant for the second phase of the Yemen Food Security Response and Resilience Project. The new funding had been designed to address food insecurity, strengthen resilience, and protect livelihoods in Yemen.

February 2023: The United States of America announced more than USD 444 million in additional humanitarian aid to the people of Yemen, USD 440 million of which will be given through USAID, bringing the total assistance by the United States of America to the humanitarian response in Yemen to over USD 5.4 billion since the conflict began in September 2014.

February 2023: New package of food security support announced by United Kingdom Minister Andrew Mitchell to directly support up to 40 000 Yemeni people a month to alleviate hunger and poverty



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Section II: Climate change

Effects of climate change in the Arab Region

Regional studies estimate that temperatures in the Arab region could rise from 1.7 to 2.6 °C by 2050, and up to 4.8 °C by the end of the century. The effects of this increase on agriculture, livestock, fisheries, and forestry would be significant given that the productivity of these sectors is already negatively affected by the gradual degradation of land, soil, and water resources. The region is already the most arid in the world; **drought and water scarcity problems** in the area will be exacerbated under medium to long-term climate scenarios, making the region one of the most vulnerable globally to climate change. **Precipitation is projected to generally decrease** across the region, with increased seasonal and annual variability, including an increase in extreme events; an **8–10 mm decrease in annual rainfall** by the end of the century is predicted. Droughts are expected to increase in frequency by 150 percent by 2070, and flash floods will threaten coastal and low-lying agricultural areas. The highest water-induced climate vulnerability areas (including adaptive capacity) will be the upper Nile Valley, the southwestern Arabian Peninsula, and the northern Horn of Africa. The Arab region will see the **greatest expected economic losses** from climate-related water scarcity globally, estimated at 6–14 percent of GDP by 2050. Furthermore, the rise in sea level threatens coastal areas. For example, the Mediterranean Sea level is projected to rise further during the coming decades, likely reaching 0.15–0.33 m in 2050, increasing coastal flood risks in low-lying areas. **NENA is the only region in the world where harvest area shrinkage is expected by 2050**, and crop yields are expected to decline. These will seriously affect the quantity and quality of food production and food security.

Responding to these risks is necessary in order to increase the resilience of agriculture in Arab countries, including the most vulnerable smallholder farmers. This requires designing

and implementing climate change adaptation⁵ measures, such as scaling up climate-smart agricultural practices and crop diversification, conservation agriculture, crop rotation, modification of sowing and planting times, and ecosystems restoration actions. Such methods aim to address water scarcity, land degradation and improve efficiency in agriculture while maximizing co-benefits for mitigating global warming. Adapting to climate change also requires planning and multistakeholder coordination at sectoral and national levels to ensure climate actions consider the role of women, youth, and marginalized populations. Efforts at the regional level can also support the sharing of best practices and innovations, consolidation of regional climate data and knowledge, and the mobilization of financial and technical resources.

Climate change policies

All the Arab countries submitted [Nationally Determined Contributions \(NDCs\)](#) according to the Paris Agreement on climate change.⁶ In them, almost all the Arab governments highlighted observed or expected [increases in the intensity and frequency of climate extremes](#), namely flood and drought. Agroecosystems are considered the most vulnerable of ecosystems to climate change impacts, particularly at risk of losses in primary production and productivity, changes in water quantity and quality, soil erosion, biodiversity loss, and increased incidence of plant and animal pests and pathogens.

Water resources constitute the most significant priority for adaptation in the NDCs, focusing on increasing irrigation efficiency through water accounting and improving rainwater harvesting and storage techniques. Afforestation, reforestation, and land and soil conservation and restoration efforts are prominent among the region's adaptation strategies. Coastal erosion is frequently mentioned as a climate-related slow-onset event affecting countries bordering the sea and ocean. Adaptation measures, such as mangrove restoration and replanting constitute a means for protecting vulnerable coastal zones.

In their first-round NDCs, around half of the NENA countries provided a mitigation contribution in the Agriculture, Forestry and Other Land Use (AFOLU) sectors. Only two (Morocco and Mauritania) set a sector-specific greenhouse gas (GHG) target. Most mitigation contributions focus on enhancing carbon sinks through afforestation, reforestation, and sustainable forest management, highlighting areas of synergy with regional adaptation priorities.

Many countries in the region have introduced [robust climate policies](#), with Jordan and Morocco being the pioneers. [Morocco](#) presented a National Plan of Action against Climate Change at COP15 in Copenhagen in 2009, and published an enhanced and more ambitious [NDC](#) in 2021 aiming at a 45.5 percent reduction of its GHG emissions by 2030. [Jordan](#) developed its first climate change policy in 2013 and launched its [climate-related sectoral plans](#), including water and agriculture plans in 2021. For other countries, fighting climate change has also been integrated into long-term strategic ambitions, such as [Egypt Vision 2030](#), [Oman Vision 2040](#),

5 According to the [IPCC \(2019\)](#), adaptation refers to the "process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects".

6 NDCs represent a country's commitment to act on mitigation and adapt to changes in climate, report on progress made, and identify support needs.

and Saudi Vision 2030. Ahead of COP26 in Glasgow in 2021, Lebanon, the United Arab Emirates, and Yemen have pledged to be carbon neutral by 2050, and Bahrain and Saudi Arabia by 2060. Jordan, Morocco, Oman, Palestine, Qatar, and Tunisia submitted more ambitious NDCs and heightened their gas emissions reduction goals. However, climate actions in conflict-affected countries such as Libya, the Syrian Arab Republic, Yemen, and Iraq to a smaller extent, lag behind in the region. Libya has not ratified the [Paris Agreement on climate change](#) yet. Egypt hosted COP27 in 2022, and the United Arab Emirates is scheduled to host COP28 in 2023.

Sharm El-Sheikh Climate Change Conference (COP27)

Agriculture and food systems face very high levels of climate risk in the region. At the same time, total emissions in the region are set to double by 2030 compared to 2015 levels. [Agriculture, Forestry, and Other Land Uses \(AFOLU\) sectors contribute 15 percent of total emissions](#), with the most prominent source being livestock. Agriculture is a vital part of the solution for addressing climate change. Yet, agriculture has not had a significant presence in the national and international climate processes for many years. However, this changed at COP23 when countries adopted the [decision](#) to launch the work programme [Koronivia Joint Work on Agriculture \(KJWA\)](#).

COP27 made [agriculture one of its thematic focuses](#), dedicating a day to [adaptation and agriculture](#). The [Food and Agriculture for a Sustainable Transformation \(FAST\) Initiative](#) aiming to improve the quantity and quality of climate finance for agriculture and food systems by 2030 was launched by FAO and the Egyptian COP27 Presidency. Other food systems-related initiatives launched at the Conference included the [Initiative on Climate Action and Nutrition \(I-CAN\)](#), the [AWARE](#) initiative focusing on water-related adaptation to climate change, and the [Global Waste Initiative 50 by 2050](#), which included tackling food loss and waste.

Parties reiterated the importance of agriculture in the decision on the [joint work implementing climate action on agriculture and food security](#) at COP27. This four-year joint work includes implementing the outcomes of [KJWA](#) and [previous activities addressing issues related to agriculture](#) and future topics, including enhancing research and development on issues related to agriculture and food security.

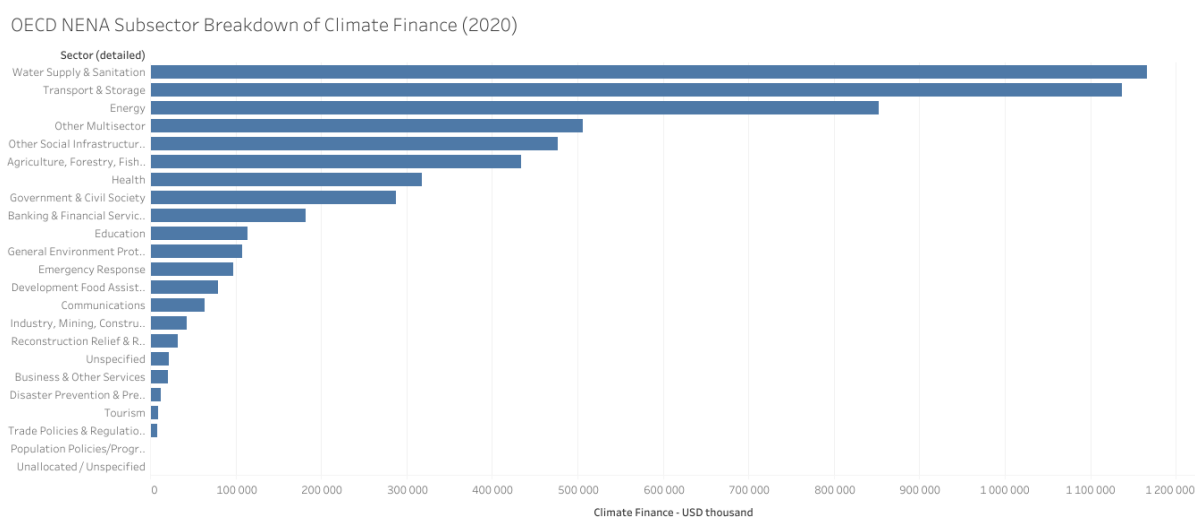
The critical role of water was highlighted in the final COP decisions and during COP27. Countries also pledged to launch a funding facility for loss and damage from climate change to support vulnerable developing countries. This is particularly important in developing countries where agriculture absorbs about a quarter of the damages caused by extreme weather events and for the large proportion of smallholder farmers who undertake the bulk of agricultural production.

Looking ahead at COP28, FAO is a partner organization in the Agriculture Innovation Mission for Climate (AIM4C) initiative launched by the United Arab Emirates and the United States of America, with the aim of doubling investment commitments from 42 member governments to reach USD 8 billion to support innovation for agricultural adaptation and emissions reductions.

Climate finance

Climate finance refers to the various types of financing (local, national, or international) from public, private, and blended sources in support of climate change mitigation and adaptation actions. Recent analyses show that flows of climate finance to agriculture, land-use, forestry, and water sectors lag behind others. Moreover, only 1.7 percent of climate finance goes to small-scale farmers in developing countries, despite their disproportionate vulnerability to the impacts of climate change. Such trends are also evident in the Arab region, where finance for mitigation exceeds that for adaptation by five to seven times. Thus, the quantity and quality of climate finance towards adaptation and agrifood sectors in the Arab region must be improved.

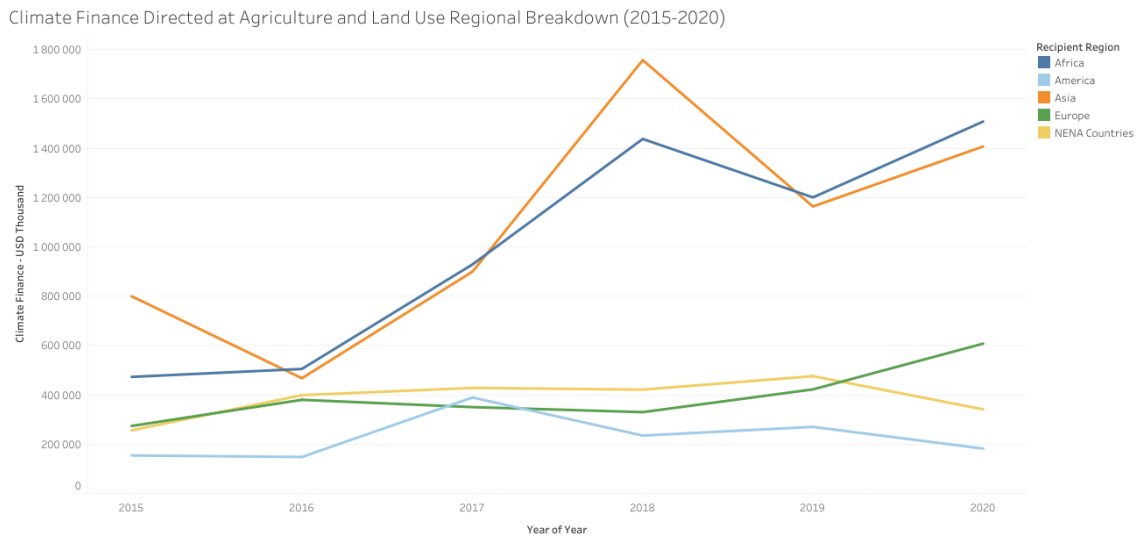
Figure 9. OECD subsectors climate financing breakdown for the Arab region (2020)



Source: OECD. Climate Change: OECD DAC External Development Finance Statistics. In: OECD. Paris. Cited February 2023. <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm>

Figure 9 shows that due to scarce water resources in the region, the water and sanitation sector received the most extensive climate finance inflow in 2020 in the Arab region (around USD 117 million). On the other hand, the agriculture, forestry, and fishery subsectors were the sixth most financed subsectors in climate finance (about USD 440 million).

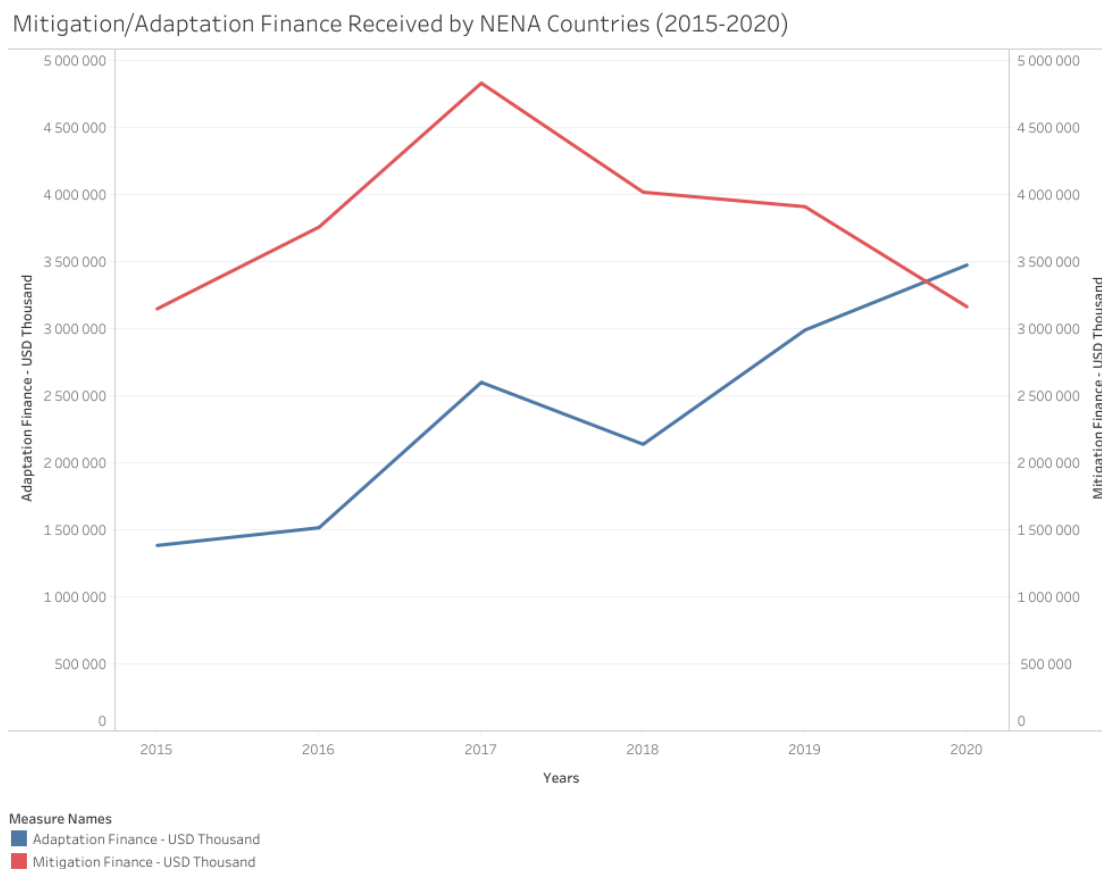
Figure 10. Climate finance directed towards agriculture and land use regional breakdown (2015–2020)



Source: OECD. Climate Change: OECD DAC External Development Finance Statistics. In: OECD. Paris. Cited February 2023. <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm>

Although NENA countries are among the most vulnerable, most water-stressed, and the least climate-resilient regions, these countries are among the **lowest receiving regions in the world in climate finance** directed towards agriculture and land use (around USD 400 million in 2016–19). In 2020, Arab countries received 8.4 percent (USD 0.34 billion) of the USD 4.04 billion global climate finance directed towards agriculture. At the same time, the rest of Africa received 37.3 percent, Asia 34.8 percent, Europe 15.0 percent, and America 4.5 percent of global agriculture-related climate finance in 2020. Figure 10 also highlights how finance directed towards the NENA region has stagnated and even decreased in 2020, despite climate finance increasing in certain regions such as Africa and Asia.

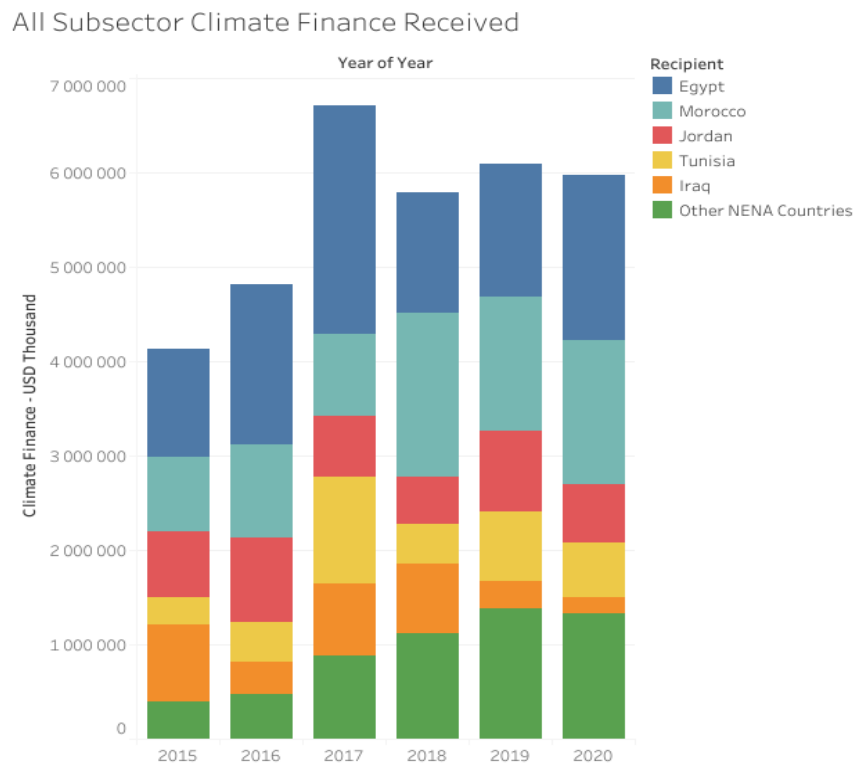
Figure 11. Mitigation/adaptation finance received by NENA countries towards agriculture and land use (2015–2020)



Source: OECD. Climate Change: OECD DAC External Development Finance Statistics. In: OECD. Paris. Cited February 2023. <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm>

Figure 11 shows that most climate finance received by Arab countries across all sectors targeted mitigation until 2020. However, 2020 might present itself as an inflection point for climate finance as national strategies started to shift their focus to adaptation instead of mitigation. On average, mitigation-related climate finance was USD 3 800 billion, while adaptation finance was USD 2 347 billion USD between 2015 and 2020.

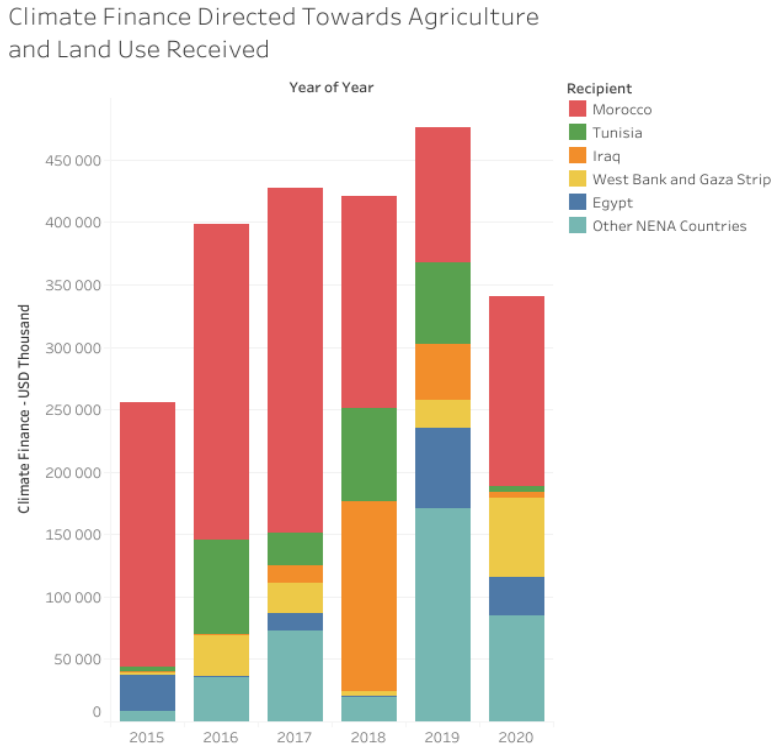
Figure 12. All subsector climate finance received by NENA countries (2015–2020)



Source: OECD. Climate Change: OECD DAC External Development Finance Statistics. In: OECD. Paris. Cited February 2023. <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm>

Figure 12 reveals that Egypt, Iraq, Jordan, Morocco, and Tunisia are the primary recipients of climate change finance flows in the region between 2015 and 2020 in all sectors. In 2020, Arab countries received USD 5.92 billion in climate change finance, out of which Egypt received USD 1.75 billion (29.3 percent of total Arab climate finance flow), Morocco USD 1.53 billion (25.7 percent), Jordan USD 0.61 billion (10.2 percent), Tunisia USD 0.59 billion (9.8 percent) and Iraq USD 0.17 billion (2.8 percent) and other Arab countries USD 1.33 billion (22.2 percent). The amount of aid received by NENA countries peaked in 2017 and has leveled out. However, it is also worth noting that the amount of finance flows received by other NENA countries has also been steadily increasing since 2015.

Figure 13. Climate finance received directed towards agriculture and land use in NENA countries (2015–2020).

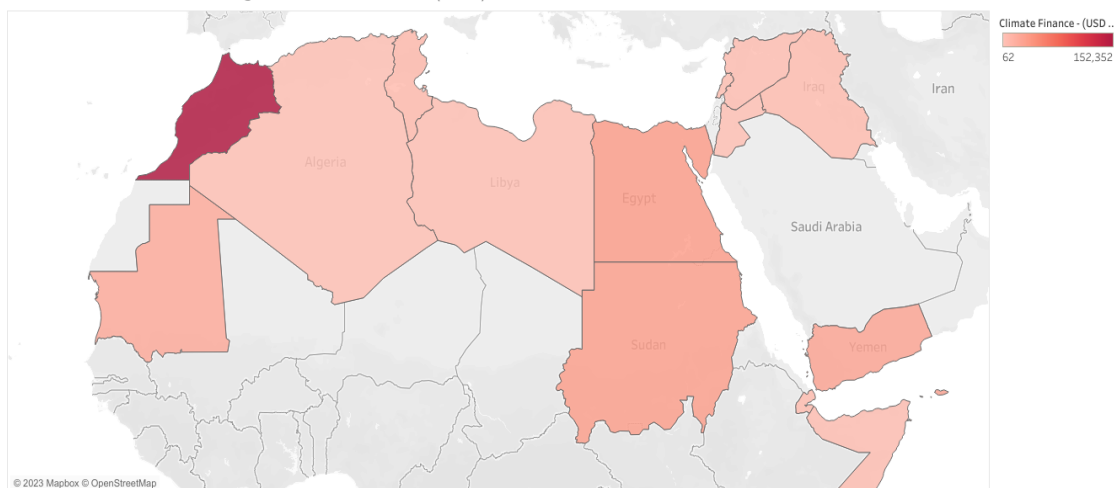


Source: OECD. Climate Change: OECD DAC External Development Finance Statistics. In: OECD. Paris. Cited February 2023. <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm>

Morocco is largely the most significant recipient of climate finance, directed explicitly toward agriculture and land use (Figure 13, 14). In 2020, Arab countries received USD 341 million in climate finance towards agriculture and land use, out of which Morocco received USD 152.4 million (44.7 percent of the total), Palestine USD 63.4 million (18.6 percent), Egypt 31.6 million USD (9.3 percent), Tunisia USD 5.2 million (1.5 percent), Iraq USD 3.9 million (1.1 percent), at the same time other Arab countries got USD 84.5 million (24.8 percent). However, it is worth mentioning that the proportion received by other countries has been growing since 2018.

Figure 14. Map chart of climate finance received by NENA countries for agriculture and land use subsectors (2020)

Climate Finance Directed at Agriculture and Land Use (2020)



Source: OECD. Climate Change: OECD DAC External Development Finance Statistics. In: OECD. Paris. Cited February 2023. <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm>

Note: Final boundary between the Sudan and South Sudan has not yet been determined. Final status of the Abyei area is not yet determined.

Table 1: Top climate finance providers in agriculture and land use subsectors in Arab countries (2020 - USD thousands)

Top climate finance providers - agriculture and land subsectors (2020 - USD thousands)

World Bank	158 020
France	40 907
EU Institutions (Excluding EIB)	38 359
International Fund for Agricultural Development	20 836
African Development Bank	19 861
European Bank for Reconstruction and Development	14 855
Germany	14 324
Green Climate Fund	11 540
Italy	7 430
Belgium	3 989
Spain	3 094
Global Environment Facility	2 500

Source: OECD. Climate Change: OECD DAC External Development Finance Statistics. In: OECD. Paris. Cited February 2023. <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm>

The World Bank was by large the most significant climate finance provider (Table 1) in the Arab region in 2020 (USD 158 million), followed by France (USD 41 million) and the EU institutions (USD 38 million). It is worth mentioning that some high-income countries in the region did not receive any climate finance for agriculture and land use in 2020, such as Bahrain, Oman, and Saudi Arabia (Figure 13). On the other hand, the role of Gulf countries as climate finance providers in the region is slowly growing.

Domestically, [governments in the NENA region](#) are taking steps to [mobilize climate finance](#) by providing an encouraging environment and innovative financial instruments that boost climate adaptation and mitigation initiatives. For example, [Egypt](#) launched the first green sovereign bond in the region, worth USD 750 million and sold at a 5.25 percent yield. [Such green bonds help to finance](#) green energy, clean transportation, waste management, water efficiency, and green buildings, among other environmentally friendly products and projects. However, [the NENA region](#) accounted for just around 1 percent of the total USD 228 billion worth of green bonds issued in 2020, underscoring the size of the untapped opportunity in the region. [Debt swaps are also considered an option to finance investment](#) in adaptation and green projects.

Policies in Arab countries enhancing climate change adaptation and mitigation

The following section presents the climate-change-related policies and innovations Arab countries are introducing to adapt to climate change and to manage demands on limited natural resources. These policies aim to increase production in harsh climatic conditions and improve food security while transforming food systems to be resilient against climate change-induced shocks. For example, in recent years, [controlled-environment agriculture](#) has become more critical in delivering locally produced fresh, safe, healthy premium fruits and vegetables, especially in the Gulf region. In addition, many other measures aim to increase water efficiency in the region. Examples include: investing in desalination⁷ plants, dams, water harvesting, and advanced smart or drop irrigation technologies.

This section also presents projects that FAO and other international organizations are undertaking in the region to help countries with climate change adaptation and mitigation. Some FAO programmes are focused on the whole NENA region, such as the [FAO Regional Initiative on Water Scarcity](#), which has the following objectives: enhancing policies, investments, governance, and best practices to increase water and land productivity sustainably; providing tools for strategic planning of optimal and sustainable allocation of scarce water resources; and implementing a regional collaborative strategy for a water-reform agenda.

7

Desalination is the process of removing salt and other impurities from oceanic or brackish water.

Algeria

Algeria's economy is mainly based on the oil and gas sector, which produces the largest share of GHG emissions. The [Agriculture, Forestry and Other Land Use sectors account for 11 percent of the total GHG emissions](#). Algeria also submitted its INDCs⁸ in 2015, which announced Algeria's plan to reduce national GHG emissions by 2030 by 7 percent, depending on domestic capabilities, and by 22 percent if international support were provided.

[Algeria's National Climate Plan](#) provides an overview of climate change vulnerabilities in Algeria. It proposes over 70 action measures, including adopting renewable energy, achieving 35 000 hectares of forests, and developing another 175 000 hectares, waste recovery, and green transport.

Despite scarce land and water resources, Algeria has [tripled its food production since 2000](#). The Agricultural and Rural Renewal Programme, launched in 2010, incentivizes farmers to switch to higher-yielding varieties of staple crops like wheat. In addition, bonuses were given to farmers who achieved large harvests of short-cycle crops such as tomatoes that satisfy local demand and [require little water to achieve high yields](#). A crucial complement to this government support was the introduction of innovative irrigation systems. For example, in the El Oued desert region, rotating sprinklers that draw from water tables beneath the desert (a modern version of the traditional "[Ghout](#)" irrigation technique) are used in areas with full sun ideal for growing fruits and vegetables.

Furthermore, the government has [encouraged private sector investment](#) by removing most foreign ownership restrictions and has sought to further boost agricultural production by lifting bans on importing agricultural equipment. For example, in the desert city of Touggourt, Algeria's National Office of Irrigation and Drainage collaborated with Spanish company Alcantara on a USD 9 million public-private partnership to build a complex of horticultural greenhouses. The complex has four multichapel greenhouses of 10 hectares each. It uses [geothermal energy⁹ in the agricultural production of organic zucchini](#) (and later cherry tomatoes, chili peppers, and peppers) exported to the European market. The complex also has a demineralization block which allows for the cooling and softening of salt water.

In 2022, FAO and ESCWA supported developing a climate-proof watershed management plan and resilience package in the Algérois basin. Given the increasing scarcity of freshwater driven by present and expected climate change, this support aimed to make recommendations for improved water resources management. An integrated vulnerability assessment based on downscaled RICCAR climate change projections formed the basis for stakeholder consultations toward designing a tailored package of recommended actions for the resilience of agricultural communities in the watershed.

FAO also supports the Government of Algeria in implementing its National Land Monitoring and Information System to enhance the country's capacity to report on its climate actions under the United Nations Framework Convention on Climate Change (UNFCCC). The project

⁸ [\(Intended\) Nationally Determined Contributions](#) (INDCs or NDCs) are the primary means for governments to communicate internationally the steps they will take to address climate change in the framework of the UN Framework Convention on Climate Change (UNFCCC). INDCs can also address how countries will adapt to climate change impacts, and what support they need from, or will provide to, other countries to adopt low-carbon pathways and to build climate resilience.

⁹ Geothermal energy is the energy recovered from the boreholes to heat the greenhouses, thanks to radiators. This technique makes it possible maintain the same climate conditions throughout the year, especially during winter when nightly temperatures drop.

boosts the capabilities of technical experts from Algeria to conduct GHG national inventories and monitor national and subnational land mitigation activities.

Bahrain

Bahrain is highly vulnerable to climate change, and the water sector is especially vulnerable given the country's extreme water scarcity. Therefore, the country's [NDC](#), submitted in 2021, includes both adaptation actions (primarily in the coastal resilience to sea-level rise and the water resources management), and adaptation actions with mitigation co-benefits, such as forest management and economic development and diversification. Undertaken efforts to make forestry more sustainable include:

- ▶ Promoting afforestation to support an increase in green areas;
- ▶ Identifying and creating a list of trees and vegetation suitable for local climate;
- ▶ Encouraging nationals and residents to plant trees;
- ▶ Revising building permits to include landscaping; and
- ▶ Building resilience against climate change risks affecting the mangroves habitats.

To increase the resilience of livelihoods against disasters, the NDC envisages the following specific actions:

- ▶ Providing more resilient coastal infrastructures;
- ▶ Modelling the impact of climate change on freshwater resources, conducting comprehensive auditing of water management and use, making use of greywater, and harvesting rainwater; and
- ▶ Creating a blue carbon inventory to augment Bahrain's existing GHG emission tracking system.

Bahrain's Economic Vision 2030 aims to make the environment more sustainable, including [agriculture and forestry](#), and proposes to conserve natural spaces for future generations, and invest in technologies that reduce carbon emissions, minimize pollution, and promote the sourcing of more sustainable energy. Furthermore, the [National Initiative for Agricultural Development](#) (NIAD) aims to establish an effective agricultural sector compliant with the Economic Vision 2030 that would address challenges such as water and land scarcity, and encourage traditional farming. The initiative promotes modern technologies in agriculture and supports agricultural and marine resources projects by:

- ▶ Supporting farming entrepreneurs through the Agricultural Incubators Centre in Hoorat A'ali and developing their pioneering ideas using modern agricultural techniques to grow crops with high economic returns;
- ▶ Building greenhouses;
- ▶ Planting and restoring the environment of mangroves in bays and on coasts;

- Developing an online platform to strengthen local agricultural production by providing a one-stop-shop for research, scientific data, statistics, satellite images, training programmes, as well as contact details of Bahraini farmers to support and market their produce.

In its national afforestation strategy and to reach net zero emissions by 2060, Bahrain [plans to double its mangroves](#)¹⁰ to reach 3.6 million trees by 2035. The Government also prioritizes reviving date palm cultivation, a traditional, climate-resilient crop, to improve food security and farmers' livelihoods.

Alongside the movement to grow indigenous crops, the region has experienced a massive push towards Controlled Environment Agriculture (CEA), which encompasses all types of indoor agriculture where the environment is controlled via technologies such as artificial light and hydroponics.¹¹ Greenhouses, and vertical farms, where the crops are stacked in trays on multiple levels or in towers, are the most common types of indoor farms and are popular in Bahrain. A key advantage of vertical farming is that it provides a variety of agricultural products, particularly leafy vegetables, and strawberries, in small areas with less water and in an environmentally friendly manner; it also uses [80 to 99 percent](#) less water than conventional farms, which explains why Gulf countries invest [substantially](#) in them. Furthermore, crops can be produced in locations close to consumers, reducing the need to transport products through traditional means that increase pollutants.¹² For example, Peninsula Farms, a local farm in Bahrain, cultivates green leafy vegetables with [98 percent crop yields](#) throughout the year using hydroponic greenhouse systems. The Government of Bahrain has also invested in a one-hectare greenhouse combining aquaponics¹³ and hydroponics. Kingpeng, the greenhouse manufacturer, undertook the project and [expanded it to two hectares](#).

Bahrain has already increased agricultural production by expanding cultivated areas and adopting hydroponics. Over the last three years, it has produced 418 tonnes of vegetables annually through hydroponics and aims to increase this to 10 000 tonnes annually according to its [Food Security Strategy](#).

Climate change is making the challenge of water management increasingly urgent within the region. Bahrain relies to a large degree on groundwater, including for agriculture. A project of the [Green Climate Fund](#) enhances the resilience of the water sector by promoting demand management and the generation of new water supplies across Bahrain. The project aims to save 20 to 30 percent of the water consumption of the targeted households. It helps to establish and operate a knowledge platform on climate-resilient integrated water resources

10 Mangroves sequester carbon 2 to 4 times more than mature tropical forests. As a result, they contain the highest carbon density of all terrestrial ecosystems and provide an important biological habitat for crustaceans, marine organisms, and birds.

11 Hydroponics is the system of growing plants without soil, where the plants are fed with an aerated solution of nutrients, and the roots are either supported within an inert matrix, or are freely floating in the nutrient solution.

12 Despite the benefits, [vertical farming faces some limitations](#). Farms require artificial sources of light, which are typically energy-intensive. The initial cost of setting up a vertical farm can also be significantly higher than that of a traditional farm due to more complex and expensive infrastructure, lighting, and water systems. The hydroponic system also limits the types of products that can be grown to leafy greens, excluding plants such as corn, wheat, and root vegetables. Currently, [80 percent of crops](#) grown by vertical farms are lettuce, spinach, broccoli, cucumbers, or peppers.

13 Aquaponics is a hybridization of aquaculture and hydroponics based on a symbiotic relationship between fish, beneficial bacteria, and plants. Fish culture and soilless plant culture are combined in an integrated and codependent multicrop system that simultaneously produces protein and various fruits and vegetables (for example, tomatoes) by recycling water and nutrients. The fish kept in water tanks produce waste that contains ammonia; the naturally occurring aerobic bacteria convert ammonia to nitrite and then nitrates. This nitrate-rich water, which serves as the primary plant nutrient, is circulated through the hydroponic section of the system housing the crops. The ammonia/nitrate-free water is then returned to the fish, and the whole cycle is repeated.

management framework across different sectors. In addition, the project initiates an awareness campaign highlighting the benefits of wastewater reuse and produces guidelines for rainwater harvesting and greywater recycling.

Comoros

The Union of the Comoros is [among the most climate-vulnerable countries in the world](#). 54.2 percent of the population lives in areas highly exposed to sea level rise and other climate change risks. Models predict an increase in the annual average temperature, and the increase and intensification of risks associated with climate change, such as sea level rise, floods, droughts, and cyclones. Agriculture and biodiversity are the sectors most vulnerable to climate change.

According to the mitigation ambition set up by the country's [2015 NDC](#), it targets a net reduction of GHG emissions of (excluding LULUCF) 23 percent, and an increase in its net CO₂ absorption sink of 47 percent by 2030, compared to the reference scenario. The energy, agriculture, and waste treatment sectors are currently emitting the highest levels of GHG. Adaptation can be found in the newly adopted [Emerging Comoros Plan 2030](#), the flagship national strategy guiding the country's development and green recovery efforts with the aim of making it "a country resilient to shocks in all dimensions of sustainable development" by 2030. Its NDC sets the following adaptation objectives in the agriculture sector:

- ▶ Establishing a resilient and climate-smart agricultural policy;
- ▶ Developing agropastoral irrigation; and
- ▶ Creating an effective early warning and intervention system in the event of the emergence of new bovine or caprine diseases.

In the biodiversity and forest sector, it intends to expand protected and reforested areas.

The United Nations has selected the initiative to [restore sensitive ecosystems](#) in the Union of the Comoros as one of [ten pioneering initiatives](#) to revive the natural world. The creation of Mohéli Marine Park has more than doubled the live coral cover and increased sea turtle nests. The effort was selected under the [United Nations Decade on Ecosystem Restoration](#), a global movement coordinated by UNEP and FAO designed to prevent and reverse the degradation of natural spaces across the planet.

Contributing to the Emerging Comoros Plan 2030, the UNDP project "[Strengthening the resilience of climate-smart agricultural systems and value chains in the Union of Comoros](#)" aims to increase the resilience of 11 percent of the population by focusing on crucial agricultural value chains vulnerable to the impact of climate change, including the three primary export commodities: clove, vanilla, and ylang-ylang. Implemented over a period of five years, the intervention will build capacities and support investments in climate-smart practices, more autonomous supply of inputs, better climate risk management, and better access to knowledge and training, providing resilient livelihood options for smallholders while reducing import dependence and increasing access to better quality, locally produced food.

In February 2022, in collaboration with UNDP through projects on resilience to climate change funded by the Green Climate Fund ([GCF](#)) and Global Environment Facility ([GEF](#)),

the Government launched the broad reforestation campaign, [One Comorian, One Tree](#), to protect watersheds. The campaign aims to plant 613 000 new trees on 571 hectares of land throughout the country until 2025 and will improve access to water and protect vulnerable and depleted ecosystems.

Djibouti

Parts of Djibouti, Ethiopia, Kenya, and Somalia are experiencing the driest conditions and hottest temperatures since satellite record-keeping began, due to the recurring [La Niña weather phenomenon](#). Djibouti is projected to experience rising temperatures, increasing water scarcity, increased evapotranspiration, and more frequent floods and droughts due to climate change.

Djibouti submitted its [Second National Communication](#) in 2014, and its [NDC](#) in 2016. Together with [Djibouti Vision 2035](#), these strategies aim to increase the country's adaptive capacity to climate change and enhance sector collaboration, specifically for water resource management, renewable energy generation, and coastal zone protections. The Government has also committed to increasing the capacity building of institutions and sectors to improve understanding of climate change impacts and critical adaptation measures required. Efforts are also made to improve farmer and pastoralist knowledge about seasonal variability and longer-term climate changes.

Djibouti has committed to a 40 percent reduction of GHG emissions by 2030 with [mitigation actions](#) including building onshore wind farms, installing photovoltaic plants, and exploiting geothermal energy potential further, and conditional mitigation actions such as reforestation with silvopasture practices. Given Djibouti's considerable vulnerability to climate change, adaptation is a priority. Key adaptation priorities include: reducing exposure to drought, protection against rising sea levels, improved access to water, biodiversity protection, and the greater resilience of rural populations.

Djibouti and its donors are investing in [projects to improve the country's agricultural resilience to climate change](#). Efforts include enhanced water management capabilities, particularly in response to severe water shortages and prolonged periods of drought, and increasing the adaptive capacity and resilience of rural, agropastoral communities. The World Bank approved a USD 20 million grant from the International Development Association in December 2022 to help Djibouti mitigate food security risks posed by food supply shocks and severe droughts. Project activities will finance agricultural inputs to support crop and fodder production, small greenhouses equipped with drip irrigation to help increase farm production and provide means of adaptation to climate change, and assets and essential inputs for livestock production. Project activities will also include training programmes for farmers and livestock herders on climate-resilient practices and technologies. The project is estimated to reach approximately 21 percent of the total rural population of Djibouti, with priority given to women-headed households and youth.

A [Regional Research Observatory on the Environment and Climate \(RROEC\)](#) was inaugurated in Djibouti in October 2022 with the assistance of the International Atomic Energy Agency (IAEA) in a bid to produce data and climate models to inform political decisions on climate adaptation and resilience for Djibouti itself, and across the East African region. In addition,

RROEC will help Djibouti to manage better water and food resources threatened by global warming. RROEC uses nuclear and other related techniques to produce data, climate models, and mapping tools which governments and aid agencies can use to help manage and prevent water or other environmental crises.

The African Development Bank and the Global Centre for Adaptation are releasing **USD 3.7 million to improve the living environment of about 600 000 Djiboutians** affected by climate change. The project will strengthen climate resilience in the Djiboutian capital by constructing several infrastructures, mainly in the agriculture and sustainable energy sectors.

Egypt

Egypt's COP27 presidency provided a unique opportunity to strengthen its role in climate policy and action. Its climate change policy has evolved from adhering to specific international commitments to defining a long-term strategy aligned with the ambition to become a regional leader on climate change. The country has already taken significant steps to build **a solid institutional basis for climate action**.

Egypt's **Updated first NDC** outlined the following adaptation targets in agriculture:

- Adapting crop production in the Nile Valley and Delta (beneficiary: 10 million people);
- Setting-up on-farm irrigation in old lands (beneficiary: 6 million people);
- Modernizing on-farm practices for climate resilience (beneficiary: 1.75 million people); and
- Increasing crop yield by 10 to 15 percent.

Egypt's NDC also outlined the following adaptation policy actions and measures for the agriculture sector:

- Using modern surface irrigation techniques to increase water efficiency, changing cropping patterns to more tolerant crop species, and protecting the land from degradation;
- Preserving and expanding the biodiversity of strategic crops and livestock varieties and introducing new traits (i.e. heat and salinity tolerant, water-conserving, pest resistant) to maximize production efficiency under the expected extreme climatic conditions;
- Protection of livestock, poultry, and fish and developing prevention and immunization programmes. Closing the feed gap by introducing new techniques for producing non-traditional animal fodder of higher nutritional value as a source of energy, fiber, and protein;

- Reviewing new and existing land use policies and agricultural expansion programmes to consider possibilities of land degradation in affected areas resulting from the Mediterranean Sea level rise. Altering agricultural systems or lands to adapt to new climate conditions, such as the waterlogged lands north of the Delta wetlands;
- Building an effective institutional system for crisis and disaster management for agricultural areas by strengthening the capacity of monitoring, forecasting, analysis, and establishing early warning systems; and
- Supporting smallholder farmers in adapting to climate change through the multistakeholder engagement approach (i.e. farmers, civil society, agricultural extension, agricultural cooperatives, and others), capacity building in the resource management of their land (i.e. soil, water, fertilizer, and outputs), and promote the use of traditional knowledge and nature-based solutions.

The most recent national articulation of climate policy is reflected in [Egypt's National Climate Change Strategy 2050](#) (NCCS), launched in May 2022. The NCCS reflects continuity with other national articulations, such as Egypt's Sustainable Development Strategy (Vision 2030). Egypt has taken essential steps to achieve adaptation and mitigation goals under Vision 2030. However, while strategies have been put in place, in many cases, their implementation remains a challenge.

Egypt launched its National Adaptation Plan (NAP) process, which aims to decrease the country's vulnerability to climate change and enhance multistakeholder coordination on adaptation planning, monitoring, and evaluation.

Through the Scaling up Climate Ambition on Land Use and Agriculture through Nationally Determined Contributions and National Adaptation Plans ([SCALA](#)) programme funded by the German Government. FAO and UNDP contribute to Egypt's NAP process and implementation of its NDCs by supporting the agriculture sectors in assessments, capacity building and leveraging of private sector engagement in building the climate resilience of agrifood value chains, with a focus on horticulture.

FAO supports Egypt in sustaining rural community development and enhancing the marketing of agricultural products. This is achieved through the ["Food Losses and Waste Reduction and Value Chain Development for Food Security in Egypt and Tunisia"](#) project focusing on reducing food loss and waste in the tomato and dairy value chains. The project aims to enhance the marketing of agricultural products by making them more accessible to local and regional markets. By reducing food loss and waste, the project will increase economic and environmental efficiency and improve food security for the local population.

Management of available water resources and increasing water productivity in Egypt were among the most critical objectives under the framework of the regional FAO project ["Implementing the 2030 Agenda for the water efficiency/productivity and water sustainability in the Near East and North Africa region,"](#) delivered by the end of 2022. The project aimed to achieve the sixth goal of the Sustainable Development Goals 2030 by supporting eight countries in the NENA region to manage and strategically allocate water resources by integrating water, food security, and energy policies through the use of four main action packages:

- Water accounting through the development of solid water accounting systems;
- Enhancing water productivity by enhancing crop water productivity in selected agricultural systems with assessment and adaptation processes;
- Defining the relationship between water, energy, and agriculture while setting the limits of safe conditions to ensure water sustainability; and
- Strengthening communication, raising awareness, involving stakeholders, and developing capabilities.

Egyptian investments in early warning infrastructure include the development of three weather radars to improve weather prediction and installed 24 devices used to measure the amount of evaporation, which allows for the determination of the quantities of irrigation water required. The private sector also plays a crucial role in driving smart farming initiatives. [IrriWatch](#), an app developed in the Kingdom of the Netherlands, helps farmers optimize irrigation using a 'virtual sensing' technology that uses measurements of different thermal satellites to detect soil water potential and soil moisture data. Egyptian startup [Baramoda](#) aims to solve the water challenge by producing compost, which can reduce the amount of water needed by 30 percent. Leading mobile operator Vodafone Egypt is leveraging its scale and reach in rural areas to provide smallholder farmers with agricultural advisory via a daily SMS through the '[Egyptian Farmers](#) initiative'.

In partnership with Cairo's MSA University, the Ministry of Water Resources and Irrigation has created [a handheld device to measure soil moisture](#). The device sends a message to the farmer's mobile phone regarding water levels, helping them make appropriate crop decisions.

Iraq

Affected by increasing temperatures, insufficient and diminishing rainfall, intensified droughts and water scarcity, frequent sand and dust storms, and flooding, Iraq is the [fifth-most vulnerable country to climate breakdown](#). Climate models project that under a medium to high emissions scenario, [air temperatures will very likely rise by up to 4.8 °C](#) by 2080, compared to pre-industrial levels. Water policies in neighboring countries have shrunk vital water sources. In addition, rapid population growth, urbanization, and inefficient water use by the agricultural and industrial sectors are propelling the demand for more water. As a result, Iraq is predicted to see a [20 percent drop in water availability](#) by 2050, which could parch a third of its irrigated land.

Iraq finalized its [NDC](#) in December 2021, which outlines policies related to food and water provision, emphasizing the importance of making these sectors resilient by [developing a comprehensive water and land strategy](#) until 2035.

Water and agriculture were given priority in the new climate policy. For example, the NDC suggested investing in desalination, reclaiming land to stop desertification, and increasing crop yields by introducing climate-smart agriculture. This includes adapting advanced irrigation systems and encouraging drought-tolerant crop varieties. However, the implementation strategy, timeframe, and funding mechanisms of these policies remain unclear. Iraq is still counting on international support to realize these efforts.

Iraq's private sector has been essential in establishing various best practices regarding land restoration and using smart irrigation systems that may positively impact water and food security. This has particularly been the case in the middle and southern parts of the country. For example, [Fadak Farm](#) was established in the western desert's Karbala governorate in 2016 by the Shia Endowment Authority. The 2 000-acre farm depends on artesian wells for drip-irrigating date palms, including rare species, and other climate-resilient trees.

FAO supports the Government of Iraq in several projects to promote climate-smart water management and good agricultural practices to address the expected impacts of severe water stress under climate change. A [USD 10.2 million programme](#) signed by the Swedish International Development Cooperation Agency (Sida) and FAO in November 2022 will enhance the climate resilience of vulnerable agriculture households in the Missan, Al-Muthanna, Najaf, and Thi-Qar Governorates. Activities under the agreement include strengthening water management institutions and the water distribution system, and promoting climate-smart agricultural practices. Additionally, the 'Support to Iraqi farmers' project mitigates the impact of forecasted drought on agricultural livelihoods through inputs and capacity development of stakeholders in Karbala, Muthanna, and Najaf.

The International Committee of the Red Cross (ICRC) and the Iraq Red Crescent Society work to [alleviate water stress](#) by rehabilitating water pumping and treatment stations, pipe networks, and irrigation systems. Furthermore, a USD 10 million programme of the [Adaptation Fund enhances water availability and use efficiency](#) and promotes adaptive agriculture production systems and technologies. In addition, it assists the country with strengthening its capacity at the national level for monitoring climate change patterns and providing relevant information to key stakeholders and farmers to enable them to undertake adaptation and risk mitigation measures through an early warning system in the four target governorates (Qadisiya, Missan, Muthanna, and Thi Qar). The programme runs until 2025.

Jordan

Over the last 25 years, the Kingdom of Jordan's annual mean [temperature has risen by more than one degree](#) Celsius. By 2070–2100, the average temperature increase could range between 2.1 °C to 4.5 °C., and the accumulated precipitation could decrease by 15–35 percent—the decrease would be more marked in the western part of the country. All projections predict a drier climate indicated by a warmer summer, drier autumn, and winter. The warming would be more significant in summer, and the precipitation reduction would be more critical in autumn and winter than in spring. The median value of precipitation is expected to decrease by 35 percent by autumn of 2070–2100. The dynamic projections predict more heat waves. In pessimistic but possible projections, for a summer month, the average maximum temperature for the whole country could exceed 42–44 °C, according to its NDCs document.

The country's principal crops require early rainfall, which used to sometimes occur in September, but over the past few years, rainfall has been delayed till December. [Erratic rainfall](#) distribution and frequent shifting in the rainy season have harmed the farmers and crops. As a result, the [suitability profile of the key crops currently being grown will change](#); for example, potato suitability will deteriorate, and that of barley and wheat will become more marginal. Olive yields will remain stable, while those of tomatoes and dates are expected to

increase. Jordan's Third National Communication on Climate Change expects a significant impact on the agricultural sector. It predicts that increasing evaporative demand, owing to rising temperatures, could increase irrigation requirements by 5 to 20 percent, possibly more, by the 2070s.

Jordan is the second poorest country in terms of water scarcity. The agriculture sector already consumes 50 percent of Jordan's available water resources, and water scarcity is the main challenge hindering the ability to increase the percentage of cultivated lands. Under the medium to high emissions scenario, annual per capita **water availability will decline by around 75 percent** compared to the year 2000.

Jordan raised its macroeconomic GHG emissions reduction target from 14 percent to 31 percent compared to the business as usual scenario, according to the **updated NDC**.

Sustainability is a cornerstone of **Jordan's Economic Modernization Vision**. It foresees, among others:

- Adopting modern agricultural techniques that adapt to climate change, including integrating the best and environmentally friendly practices;
- Promoting improved water efficiency and water quality and identifying new water resources; and
- Improving waste management, recycling, and reuse.

The Kingdom of Jordan has a multipronged strategy and action plan to mitigate the implications of climate change that are based on optimally utilizing available **water resources**, increased reliance on water harvesting, introducing new technologies such as hydroponics and aquaponics, training farmers to plant less water-intensive crops, increasing zero-interest loans to farmers (JOD 40 million in 2022), and training farmers.

Around 180 million m³ of its total annual water consumption comes from treated water. Jordan is currently home to 168 water-harvesting structures for agricultural purposes, with a total capacity of 60 million m³. In addition, work is underway to build 5 000 wells for rainwater harvesting in the western parts of the country, stretching from Irbid to Wadi Musa, where precipitation is more than 200 mm. In the eastern and southern parts of the country, work is also underway. In 2022 Jordan planned to build 60 water harvesting structures and wells; in 2023, additional 100 water harvesting structures and wells will also be operational.

Alarming depletion of groundwater is being dealt with through a recharging programme. In the south and east regions, Jordan is **recharging the groundwater** through excavated ponds and dams (rainfall rates are sufficient to recharge groundwater alone in the north.)

Other water projects include:

- National Conveyance Project (NCP): The USD 2.9 billion project will provide 300 m³ of desalinated water from the Gulf of Aqaba to Amman annually. The NCP will be implemented by early 2024 and will produce desalinated water by 2028;
- Reduction of Non-Revenue Water (NRW) projects: These projects are ongoing through June 2023, with a budget of USD 60 million; and

- Smart Metering, Monitoring & Controlling Systems Under NRW Project: This USD 70 million project is part of an NRW project with Jordanian water utilities and is ongoing through July 2025.

FAO is implementing the [Regional Initiative on Water Scarcity](#) in Jordan to [enhance water harvesting, conjunctive use of groundwater, and solar power for lifting irrigation water](#).

In April 2022, a [USD 33.25 million FAO project](#) was signed with the aim of improving water use efficiency in agriculture in Jordan. The Green Climate Fund provided USD 25 million for the project, while the Government of Jordan, FAO, and UNDP will provide USD 8.25 million. The project focuses on infrastructure to maximize the optimal use of water and rationalize its consumption, spread awareness related to water scarcity, and enable the private sector to market and sell technologies that serve water harvesting, management, and saving.

In September 2022, the World Bank approved a [USD 125 million loan](#) to Jordan to support the agricultural sector and improve climate resilience. More than 30 000 farming households will receive financing between 2022 and 2027 to [adopt climate-smart and water-efficient agriculture practices](#), such as rainwater harvesting equipment and modernizing irrigation systems. In addition, a [World Bank report models a reduction in agriculture's reliance on the use of groundwater](#) by transitioning to hydroponics – which involves growing plants, usually crops or medicinal plants, without soil – and increasing water productivity.

In November 2022, the International Union for Conservation of Nature (IUCN) inaugurated the [Smart DESERT](#) project where 15 000 farmers and young entrepreneurs will be trained to reduce production costs through efficient use of energy, solar power, and water management systems. A smartphone application will also be developed to provide farmers with an early-warning system for natural disasters. Using artificial intelligence to extrapolate information on weather conditions and weather forecasting, the application will protect farmers and their crops against floods, locusts, frost, and other risks.

The Kingdom of Jordan also uses effective foreign policy to address water scarcity challenges. For example, according to the [Water-for-Energy deal](#) signed with Israel in November 2021, Israel would supply Jordan with desalinated water in return for solar power. The project would see Jordan build 600 megawatts of solar generating capacity, which would be exported to Israel, contingent upon Israel providing water-scarce Jordan with 200 million m³ of desalinated water.

Furthermore, Israel and Jordan signed a [Joint Declaration of Intent](#) at COP27 in Sharm El-Sheikh on cooperation in the ecological rehabilitation and sustainable development of the Jordan River. As part of the measures, the two governments will remove pollution sources in their respective territories by constructing wastewater treatment facilities and connecting communities along the river to advanced sewage infrastructure, as well as treating other sources of pollution. Moreover, they will endeavor to improve the quality of freshwater flows in the river.

Private sector efforts also contribute to combating water shortages. For example, [Faisal Farm](#) uses [aeroponics](#), a system developed from hydroponics, which allows crops to be grown without soil using 90 percent less water than conventional growing methods. Although some plants did well in hydroponic systems, many lacked enough oxygen to thrive. So the technique evolved to allow [plant roots to hang in the air](#) while spraying with a fine mist of nutrient-rich

water. The nutrient solution is recycled, so no water is wasted, and plants are healthier, grow faster, and produce more. The technique also makes crops less vulnerable to pests and plant diseases.

As a climate change mitigation measure, the Ministry of Agriculture is also working on a sustainable [reforestation project](#) to be implemented in 2022–2023. One million trees will be planted from the south to the north in an area covering 2 500 hectares using treated water. The project is part of Jordan's commitment to plant 10 million trees in the upcoming ten years. Planting more trees would increase Jordan's resistance to climate change as trees would increase the country's sink capacity to absorb more emissions.

Kuwait

[Kuwait Vision 2035](#), known as New Kuwait, aims to transform the country into a trading and financial hub regionally and internationally, in addition to improving the business environment to attract global investors. One of the significant pillars of Kuwait's National Development Plan is to achieve food security, improve nutrition, and promote sustainable agriculture, though [harsh climatic conditions, water scarcity, and soil resources are significant constraints](#) faced by Kuwait's agriculture sector. Approximately 90 percent of Kuwait's land is considered not agriculturally viable; the total area potentially used for agriculture is less than 1 percent of the country, and the area used for cultivation is even less.

Kuwait has [developed new varieties of crops that can adapt to high temperatures](#) and have high resistance to salinity and drought. In addition, Kuwait Environmental Public Authority (EPA) has established the electronic environmental Monitoring Information System of Kuwait (eMISK) and 'Beatona.' The eMISK aims to build and maintain a comprehensive geoenvironmental database of Kuwait and a geographic information system (GIS) system to facilitate updating and analyzing environmental data. At the same time, the 'Beatona' initiative aims to increase public awareness through sharing real time environmental news and information. In addition, Kuwait has implemented a project called the Kuwait Green Wall Project, which aims to protect the country against dust storms by planting three rows of 315 000 trees along 420 km of the border to hold back the moving sand.

Kuwait has built several desalination plants in addition to water distribution systems via pipelines, and irrigation systems for farmers. The country is investing USD 5.5 million jointly with the Massachusetts Institute of Technology (MIT) to conduct research on updating the existing desalination plants and next generation desalination plants.

Applying water conservation technologies was also one of the adaptation options to reduce water consumption by 20 percent. The [Water Resources Development and Management Program](#) (WRDM) was initiated by the Kuwait Institute for Science and Research (KISR). This programme was designed to develop integrated water policies, management options, and action plans to solve water scarcity problems and increase Kuwait's water security and resilience. KISR has also initiated the Wastewater Treatment and Reclamation Technologies Program, which aims to conduct research on reclaiming and reusing Kuwait's wastewater to utilize it for irrigation purposes. About 65 percent of Kuwait's treated wastewater is reused in irrigation already.

Protected greenhouse production is also heavily relied on due to environmental and water resource constraints. The first large-scale indoor vertical farm in the Near East opened in Kuwait in 2019. Local production now includes 250 varieties of leafy greens and herbs using [dryponics](#), a unique method of growing salad indoors that keeps the plants alive, with the roots intact, until the final moment before consumption. The innovative facility of approximately 3 000 m² of farming space has a daily output capacity of up to 550 kg of salad, herbs, and cress and uses cutting-edge vertical farming methods consuming 90 percent less water than traditional farming, 60 percent less fertilizer, and zero pesticides.

Another climate-smart innovation introduced in Kuwait is the [Tower Farm](#) where plants are cultivated in aeroponic towers in a greenhouse. One advantage of setting up a Tower Farm in a climate-controlled environment, aside from saving up to 95 percent water compared to conventional farming, is the space-saving factor. Tower Farms can save up to 80 percent of space compared to other hydroponic technologies. Space saving translates into a lesser cost when building and operating a greenhouse and a lesser energy footprint to grow the same number of crops. [Aeroponics systems](#) where cultivars are grown on mobile automated benches with roots hanging “in the air,” have also been [introduced in Kuwait](#).

Lebanon

Despite the country’s rich water resources, [climate change is causing similar challenges in Lebanon](#) as in many other places across the region. Year after year, Lebanon experiences an increasing number of heatwaves.

The [temperature is expected to increase](#) by around 1 °C on the coast to 2 °C inland by 2040, which is expected to increase further by 3.5 °C to 5 °C respectively by 2090. The rainfall pattern is also expected to be affected and is projected to decrease by 10 to 20 percent by 2040, and by 45 percent by 2090. As a result, a less wet and sustainably warmer condition will expand the hot and dry climates. Temperatures will rise above 35 °C on summer days, and above 25 °C on tropical nights. Drought periods throughout the country are expected to increase by 9 to 18 days by 2090. In addition, climate change will reduce 40 to 70 percent of the snow cover, which will decrease the water supply in rivers and groundwater recharge and will impact the [water](#) availability during the summer and drought periods.

[Agriculture](#) is the most vulnerable sector to climate change. The overall agricultural yield of crops will be affected, and a decrease in production is expected. In addition, tremendous pressure will be placed on the [power production](#) and supply system due to the higher cooling demand in summer. [Water](#) will face a reduction of 6 to 8 percent of the total volume of water resources with the rise of 1 °C in temperature, and 12 to 16 percent with the rise of 2 °C.

[Adaptation is a priority](#) in Lebanon’s NDCs, and the priority sectors include water, forestry and agriculture, and biodiversity. However, as stressed by the [Roadmap to the recovery of the water and wastewater sector in Lebanon](#) issued by the Ministry of Energy and Water in May 2022, deep reforms are needed for the Government to ensure just access to water and sanitation services.

[Ground Vertical Farming](#), a startup, [saves water usage by up to 90 percent](#) by recirculating water. At the same time, [Robinson Agri](#), a leading producer of greenhouses, has implemented smart irrigation solutions

The International Centre for Agricultural Research in Dry Areas (ICARDA) is [preserving the genetic diversity of crops and helping breed climate-resilient varieties of seeds](#). With seed banks in Lebanon and Morocco and offices across the region, ICARDA's work in non-tropical dry areas focuses on preserving agrobiodiversity and growing crops in arid conditions of vital importance for global food security in a sustainable way. Varieties selected for their adaptation to local conditions and resilience to drought and heat can thrive without the use of expensive hybrid seeds and agrochemicals promoted by agribusinesses. This boosts farmers' finances and food security and can improve production on sustainable farms based on the principles of agroecology.

FAO supports Lebanon through the Smart Adaptation of Forest Landscapes in Mountain Areas (SALMA) project, funded by GEF, which aims to achieve climate resilience of forest ecosystems and rural mountain communities while contributing to reduced soil and water erosion, forest fire prevention, pest management, diversification of livelihood income, and improved adaptive capacity. Gender mainstreaming is an essential strategy, with women participating in selecting reforestation areas and ensuring gender balance in forest management and reforestation committees.

As part of a FAO-ESCWA initiative that also included Algeria, climate-resilient watershed packages were designed for Nahr Al-Kabir and Nahr Al-Kalb river basins. An integrated vulnerability assessment mapped exposure to climate change signals across each basin. Recommendations to counter low adaptive capacities, combined with expected risks of degraded water quality, scarcity, and drought, included deploying nature-based solutions such as wetlands and multipurpose green infrastructure and scaling up traditional water management systems.

Libya

As of February 2023, Libya still needs to have a Nationally Determined Contribution or National Adaptation Plan in place. While the Libyan Government [has yet to express a clear climate change strategy](#), defining and pursuing mitigation and adaptation goals will be critical to future prosperity. Libya is geographically vulnerable to climate change, experiencing land degradation and desertification, and already has minimal fresh water and arable land. Its economic development is also hindered by issues like drought, conflict, and challenges with migration, all of which climate change may exacerbate.

In 2019, Libya adopted a five-year investment plan for advancing the water resources sector in 2020–2024 within a national strategic plan related to water resources. In addition, regarding the transboundary water challenges, various conventions, agreements, and instruments have been established between Libya and neighboring countries to provide a framework for the joint management of cross-border aquifer resources to address vital challenges, including water scarcity.

FAO has [two complementary projects](#) in Libya: "Monitoring, evaluation, and rationalization of water use for the agriculture sector in Libya," funded by the Italian Agency for Development Cooperation (AICS), and "Evaluation of irrigation infrastructure, crop mapping and estimation of agricultural water use in Libya" funded by the African Development Bank. The two projects use satellite image analysis with specific algorithms to determine the spatial and temporal

variability of agricultural water, and land productivity. They aim to establish a national water platform, MERWAT-Libya, the digital data sharing and dialogue platform using FAO's Water Productivity Open-access Portal (WaPOR) and field surveys on crop mapping and water uses. WaPOR portal provides near real-time information on evapotranspiration, land use, and water productivity data. The MERWAT platform will enable the Ministry of Water Resources and the Ministry of Agriculture in Libya to monitor, evaluate and rationalize water use in the agriculture sector in Libya.

FAO is working in Libya with the financial support of the Government of Italy through the "Strengthening natural resources management capacities to revitalize agriculture in fragile contexts" project, which aims to enhance the country's capacity to manage natural resources in the context of climate change and focuses on training government representatives and relevant stakeholders on climate change adaptation, hydrological modeling, and economic analyses of water use under climate change and variability, and provides methodologies to assess vulnerability to, and impact of, climate change at the national and subregional levels.

Morocco

Morocco submitted its [updated NDC](#) in 2021 and its Third National Communication in 2016. Climate change already has a significant impact on Morocco's economic and social development. The mean annual temperature is projected to increase by 1.5 °C to 3.5 °C by 2050 and possibly by more than 5 °C by the end of the century. Climate change trends have already put pressure on the country's natural resources, affecting the resilience of forest ecosystems and the agriculture sector, particularly due to water scarcity. Morocco is working to improve its resilience to climate change and make progress towards a green economy. The country's water resources, agriculture and forestry, energy, and health sectors are key priority areas. As Morocco works to finalize its National Adaptation Plans, it is guided by the National Climate Change Policy (2014) to respond to climate change and disaster risks.

Sustainable development and the fight against climate change are part of the fundamentals of the [Green Morocco Plan](#). Outlining the following measures has had positive effects on the environment:

- Mitigation measures: Fruit trees plantation programme, rationalization of the use of fertilizers and pesticides, management of agricultural waste, etc.
- Adaptation measures: National programme for saving irrigation water, grants from the Agricultural Development Fund, and agronomic research.

Morocco has made progress in recent years in expanding irrigation for agriculture. Furthermore, over the last 15 years, significant efforts have been made to increase water productivity in agriculture with on-farm irrigation techniques (drip and sprinkler). The National Irrigation Water Saving Programme (PNEEI) targets alleviating water stress and sustainable management of water resources for irrigated agriculture by establishing drip irrigation for over 555 000 hectares. Currently, 18 percent of farmed land is irrigated, though climate change will increase the demand for irrigation. Due to the efforts to increase water productivity, Morocco has doubled its water productivity (USD of added value/m³) after modernization in some areas. Morocco [installed the largest desalination plant in the world](#) in April 2022

and increased its water storage capacity by building dams. In addition, it is constructing 60 large dams, which would mobilize 1.7 billion m³ of water annually and support more efficient transfer of water from the northern basins to the south. The [Government has committed to improving the country's water adaptation efforts](#) through the extension of irrigation to new agricultural areas, covering an area of 60 000 hectares, by irrigation equipment located on an additional 350 000 hectares, and by reusing the wastewater to reach a capacity of 275 million m³ in urban areas and 16 million m³ in rural areas until 2030.

The World Bank approved a USD 180 million ["Resilient and sustainable water in agriculture"](#) project in March 2022 that aims to enhance water governance in agriculture, improve the quality of irrigation services, and increase access to advisory services for irrigation technologies. The programme is built around three areas. The first area involves enhancing the governance framework of water in agriculture and ensuring that water withdrawals from the agricultural sector are sustainable (implementing a more flexible water allocation process, enhancing groundwater management, and improving knowledge about the impacts of the water productivity programmes). The second area aims to provide climate-smart irrigation and drainage services by scaling up the benefits of water conservation technologies to new places, thereby enhancing resilience to droughts while reducing GHG emissions and building up soil carbon stocks. This will be done by modernizing hydraulic assets such as irrigation networks and canals and by supporting public irrigation managers in enhancing the performance of irrigation and drainage services. This will benefit smallholder farmers within the collectively managed large-scale irrigation schemes, with the target of reaching over 16 000 farmers on over 50 000 hectares. Finally, the third area connects more than 23 500 farmers with advisory services geared towards optimizing investments, enhancing climate resilience, and improving water productivity.

The Moroccan Government considers smart farming a priority. In 2020, the Government launched its "Green Generation 2020–30" strategy, which includes among its objectives the introduction of new technologies and the digitalisation of agricultural services. The strategy aims to [install more than 100 000 solar pumps for irrigation](#).

Faced with increasing climate variability, Moroccan agriculture has adapted through diversification and rising yields. Although cereal production remains dominant, there is an increasing trend towards horticulture (olive trees and almonds) and livestock production. In addition, research into smart farming conducted at Mohammed VI Polytechnic University has prompted farmers in the dry Rhamna province to [switch crops from wheat to more drought-tolerant quinoa](#) and to [experiment with drones to detect pests, water stress, and crop nutrient deficiencies](#) on farms.

The European Union and Morocco have signed the [Terra Verte \(green earth\) programme](#) worth EUR 115 million to support Morocco's agricultural and forestry sectors. One of the project's goals is to expand agricultural cultivation areas, including olives. Meanwhile, the [Moroccan Forests strategy](#) (Forêts du Maroc 2020–2030) will plant 600 000 trees, comprising more than eight different species, by 2030.

FAO supports the Government of Morocco in implementing its National Land Monitoring and Information System project for enhanced GHG reporting and land monitoring. The project, funded under the Government of Germany's IKI programme, uses Earth Map – an open-source, cloud-based monitoring and mapping application for land management and assessment to support results-based mechanisms such as REDD-plus and NAMAs.

Mauritania

Mauritania is a Sahelian country that has [historically been affected by desertification and drought](#). Extreme temperatures and weather conditions associated with climate change have recently contributed to crop degradation and soil erosion, mainly located in the south of the country and the oasis area.

Mauritania has produced a series of documents that outline the risks of climate change. Specifically, its three National Communications ([2002](#), [2008](#), [2014](#)) and the [NDC](#). The NDC outlines priorities for climate change adaptation interventions, with the main objective being to increase the resilience of rural communities to increased water stress and reduced productivity of the agricultural and livestock sectors.

The Mauritanian Government, as well as humanitarian and development actors, have made environmental preservation and regeneration a central element of their strategies and initiatives. Accordingly, Mauritania has also developed a National Strategy for the Environment and Sustainable Development.

In Mauritania, the UNHCR is specifically focused on (i) preserving and restoring natural resources; (ii) providing clean and renewable energy; (iii) promoting sustainable sanitation and waste treatment solutions; and (iv) promoting a green economy. For example, a [series of dams were built in 2021](#) with help from UNHCR. That was crucial for herds owned by local Mauritians and the sheep and cows owned by a [growing refugee population fleeing conflict in Mali](#).

A new [project](#), implemented by UNEP and supported by the [Global Environment Facility](#), will create a new protected area that will complement the [Great Green Wall](#), a Pan-African initiative stretching 8 000 km across 11 countries, including Mauritania. The Great Green Wall, which is the first flagship of the [UN Decade on Ecosystem Restoration](#), will combat desertification and drought with the planting of new trees to restore degraded land; over 100 million hectares will be restored in total. The restored land is expected to sequester 250 million tonnes of carbon and create 10 million new green jobs.

FAO supports Mauritania through the [Integrated Ecosystem Management Programme for Sustainable Human Development in Mauritania](#) project, funded by the GEF. The project aims to increase sustainable human development by restoring ecosystem services and an integrated ecosystem management approach in three southern landscapes of Mauritania. The project focuses on climate change and water activities and will work to reduce pressure on ecosystems through income generation and funding mechanisms. The project also focuses on the conservation, restoration, and sustainable management of degraded rangelands, reforestation, and promotion of technologies towards cleaner energy alternatives such as biogas and improved cook stoves.

Oman

The Sultanate of Oman has [developed a National Strategy for Adaptation and Mitigation to Climate Change 2020–2040](#) to accelerate the pace and scale of its climate action. The strategic context for adaptation is rooted in Oman's exposure to intensified tropical cyclones, increasing

temperatures, and rising sea levels. Ahead of COP27, the [Omani Government announced a commitment to reach carbon neutrality by 2050](#). In addition, the country established a strategic framework for engagement with the GCF through the Country's Programme on Climate Change initiatives and priorities. Agriculture is one of the six thematic areas identified in the country engagement programme for the GCF to finance over the medium term.

Oman has adopted significant climate change adaptation measures for food security. This sector has risen to prominence as a high-priority sector for government investment due to the considerable threat that climate change poses to food security. Adaptation measures to alleviate food insecurity in Oman prioritize domestic production through investment in megaprojects in agriculture and fisheries, and groundwater improvement for agricultural purposes through recharge dams to reduce salinity and raise groundwater levels near coastal areas. In addition, Oman has [introduced aquaponics on a large scale](#) to enhance national food sustainability.

FAO is working with the agricultural, environmental and civil aviation, and meteorological services, as well as research institutions in the country, to implement the Green Climate Fund readiness project "Building a resilient environment and sustainable agriculture and water sectors." The project has completed a repository of climate change information and will focus on assessing climate change impacts and potential innovative solutions in at-risk agroecological zones and enhancing the capacities of stakeholders to build a climate finance pipeline.

Qatar

Qatar launched a [national strategy to optimize the use of the country's agricultural land and water resources](#) and insulate domestic food needs from external shocks. According to Qatar's NDC submitted in 2021, the strategy focuses on four pillars:

- Enhancing international trade and logistics;
- Increasing domestic self-sufficiency in some niches (vegetables, red meat, and fisheries production);
- Building strategic reserves; and
- Enhancing domestic markets.

Other measures include: (i) developing the hydroponics greenhouse cluster to reach 70 percent self-sufficiency on greenhouse vegetables; (ii) creating adequate reserves including perishables, selected non-perishables, potable water, and groundwater reserves to buffer against potential production disruptions. In addition, Qatar aims to move towards more sustainable agriculture practices, including better optimization of agrochemicals usage and water efficiency.

To increase the resilience of livelihoods to disasters, the proposed interventions include: (i) efficient water management, including increasing awareness among customers with high consumption, switching to treated sewage effluent for irrigation in parks, and using recycled water in district cooling; (ii) restoring marine habitats, mainly growing mangrove trees; and (iii) enhancing the overall infrastructure in the country with a strong focus on sustainability.

Qatar has increased its self-sufficiency over the past years, especially following the 2017 GCC crisis when some countries in the region imposed a blockade on the country. The harsh climate, limited freshwater and land availability, and the need to expand the self-sufficiency of agricultural production, have led to an increase in greenhouses. The Government has set solid targets to increase self-sufficiency up to 70 percent in greenhouse vegetables, and to reach 110 hectares with high-tech greenhouses by 2023. As a result, [domestic vegetable production more than doubled](#) from 2017 to 2020. Between 2018 and 2022, the [Government of Qatar distributed 5 777 greenhouses to farm owners](#) to ramp up production.

Furthermore, the Ministry of Municipality and Environment declared 34 new strategic investment projects in greenhouses technology in 2018. Additionally, the adoption of hydroponic greenhouses and the collaborations with Spanish companies in Qatar have offered a variety of valuable businesses in the country. The Qatari Agricultural Development Company (Agrico) started production in Qatar's biggest aquaponics project (combination of aquaculture with hydroponics) in 2021 with a production capacity of 32 000 tonnes per year of various vegetables.

At the international level, Qatar also launched an initiative to establish the [Global Dryland Alliance](#), one of the international mechanisms to confront climate change and achieve food security. As a result, the alliance was granted the "Observer" status at the United Nations General Assembly (UNGA).

Saudi Arabia

In 2016, the Kingdom of Saudi Arabia embarked on [Vision 2030](#), which aims to reduce the country's dependence on oil, diversify its economy, and develop different public service sectors. Vision 2030 defines agriculture as one of the five main strategic sectors and sets four main targets:

- ▶ Efficient and sustainable use of agricultural and natural resources (especially water);
- ▶ Comprehensive and sustainable food security;
- ▶ Improvement in farm efficiency and productivity; and
- ▶ Sustainable rural development.

According to its [Updated first NDC](#), the Kingdom of Saudi Arabia is developing and implementing holistic and harmonized programmes to address climate change challenges. Examples include the Saudi Green Initiative, which aims to plant trees and rehabilitate land over this decade. Since the launch of the Saudi Green Initiative, [over 18 million trees have been planted](#) (13 million of which were mangroves), and 17 new initiatives have been launched across the country to restore natural greenery and protect against the impacts of climate change. In [January 2023](#), the Ministry of Environment, Water and Agriculture started implementing the first phase of two initiatives to plant 49 million fruit and lemon trees in various regions of the Kingdom as part of the Saudi Green Initiative. These include 45 million fruit trees in agricultural terraces and four million lemon trees with renewable water by the year 2030. Furthermore, Saudi Arabia will hold an annual Summit titled "[The Middle East Green Initiative](#)," which aims to plant fifty billion trees in the Middle East region.

Other adaptation measures of its updated NDCs target water scarcity. Saudi Arabia leads the world in the [desalination of seawater](#), with 27 desalination plants, which provide the country with about 70 percent of its domestic water supply. The Government is taking several steps in deploying new reverse osmosis desalination technologies, which require approximately 30 percent less energy-intensive than conventional technologies. The old water distribution network will be replaced with a new one to minimize the leakages. Saudi Arabia is also increasing the use of treated wastewater, encouraging rainwater harvesting, and employing new irrigation techniques such as surface irrigation, drip irrigation, sprinkler irrigation, and subsurface irrigation. Finally, it prioritizes an early warning system against extreme meteorological events (such as floods, sandstorms, and droughts).

The Kingdom of Saudi Arabia and private companies invest considerable amounts in modern agriculture technologies to grow produce in controlled environments. Smart farms introduce fresh produce to the markets with far less water than traditional farming techniques. In [January 2023](#), the Minister of Environment, Water and Agriculture announced a USD 1.06 billion plan to increase agricultural production in greenhouses until 2025. The investment would boost output in greenhouses by 430 000 tonnes, bringing the total production capacity of the greenhouses to more than 1 million tonnes annually.

[Red Sea Farms](#) developed a smart greenhouse with saltwater, solar power, and advanced greenhouse control systems to grow food without a significant carbon footprint and energy requirements. It also developed an AI-enabled system that monitors and maintains greenhouse systems to optimize energy savings and plant growth. Thanks to solar panels and heat-blocking glass, many greenhouses also see drastically reduced energy requirements from cooling. The new system saves approximately [300 litres of freshwater per kilogram of produce grown](#).

In April 2022, Saudi supermarket chain Tamimi Markets, announced a joint venture with Japan-based Mitsui & Co., and Italian agricultural technology provider Zero SRL, to [develop vertical smart farms](#) in Al Kharj to supply fresh produce to local markets.

In February 2023, Saudi Arabia's Public Investment Fund signed a joint venture agreement with AeroFarms, a US-based sustainable agriculture company. The two entities will establish a company in Riyadh to build and operate indoor vertical farms in Saudi Arabia and the broader Middle East and North Africa area. The first farm is expected to be the [largest indoor vertical farm in the Arab region](#). It will have an annual production capacity of up to 1.1 million kg of crops. The initiative will result in higher yields and up to 95 percent less water than traditional field farming. Furthermore, the Chinese company, Kingpeng, [installed 2.2 hectares of greenhouses](#) in February 2023.

Somalia

Somalia is the [second most climate-vulnerable](#) country in the world, and is currently hit by severe famine. Four rainy seasons in a row have failed– a climatic event not seen in at least 40 years. Somalia has seen a threefold increase in severe climatic events since 1990.

[The temperature in Somalia is projected to rise between 1.4 to 1.9 °C by 2030](#), 1.5 to 2.3 °C by 2050, and 1.4 to 3.4 °C by 2080, compared to preindustrial levels, with coastal regions

being less affected than the rest of the country. The annual number of very hot days (with daily maximum temperature above 35 °C) is projected to increase with high certainty all over Somalia, with central Somalia being particularly affected. There will very likely be high inter-annual variability in the amount of precipitation. The sea level is projected to rise with high certainty. The median climate models project a sea level rise of 12 cm until 2030, 20 cm until 2050, and 36 cm until 2080 under RCP2.6,¹⁴ compared to the year 2000. Under RCP6.0, the sea level is projected to rise by 11 cm until 2030, 21 cm by 2050, and 42 cm until 2080, according to the multimodel median.

According to [Somalia's National Climate Change Policy](#), in terms of adaptation, sectors that need particular attention are agriculture, livestock, water, marine resources, forestry and biodiversity, infrastructure, and urbanization. Policy measures include capacity building, promotion of technologies and investment in climate-resilient infrastructures, and establishing an early warning system. Investments in small scale and community-level infrastructures will also be encouraged. Somalia will promote renewable energies and adopt energy-efficient technologies to mitigate climate change. The authorities will also improve water, waste, and sewage management to reduce overall resource use and increase efficiency.

However, a lack of regulatory tools for existing legislation and approved laws and inadequate institutional, human, and financial capacity inhibit the implementation of the climate change programmes and activities stipulated in these policies. With the current humanitarian crisis and the quest for peace and stability, Somalia needs more financial resources to address climate change, but its fragile governance acts as a barrier to accessing climate financing.

[International and local non-governmental organizations](#) are putting much emphasis on adaptation to climate change. Due to their significant presence in Somalia, UN agencies have paved the way for mainstreaming climate change in development projects, such as the UNDP and FAO Joint Resilience Programme. In addition, WFP has been working with government ministries to implement climate activities designed for smallholder farmers and vulnerable groups. Partnerships between the government and development partners remain crucial to building a climate-resilient Somalia.

Sudan

Two-thirds of the Sudan's land is arable, accounting for half the arable land in the Arab world. However, the land is [severely exposed to climate change](#), which is expected to increase temperatures and change precipitation levels. Higher temperatures and evaporation rates, reduced soil moisture, and increasingly variable and reduced rainfall will exacerbate the risk of future water crises in the country.

Mid-century mean annual temperatures are projected to increase between 1.5 °C in the best scenario¹⁵ and 2.6 °C in the worst scenario. By 2060, climate models forecast between 1.5 °C and 3.1 °C warming for the August rainy-season baseline and between 1.1 °C and 2.1 °C above

¹⁴ RCPs, or Representative Concentration Pathways, make predictions of how concentrations of GHGs in the atmosphere will change in the future as a result of human activities. The four RCPs range from very high (RCP8.5) to very low (RCP2.6) future concentrations. The numerical values of the RCPs (6.0, 4.5, 2.6, and 8.5) refer to the concentrations in 2100.

¹⁵ Best scenario is SSP1, worst case scenario is SSP5. SSPs ([Shared Socioeconomic Pathways](#)) look at [five different ways](#) in which the world might evolve depending on the success of climate change policies (reductions of emissions).

the January dry-season baseline. Rising temperatures may intensify droughts by increasing evapotranspiration and reducing soil moisture. 2050 projections indicate changes in rainfall ranging from a reduction of 9 percent to an increase of 9 percent.

As one of the world's least developed countries, extreme weather, recurrent floods and droughts, and changing precipitation interact with other vulnerabilities – such as ecosystem degradation, unsustainable agricultural practices, natural resource scarcities, and resource-based conflicts – that limit societal capacities to cope and adapt to climate change.

The Sudan has signed and ratified the Paris Agreement, and has also submitted its [Updated first NDC](#) in 2021. The NDC outlines the Sudan's commitments to climate change mitigation and adaptation, with efforts to protect the environment through:

- Transforming the electricity sector towards low-emission power generation;
- Reducing of biomass energy consumption;
- Restoring and managing gum Arabic,¹⁶ and the mangrove forest in Red Sea State;
- Restoring degraded land of both rainfed and irrigated agriculture;
- Reducing deforestation and forest degradation;
- Improving waste management through organic waste (composting), establishing landfills, solid waste and wastewater management;
- Improving risk reduction due to flooding by enhancing weather forecast and establishing an early warning system;
- Establishing monitoring systems for climate-sensitive ground and surface water resources; and
- Promoting coastal zone management, including mangroves restoration, coral reef protection, mapping the areas prone to climate risk and subject to the rise of sea level.

To improve agricultural production, the NDC recommends:

- Managing the irrigation system by restoring the existing dam system and introducing modern and climate-friendly systems;
- Adopting improved adaptation technology in both varieties cultivated and post-harvest practices;
- Improving the livestock sector resilience through the release of climate-resistant varieties, vaccinations, animal drugs, animal feeding, veterinary services, and sustainable alternation between crops and grazing according to the seasons.

A more inclusive economic and social growth can be achieved according to its NDC through (i) the implementation of the Zero Thirst programme concerning the increasing of water resilience in vulnerable areas, including supply of drinking water for both humans and livestock, sustainable utilization of groundwater, water supply to schools; (ii) the improvement

¹⁶ A [water-soluble gum](#) obtained from several acacias (especially *Acacia senegal*) and used especially in the manufacture of inks, adhesives, pharmaceuticals, and confections.

of living conditions of small farmers through modernization of agricultural systems; (iii) the establishment of farmers' social groups and networks; (iv) provisions of agricultural and rural finance; (v) the empowerment of women in facing climate disasters and promotion of gender mainstreaming approach in all interventions; and (vi) the general improvement of the health sector.

In November 2022, Norway and FAO signed a [USD 15 million agreement](#) to support Sudanese smallholder farmer and agro-pastoralist value chains in the face of climate change. The project is organized around four interventions to address: (1) watershed ecosystem adaptive and mitigation capacities enhanced; (2) climate-resilient agriculture value chain development of crucial agriculture commodities, access to market and linkages with the private sector are strengthened; (3) better access to improved and high quality seeds and enhanced scope to community seed production; and (4) knowledge and institutional capacities of the federal government and decentralized state levels to support smallholder farmers and pastoralists to respond to climate change challenges.

FAO supports the Government of the Sudan in restoring gum Arabic production and related value chains through the GCF project [Gums for Adaptation and Mitigation in the Sudan](#). This project aims to enhance the resilience of smallholder livelihoods by adopting climate-resilient practices and building capacities for adapting to climate change. Gum Arabic trees will be used to restore agroforestry systems, protect annual crops, and reduce GHG emissions by 9.23 million tonnes of CO₂ emissions. The project will benefit 1.58 million people by building the capacity of 500 smallholder gum Arabic producer associations (GAPAs) and investing in rangeland restoration. In addition, to reduce vulnerability to climate shocks, the project will facilitate contract farming arrangements with small-scale farmers and mobilize private sector financing for the GAPAs.

Tunisia

According to [Tunisia's updated NDC](#), climate projections predict an increase in the frequency and intensity of droughts in the country. The impacts will be reflected in a drop in yields and a reduction in the area of tree and cereal crops, a loss of soil fertility, and area of arable land. These changes will affect cereal production, which is expected to fall by almost 40 percent by 2050 according to the RCP8.5 scenario. The drop in olive production yields could reach 32 percent. As a result, the share of agricultural output in the national GDP would decrease by 5 to 10 percent in 2030 depending on the scenarios of economic openness of the farming sector. The highest level of vulnerability is observed in central and southern Tunisia, and the level of vulnerability is particularly critical in the south (east and west).

Priority adaptation actions for 2030 for food resilience against the effects of climate change include the following measures:

Priority 1:

- Achieving the digital transition of agro-sylvo-pastoral, livestock, fishery, and aquaculture production systems, improving sharing of information, data, and knowledge for better resilience to the effects of climate change on territories and societies through:

- Improving the monitoring of climate risks on agro-sylvo-pastoral, fisheries, and aquaculture production systems, the modelling of medium and long-term impacts on strategic products vulnerable to the effects of climate change.
- Strengthening the capacity and sharing of knowledge and know-how.
- Creating regional poles of research/action and extension/training on indigenous and introduced pastoral species *in situ* in regional pilot areas.

Priority 2:

- ➔ Anticipating and supporting the transition to an agriculture resilient to the effects of climate change (agricultural products, livestock, fisheries, and aquaculture, territories, and farmers) through:
 - Improving the conservation and development of indigenous genetic resources threatened by climate change;
 - Improving the efficiency of green water by promoting rainfed and irrigated agriculture resilient to the effects of climate change (cultivation practices, seeds, etc.);
 - Creating five pilot areas for the development of organic agriculture;
 - Valorizing agricultural waste and the use of adapted cultural and technological innovations (composting, etc.);
 - Strengthening forage autonomy and the creation of food reserves to better manage crises (waste reduction, stock management, diversification, quality improvement, adapted varieties);
 - Integrated rural development of basins and subwatersheds vulnerable to climate change and flood regulation;
 - Rehabilitating and developing degraded rangelands and esparto grasslands in the central and southern regions.

The NDC also outlines measures to enhance water resilience by improving the quantitative and qualitative management of conventional water resources, use of non-conventional waters (treated wastewater, desalination), and strengthening the technical, scientific, and institutional capacities of water stakeholders (effective institutions, integrating climate change into higher education curricula, promoting the water-energy-food nexus, improving the water accounting system, etc.).

Concerning the conservation of indigenous genetic resources, Tunisia's [National Gene Bank](#) collects and catalogues traditional and indigenous seeds that are typically more resilient to disease and the impacts of climate change from local farmers and global seed banks. Using these seeds, farmers have reported higher yields with less pesticide use.

With regards to climate-smart innovations, a [drought-monitoring technology](#) that is currently being implemented in water and agricultural ministries in Jordan, Lebanon, and Morocco will also be implemented in Tunisia. The satellite-based enhanced composite drought index (eCDI) supports effective drought management by enabling authorities to identify, early on,

the presence and evolution of drought. The technology was developed by IWMI and partners as part of the USAID-funded [MENA drought project](#).

Tunisia is also home to several smart farming innovators. One notable example is Ezzarya, a company that [installs sensors in irrigation pipes and the soil](#). A wireless box connected to software enables farmers to regulate soil salinity and inject the mineral salts necessary to improve crop yields. Irrigation and fertilization processes can be managed centrally thanks to the system, which can also identify drip leaks.

FAO supports Tunisia in improving the performance of its agricultural sector through initiatives like the "Food Losses and Waste Reduction and Value Chain Development for Food Security in Egypt and Tunisia" project. This project aims to make agriculture value chains more inclusive of small-scale producers and take advantage of regional trade opportunities, improving food security. Gender-sensitive food value chain analysis methodologies, including gender networks, are used to appraise, analyse, and assess food losses and waste in selected food value chains in Tunisia and Egypt.

Along with Algeria and Morocco, FAO supports Tunisia in improving its National Land Monitoring and Information System towards transparent NDC reporting. Altogether, 400 experts from these three countries are being trained to monitor national and subnational activities towards GHG monitoring.

United Arab Emirates

The harsh, arid environment of the United Arab Emirates makes it particularly vulnerable to climate impact. In 2017, the [National Climate Change Plan 2017–2050](#) was adopted, setting a framework for managing GHG emissions, climate change adaptation, and private sector-driven innovative economic diversification. A [National Climate Adaptation Program](#) has also been implemented to identify sectoral risks and define action plans for enhancing climate resilience.

The [Water Security Strategy 2036](#) aims to reduce potable water consumption by 20 percent and increase the reuse of treated water to 95 percent by 2036. Desalination is currently the country's largest source of potable water. To reduce the environmental impact of desalination and to address its inefficiencies, the United Arab Emirates is developing and scaling up independent water projects based on reverse osmosis technology and making efforts to expand the share of renewable energy in desalination. Initiatives are also being implemented to reduce water losses and lower water consumption. The use of treated water for purposes such as irrigation and district cooling is also steadily increasing.

Agriculture is one of the focus sectors of adaptation measures in its [Second NDC](#). To address the challenges climate change poses for food production, the United Arab Emirates is adopting sustainable and climate-smart agriculture methods, reducing food waste, and diversifying sources of food imports. Adopted in 2018, the [National Food Security Strategy 2051](#) aims to ensure access to safe and sufficient food all year round, prioritizing sustainable agricultural and consumption practices and thus promoting resilience, productivity, soil and water conservation, food diversification, and food waste reduction.

Responding to the [water-energy-food nexus](#) that characterizes the desert environment of the Arabian Gulf region, the Government of the United Arab Emirates is working closely with

research institutes and farmers to promote the adoption of modern farming solutions and technologies, such as optimized greenhouse design, hydroponics, and vertical agriculture. The Agriculture 4.0 initiative, set for implementation in 2020–2022, aims to upgrade traditional farms with technology-enabled operating models that optimize production while abiding by the water budget set by the United Arab Emirates Water Strategy 2036.

Through public-private partnerships, the Government has invested in several vertical farming projects. One prominent example is the world's largest vertical farming facility built by Emirates Flight Catering and Crop One, which will cover 12 077 m² and will produce an output equivalent to 3.6 million m² of farmland, using 99 percent less water than regular outdoor fields.

In conjunction with technology-based enhancement in domestic agriculture, the United Arab Emirates has taken a comprehensive approach to reducing food waste by engaging residents, government organizations, and businesses in initiatives to facilitate and encourage food waste treatment. For example, the nationwide Food Waste Pledge launched in 2018 encourages the country's hospitality sector to adopt efficient food production practices. As a result, the United Arab Emirates aims to cut down food waste by half by 2030.

The Government is investing heavily in [modern agricultural technologies](#). Data from the Ministry of Climate Change and Environment shows that the United Arab Emirates had [over 177 advanced farms using modern agricultural technologies and hydroponics](#) and over 100 organic farming entities in April 2022. In addition, [Abu Dhabi announced a USD 100 million investment](#) in four agritech companies, the first installment in a larger USD 272 million agritech support programme. The companies include: [Madar Farms](#), a local company with a mission to tackle food and water security challenges in the region; [Aerofarms](#), an American vertical farming company; [RDI \(Responsive Drip Irrigation\)](#), a startup developing a new irrigation system that makes it possible to grow plants in sandy soil; and [RNZ](#), another startup that develops fertilizers to grow more food more efficiently.

Yemen

Yemen has been facing [food insecurity and water scarcity, slow economic growth, and gender inequality](#) in recent years. These challenges are exacerbated by climate change; Yemen ranks 168 out of 181 countries in the Notre Dame Global Adaptation Initiative (ND-GAIN) index and is highly vulnerable to climate change. Ongoing conflict, a lack of adequate natural resources management, weak governance, and other factors seriously hinder the country's ability to address the impacts of climate change.

Yemen's temperatures have been rising steadily for the past three decades; in many places temperatures are 2 °C higher than before climate change. Research shows that temperatures will likely rise further, with estimates of 1.2 to 3.3 °C by 2060, depending on the rate of climate change. As a result, the country will likely face more extreme weather, with more substantial and intense flooding and droughts. The frequency of storms is expected to increase as well. For decades, Yemen has been suffering from water stress – both extremes of floods and droughts across the country. Sea levels are projected to rise by an estimated 0.30 to 0.54 metres by 2100.

In 2015, Yemen submitted its [intended NDC](#) to the UNFCCC. The document outlined the country's climate change mitigation and adaptation commitments. Yemen also signed the Paris Agreement in 2016, though it has yet to ratify it.

National adaptation priorities outlined in the NDC are:

- ▶ Promoting and scaling up rainwater harvesting to reduce climate-induced water shortage;
- ▶ Managing agriculture drought, as well as sustainable crops and livestock;
- ▶ Planning and implementing proper land resources management programmes;
- ▶ Sustainable natural resources management and preservation of sensitive ecosystems;
- ▶ Disaster risk management, including flood and drought management;
- ▶ Capacity building and awareness raising for integrated coastal zones and marine resources management;
- ▶ Institutional capacity for building resilience to climate change, including planning, programming, monitoring, and resource mobilization.

Under the [Technology Needs Assessments](#),¹⁷ Yemen prioritized the agriculture and water sectors for adaptation. Selected technologies to combat climate change in these sectors include:

- ▶ Agriculture: Irrigation-saving techniques, water harvesting and storage, soil management and conservation, reuse of treated wastewater and greywater
- ▶ Water: Saline water desalination, rainwater harvesting, diversion facilities, channels, wastewater recycling, and reuse.

FAO is implementing multiple projects in Yemen to enhance the country's resilience to climate risks and promote sustainable agriculture practices. In March 2021, [FAO handed over 259 rehabilitated small and medium irrigation infrastructures](#) in the Lahj and Ibb governorates to local communities as part of the [Water for Food Security Project](#) funded by the Government of Kuwait.

The GCF readiness project "Strengthening of NDA and Enabling Strategic Frameworks for Engagement with GCF," targets the government, NGOs, and civil society to build their capacities in assessing and addressing climate risks to agriculture and food security. This project also aims to develop the necessary assessments and rationale for future investments in climate-resilient activities.

¹⁷ The assessment has been undertaken by the UNEP and the UNEP Copenhagen Climate Centre on behalf of the Global Environment Facility.

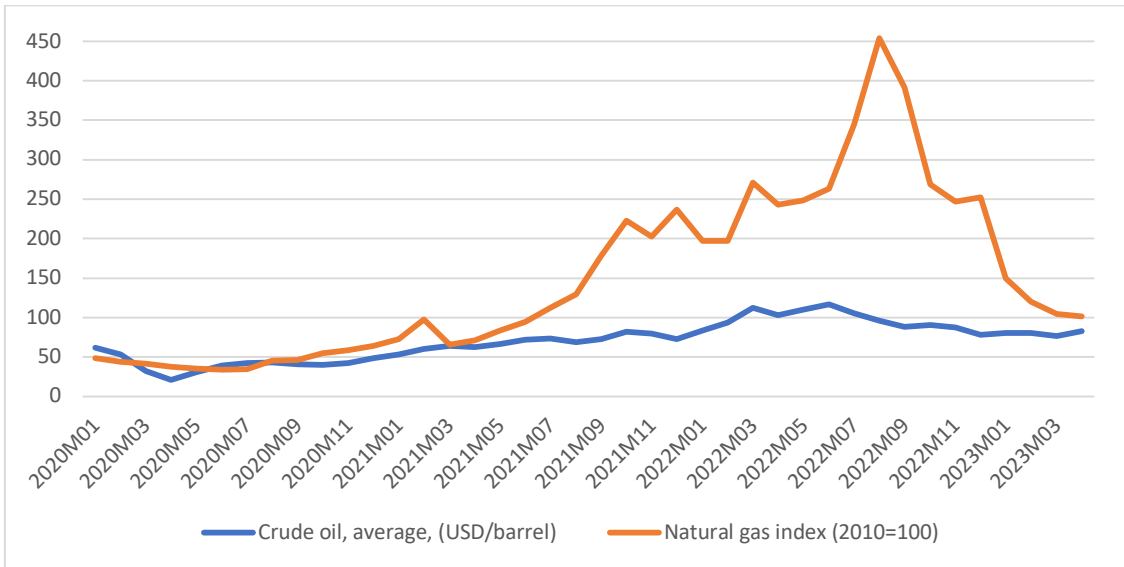
“Supporting Resilient Livelihoods and Food Security in Yemen Joint Programme Phase 3 (ERRY III),” is another project that aims to enhance the capacity of communities affected by conflict, poverty, and environmental shocks to reduce their vulnerability. This project aims to directly benefit approximately 1 270 674 vulnerable beneficiaries by strengthening community institutions, providing equal access to clean energy, and promoting sustainable livelihoods.

FAO’s “Adaptation to Climate Change in Yemen Addressing Biodiversity through Integrated Land and Water (GEF)” project targets the rural population of Yemen and aims to help them create sustainable and resilient livelihoods. The project focuses on building capacity for government and private enterprises to create and administer spatial planning, adopt and implement legally binding spatial plans, and innovative agriculture, fisheries, and livestock production practices.

Finally, the FAO “Rural Livelihood Development Project” (RLDP) aims to improve food and nutrition security, increase agriculture production, and build resilience to climate risks by adopting climate-smart technologies. The project targets women and youth and aims to enhance smallholder farmers’ adaptive capacity to climate change, increase their agricultural productivity and income, and promote sustainable farming practices.

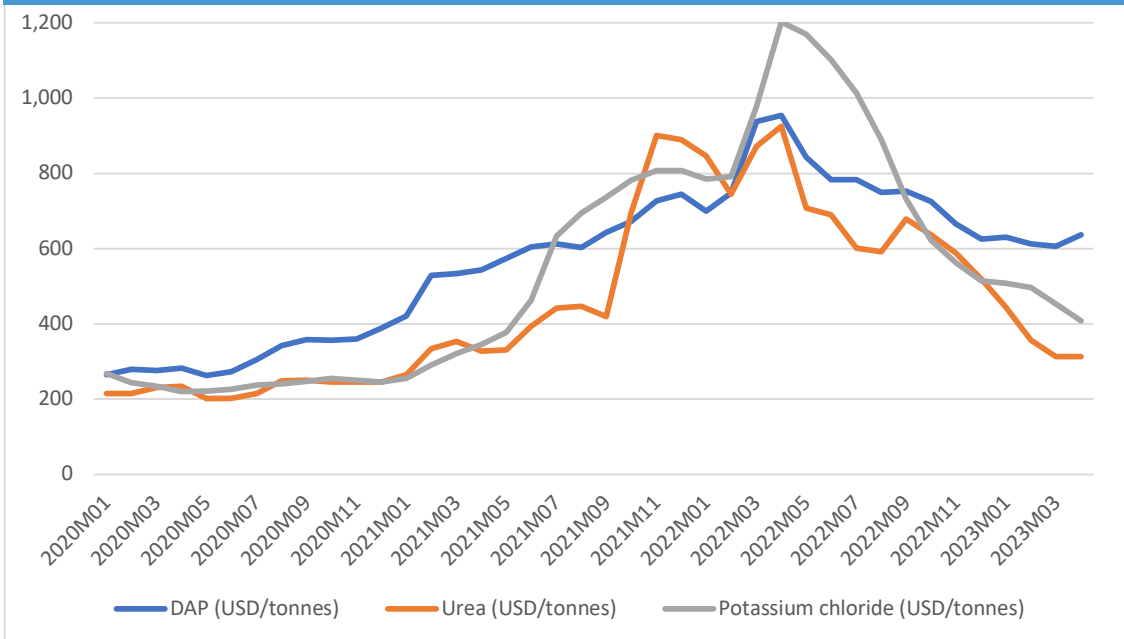
ANNEX

Figure A1. Crude oil (USD/barrel) and natural gas index (2010=100) of the World Bank



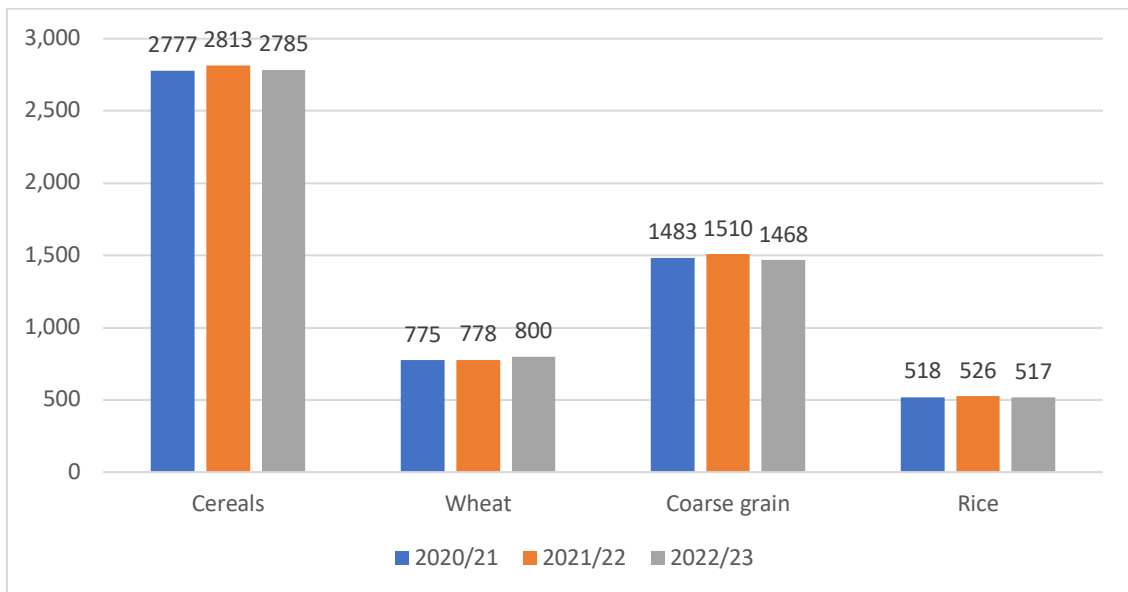
Source: World Bank (W.B.). 2023. Commodity Price Data (The Pink Sheet). In: W.B. Washington. Cited February 2023. <https://www.worldbank.org/en/research/commodity-markets>

Figure A2. Prices of fertilizers: Diammonium phosphate (DAP), urea, and potassium chloride (USD/tonnes)



Source: World Bank (W.B.). 2023. Commodity Price Data (The Pink Sheet). In: W.B. Washington. Cited February 2023. <https://www.worldbank.org/en/research/commodity-markets>

Figure A3. World cereal production (million tonnes)



Source: FAO. 2023. FAOSTAT: World Food Situation. In: FAO. Rome. Cited February 2023. <https://www.fao.org/worldfoodsituation/csdb/en/>



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