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Greening agriculture: Towards sustainable recovery and climate change action

Executive Summary

The Near East and North Africa (NENA) region is the most water- and land-scarce region in the world with agricultural land and water availability per capita far below the global average. The region also faces continued population growth. Unsustainable practices that result in widespread land and water degradation, biodiversity loss, deforestation, degradation of vegetation cover and depletion of aquatic and marine resources make increasing productivity while sustainably managing the natural resource base a major challenge. The vulnerability of most of the region's countries to climate change will further aggravate the negative impact on these resources and on food security. The COVID-19 pandemic has highlighted the vulnerability of the region's agrifood systems and the need to ensure that recovery is based on a sustainable management of these resources to sustain rural livelihoods.

This paper reviews the status, trends and challenges in the management of natural resources. It highlights the most critical water, climate and natural resource sustainability issues that threaten food systems in the region and that have detrimental effects on the region's terrestrial and marine ecosystems.

The paper calls for a paradigm shift in the use of natural resources (land, water, aquatic and marine resources and biodiversity) in the transition to greening agriculture for achieving sustainable agrifood systems. This shift necessitates putting sustainability and resource productivity and efficiency at the forefront if the region were to improve food security and nutrition while at the same time protect, restore and sustainably manage its terrestrial and marine ecosystems towards achieving the Sustainable Development Goals (SDGs).

Suggested action by the Regional Conference

1. The Regional Conference is invited to urge Members to:
 - a) Ensure that recovery programmes move away from the current situation where agricultural practices have led to land and water degradation, biodiversity loss, and continued conversion of fragile natural ecosystems (riverine, forests, wetlands) to other

Documents can be consulted at www.fao.org

uses, towards greener, more sustainable, resilient and inclusive agricultural systems. This will require a paradigm shift in national policies, planning and incentive schemes, acknowledging the multiple roles of agriculture beyond food security, and the importance of putting the region's diverse agricultural systems on the path to sustainability and climate resilience.

- b) Accelerating coordination between water, food security, climate and environmental policies, acknowledging limited water availability and the fragility of the region's ecosystems, and strengthening regional coordination mechanisms including those established by the League of Arab States on water, agriculture and climate change.
 - c) Seizing the opportunities provided by the global movement under the UN Decade on Ecosystem Restoration for increased restoration actions and that provided by the 8th Global Environment Facility (GEF), the Green Climate Fund (GCF), the Adaptation Fund and other accelerating and funding mechanisms, to mobilise investments, including private sector investments in support of large scale ecosystem restoration and climate action and scaling up of sustainable agroecological practices to restore the productivity of degraded agricultural lands.
 - d) Investing in sustainable aquaculture to expand the food production potential of their scarce aquatic resources by integrating freshwater aquaculture with crop and livestock production and by investing in modern technologies to sustainably produce freshwater, brackish water and marine species, including harsh desert environments.
2. The Regional Conference is invited to call upon FAO to:
- a) Continue work under the Water Scarcity Initiative to support countries on the adoption of integrated water management approaches to increase water productivity, including through the creation of a conducive enabling environment for informed allocation of water resources, expansion in the use of non-conventional water resources and integrating virtual water trade options in national policies and programmes.
 - b) Support countries in the development and implementation of climate change adaptation actions such as climate smart agriculture, green and climate resilient agriculture, among others, in the agriculture sectors, including under countries' Nationally Determined Contributions (NDCs) and National Adaptation Plans (NAPs).
 - c) Support countries in their efforts towards the transformation of aquatic food systems for the promotion of an integrated agriculture-aquaculture and production of freshwater or marine fish using modern, water-efficient technologies and to strengthen their capacities for the adoption of an ecosystem approach to aquaculture and fisheries.
 - d) Support countries to enhance biodiversity conservation and to mainstream biodiversity and climate change in their national policies, programmes and actions across the agricultural sectors (crops, livestock, fisheries and aquaculture, and forestry).

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Introduction

1. In the last 50 years, fast population growth stimulated a transformation of agriculture in many parts of the world, including the Near East and North Africa (NENA) region. This was achieved through a wide range of innovations, including increased use of chemical fertilisers, herbicides/pesticides, mechanisation of crop and animal production and extractive sectors (fisheries and forestry); improved crop varieties and livestock breeds; improved irrigation and water management technologies; introduction of a variety of intensive farming system innovations, including mono-cropping, intensive livestock rearing, among others. Those innovations aimed to improve agricultural productivity and profitability, in particular through increased use of external inputs. However, there was little scrutiny on the process by which agricultural productivity was achieved at the time, including environmental and social consequences.¹

2. In the NENA region, the process of agricultural intensification is still underway, with a large diversity of situations, from quasi-subsistence agriculture in some less developed areas to high-tech precision agriculture. Agricultural production is stimulated by both local food demand and global markets calling for off-season fresh products. The growing urban population (around 60 percent of the region's population) is demanding more fruit, vegetable, meat and dairy at a lower cost. This has led to a change in the food production patterns and investments to increase land and water productivity.

3. Increasing productivity while sustainably managing the natural resource base is a major challenge in the region. Often, unsustainable agriculture practices have resulted in widespread land and water degradation, biodiversity loss, deforestation and degradation of vegetation cover and depletion of aquifers. In many places, fisheries are associated with the unsustainable use of marine resources. In others, conflict and protracted crisis have led to the damage of agricultural and irrigation infrastructure critical for water storage and the restoration of ecosystems.

4. The NENA region is the most water- and agricultural land-scarce region in the world with agricultural land and water availability per capita far below the global average. Arable land in NENA accounts for less than 5 percent of the total land area, which is less than half of the global average. Agricultural land is not only limited but is also shrinking due to land degradation, population growth and a lack of adequate land use planning, posing an additional threat to food security. The region needs to produce more with less resources and a lower environmental footprint. Special attention to implementing sustainable practices should focus on dryland farming systems, such as rainfed and irrigated systems which dominate the NENA region.

5. Climate change predictions indicate that the region's vulnerability to climate change is moderate to high. Climate change will add further negative impacts on water resources and on food security. Solutions that address both resource degradation and enhance the resilience of the agricultural sectors to climate change are thus needed.

6. The erosion of local agricultural knowledge is another critical element to consider. As agriculture evolves towards high-tech intensive mono-cropping systems, the expertise of maintaining soil fertility, sharing water and producing in agro-pastoral or other multilayer/multi-output diversified systems is disappearing. The region needs to recover some of this knowledge and revitalize some traditional natural resource management practices that have proven to be sustainable (e.g. the Hima rangelands management system).

7. The socio-economic imbalances created during the COVID-19 crisis have further exacerbated the situation of millions of people who depend on these precious natural resources for food and livelihood security. Local and smallholder production needs to become more resilient to such shocks and crises. The COVID-19 pandemic has, however, provoked serious consideration of the need to reconcile development and nature and move away from the current unsustainable practices by adopting nature-based options that reduce the environmental and carbon footprint of agriculture while improving

¹ OECD, 2011

resource efficiency. This underpins the concept of greening agriculture that FAO is adopting for achieving the SDGs in its regional programme for the Near East in 2020 and beyond.

8. Addressing the aforementioned challenges requires the region to rethink what, where, and how to produce, as well as how to address consumption, trade-offs and manage synergies between the economic, social and environmental dimensions of agriculture. It requires the region to undergo a transformative shift in its agrifood systems, which brings the issues of sustainability and resource efficiency to the forefront in order for the region to improve food security and nutrition while at the same time protect, restore and sustainably manage its terrestrial and marine ecosystems towards achieving the SDGs.

9. Greening agriculture emerged as one of the priorities for food and agriculture in the region in line with the regional priority action areas: Building sustainable production systems that address water scarcity and climate change, restoring land, protecting and sustainably using biodiversity and promoting nature-based solutions, as well as engaging the agricultural sectors in a constructive dialogue with the environment on approaches that ensure both productivity and long-term sustainability of agricultural practices.²

I. Status, trends and challenges in natural resource management in the NENA region

a. Water scarcity

10. The per capita availability of renewable water resources in the region has declined by nearly 75 percent, from 2,681 m³ to 686 m³ between 1962 and 2017, and is projected to further drop to 550 m³ and 430 m³ by 2030 and 2050, respectively.³ The region is characterized by high levels of water stress, with eight countries in the global top 10 highest water stress list. More than 60 percent of the regional population, and 70 percent of their economic activities, are located in areas of high water stress.⁴ In addition to their limited availability, water resources in the region are the most variable in the world, with 15 percent larger than the global average year-to-year water variability.⁵

11. The limited water resources and arable land in the region, combined with rapid population growth over the last decades, have progressively led to a deficit between food demand and production, which is expected to grow in the coming years. This gap is compensated by food import. In this context, virtual water⁶ is increasingly gaining importance within the national water budget of all the countries of the region, which imports virtual water from all over the world, as it is the world's largest food-importing region.

12. Low economic water productivity in agriculture is characterized by the dominance of cereals, covering around 60 percent of the total harvested land. In general, around 40 percent of the value of agricultural production comes from horticulture products, compared with less than 15 percent from cereals.

13. In irrigation, operation and maintenance and the implementation of modernization and water-saving policies still rely heavily on public finance. Driven by social policies, several countries in the

² The impact of COVID-19 in the Near East and North Africa Region and FAO's Response Plan. NERC/20/8. <http://www.fao.org/3/nd678en/nd678en.pdf>

³ Water stress data is obtained from <http://www.fao.org/sustainable-development-goals/indicators/642/en/>. Projections are calculated using UN anticipated population growth rates.

⁴ World Bank (2017), *Beyond Scarcity: Water Security in the Middle East and North Africa*, World Bank Group, Washington, DC.

⁵ Antonelli, M., and S. Tamea (2015), *Food-water security and virtual water trade in the Middle East and North Africa*, *Int. J. Water Resour. Dev.*, 31(3), 326–342;

Borgomeo et al., 2020, *Tackling the Trickle: Ensuring Sustainable Water Management in the Arab Region*, *Earth's Futur.*, 8(5), doi:10.1029/2020EF001495;

Hofste, R. et al. (2019), *Aqueduct 3.0: Updated Decision-Relevant Global Water Risk Indicators*, WRI Publ., doi:10.46830/wri18.00146.

⁶ The water equivalent of the food that is imported by the region.

region provide irrigation water for free or at a negligible fee, which results in high subsidies for the sector. Overall, the weak institutional arrangements and the failure to recognize the real cost of irrigation water has led to its being undervalued and has encouraged overuse.

b. *Land and soil degradation*

14. Agricultural land in the NENA region is not only limited because of the arid nature of the region, but is also decreasing due to various degradation drivers and stress. Only 5, 29 and 2.5 percent of total land area is considered suitable for agriculture, pasture and forest, respectively (FAO, 2020). There is also high level of heterogeneity among countries in the region with regards to availability of arable land, ranging from 30 percent of arable land in Syria and Lebanon to only 0.5 percent in Oman and Saudi Arabia (FAO, 2019).

15. Land degradation in NENA is strongly linked to land use/cover change in both rural and peri-urban areas, poor farming practices and climate change impacts. The economic impact of land degradation in the region has been estimated at a cost of USD 9 billion per year.⁷

16. Arable land per capita has been consistently decreasing, from 0.4 ha in 1961 to 0.14 ha in 2018.⁸ Soil erosion, salinization and sodification, organic carbon loss, soil pollution and biodiversity loss are major challenges in several countries affecting food production and livelihoods. Ecosystem service quality and capacity are greatly reduced by degradation caused by salinity, erosion, contamination and management factors that lead to a loss of soil organic matter. Soil degradation, especially where agriculture is practiced, is a real threat in all countries of the region and remains a major limitation to the reliable supply of food.⁹

17. Overuse of agrochemicals (pesticides and fertilizers), in particular in areas practicing intensive agriculture is one of the major reasons for soil and water pollution. Use of pesticides differs in the region with larger pesticide use in Morocco, Egypt and Algeria, while Palestine is the highest in terms of pesticide use per area of cultivated land, with 9 kg/ha (FAO and UNEP 2021). A recent FAO publication on soil pollution states that more than 49 000 tonnes of pesticides are being used annually in agriculture in NENA with diverse levels of annual consumption in different countries.¹⁰

18. Regarding fertilizer consumption (kg/ha of arable land), six countries from the region rank among the highest 20 countries in the world.¹¹ Egypt, for example, is the largest nitrogen fertilizer consumer in Africa, with an increase in the total nitrogen (N) input to croplands and higher N footprint and possibility of contaminating water with the leached nitrate.¹² Analysis of soils from the Jordan valley showed a high concentration of lead (50 - 150 mg/kg), zinc (100 - 300 mg/kg) and cadmium (4 - 7 mg/kg) due to use of poor quality irrigation water and the application of fertilisers and pesticides (FAO and UNEP 2021).

19. Inappropriate management practices, land use competition and complex land tenure issues challenge rangelands which are the dominant land cover class in NENA. Countries' limited capacities in rangelands management, including equitable access to resources and lack of inclusive territorial development also constrain the region's ability to combat rangeland degradation, improve livestock production and conserve rangeland biodiversity. A recent study estimated rangelands degradation in the

⁷ FAO and ITPS. 2015. *Status of the World's Soil Resources (SWSR) – Main Report*.

⁸ FAO. 2020. *FAOSTAT*. [online] <http://www.fao.org/faostat/en/>.

⁹ FAO. 2015, *Status of the World's Soil Resources, Regional Assessment of Soil Changes in the Near East and North Africa*.

¹⁰ FAO and UNEP. 2021. *Global assessment of soil pollution*

¹¹ Knoema. 2017. *Fertilizer consumption per unit of arable land*. World Data Atlas.

¹² Ahmed S. Elrys, Sajjad Raza, Ahmed I. Abdo, Zhanjun Liu, Zhujun Chen, Jianbin Zhou (2019). Budgeting nitrogen flows and the food nitrogen footprint of Egypt during the past half century: Challenges and opportunities. *Environment International* 130, (2019) 104895

Arab countries for the period 2000 – 2015 at 104,107 Km², which accounts for 3.3 percent of the total land area.¹³

20. Deforestation is another major concern putting pressure on already-limited forest resources in the region. Based on the Global Forest Resource Assessment (FRA) 2020, naturally-regenerating forests declined by 16 percent during the period 1990-2020, while other wooded lands recorded a yearly loss of 1 percent over the period 2015-2020¹⁴ (SDG 15.1).

c. Aquatic and marine resources depletion/unsustainable fishing

21. All NENA countries have access to marine areas. Therefore, fish and aquatic products constitute a major source of livelihoods, food and nutrition. However, while average consumption is steadily increasing, it is still low at 12 kg per capita per year. Only four countries (Oman, UAE, Egypt and Qatar) consume more than the global average of 20.5 kg per capita per year.

22. Fish production is growing at a slower pace than population growth. Fears of overfishing in the seas of the region is growing, with the Mediterranean and Black Sea areas reporting 62 percent of their stocks as biologically unsustainable, while there is a lack of data on other seas.

23. Climate change will greatly affect fisheries in the region, with different effects depending on the area. The Arabian Sea is among the marine areas with the highest predicted increase in temperature and reduction in precipitation by the end of century, with forecasts of a 4°C rise and a 40 percent precipitation reduction under the high emissions scenario. The occurrence of harmful algal blooms due to pollution will also become more frequent, intense and widespread.

24. Many countries are investing in aquaculture to expand the food production potential of their scarce aquatic resources by integrating freshwater aquaculture with crop and livestock production, or by investing in modern technologies to produce sustainable freshwater, brackish water and marine species in harsh desert environments. In NENA, aquaculture production has increased by 132 percent in 20 years, reaching 1,788,666 tonnes in 2019. However, very few countries have reached a significant volume so far, with Egypt accounting for 92 percent of the total of production and Saudi Arabia accounting for 4 percent.

d. Loss of biodiversity and ecosystem services habitat

25. Forests, though limited in extent, and soils are major habitat for the region's terrestrial biodiversity, avoiding deforestation and forest fragmentation is critical for conserving the region's biodiversity (SDG 15.1 & 15.3). Improving soil biodiversity and adopting biological methods of improving soil quality such as the use of soil organisms are some examples of nature-based solutions based on healthy soils that will address land degradation.

26. In 2019, the FAO Conference approved the *FAO Strategy on Mainstreaming Biodiversity across Agricultural Sectors*¹⁵ to mainstream biodiversity across FAO policies, programmes and activities to support countries in transforming their agrifood systems, reduce the negative impacts of agricultural practices on biodiversity, promote sustainable agricultural practices and to conserve, enhance and restore biodiversity as a whole. The 2021-23 Action Plan for the Implementation of the FAO Strategy¹⁶ outlines a wide range of activities.

¹³ Darfoui, E. 2018. First Unified Arab Report on Land Degradation Neutrality (Arabic). Note: The information contained in the report is based on different sources. In most cases, it refers to the region defined by FAO as the 'Near East and North Africa' (NENA). Other sources refer to the 'Arab Region', which includes all the countries of the NENA region + Somalia, Djibouti and the Comoros. In the text, reference is made systematically to the country grouping to which the information refers.

¹⁴ FAO, Global Forest Resources Assessment (FRA) 2020, <https://fra-data.fao.org/WO/fra2020>

¹⁵ CL 163/11 Rev.1

¹⁶ CL 166/9 Add. 1

27. A recently-completed FAO regional assessment on the status of mainstreaming biodiversity across agriculture in the NENA region (FAO, 2021)¹⁷ showed that good progress was achieved during the last two decades (2001-2021) in NENA countries in integrating the diversity of biological resources at the species level (e.g. *in situ* and *ex situ* conservation, and afforestation). However, there is slow progress made so far at the genetic and ecosystem levels. The assessment also showed that the integration of soil biodiversity into national action plans (NBSAP, NDCs, NAPDCs) is still lacking, a matter that requires more attention from countries if the status of biodiversity for food and agriculture in the region is to be improved. The study showed that NENA countries have made good progress on biodiversity mainstreaming in governance and policy, and to a lesser degree in the areas of inclusiveness and partnership. At the same time, little progress has been made so far on data and knowledge; gender and social equity as well as on monitoring, reporting and awareness.

e. Impacts of climate change

28. Modeled impacts of climate change show that the Arab region will experience an average mean increase in temperature of 1.2 °C – 1.9 °C at mid-century (2046-2065) under Representative Concentration Pathway (RCP) 4.5 and 1.7 °C – 2.6 °C under RCP 8.5.¹⁸ Projections show overall that agricultural areas dedicated to rainfed and irrigated crops (which cover 22 percent of the region's surface area) and livestock production will suffer moderate to high vulnerability to climate change.

29. Precipitation levels are projected to decline in the region due to climate change, particularly in the Maghreb countries and Egypt. As a result, the region is expected to become a global hotspot for droughts, which would deeply aggravate the region's current water stress conditions. Unless action is taken, the NENA region is projected to lose between 6 and 14 percent of its GDP by 2050 resulting from water scarcity induced by climate change. Potential agricultural income is expected to decline between 4.2 percent and 6.8 percent by 2070 due to climate change, translating to a total decline of between USD 196 billion to USD 318 billion in 2070.¹⁹

30. Adaptation in the agricultural sectors, forestry and water resources are the top priorities of countries' NDCs under the Paris Agreement on climate change.²⁰ The region requests more than twice as much finance for adaptation than it does for mitigation, and yet it receives nearly five times more public international finance for mitigation than it does for adaptation. Only a handful of NENA countries are accessing bilateral and multilateral climate finance at scale.

II. Impact of COVID-19 on agrifood systems and main responses for building better

31. Agrifood systems in all the countries of the region have experienced different impacts from COVID-19, depending on economic situations and levels of employment in agriculture. The estimated rise in the number of poor people during the pandemic, which was widely concentrated in rural areas as compared to urban areas,²¹ may have implications on the region's land and water resources. Poverty can lead people in rural areas to overuse available soil, land and water resources to produce more, overcut forest trees to generate income or cultivate marginal lands to secure more food, thus causing more degradation.

32. The disruption to food systems caused by the COVID-19 crisis has amplified the vulnerability of food and agriculture production systems in the NENA region and created opportunities to invest in

¹⁷ FAO, 2021. Regional assessment on the status of mainstreaming biodiversity across agricultural sectors. FAO Regional Office for the Near East. Cairo, Egypt (unpublished).

¹⁸ RICCAR, 2017.

¹⁹ FAO and CMCC, 2020. The economic costs of climate change on agricultural income and labour supply. Unpublished.

²⁰ FAO, 2021. Regional analysis of nationally-determined contributions in NENA. (forthcoming)

²¹ The impact of COVID-19 in the Near East and North Africa Region and FAO's Response Plan. NERC/20/8 <http://www.fao.org/3/nd678en/nd678en.pdf>

longer-term, green and resilient transformation. Such a transformation is necessary to avoid further undermining of biodiversity, soil loss and land degradation.

33. Responses for building back better will require careful review of the sustainability of the region's food systems, including through addressing the challenges associated with soil and land degradation, water scarcity, biodiversity loss, climate change effects, food loss and waste and ensuring healthy diets. The region will need to adopt nature-based and innovative solutions in its agricultural development models and focus on the efficiency, resilience and sustainability of agricultural practices.

III. Opportunities and response actions

34. COVID-19 has emphasized the centrality of food and agriculture to a green recovery and to efforts to build back better. There is growing recognition that the objectives set out in the SDGs are unlikely to be met unless ecosystem degradation is halted and restoration is undertaken at larger scales to reverse this negative trend. Greening agriculture should become a major strategic objective for all countries in the NENA region. It has been noted that avoiding biodiversity degradation is among the cheapest nature-based measures to implement, enhancing plant and animal habitats and offering co-benefits for climate change mitigation, thus enhancing resilience of biodiversity in the face of climate change.²² The UN Decade on Ecosystems Restoration launched in June 2021 provides a unique opportunity for scaling up global efforts in ecosystem restoration, including in the NENA region. Undertaking large-scale restoration efforts is key for addressing the region's natural resource degradation and for the transition to greening agriculture.

35. Greening agriculture cannot be achieved without greening consumption across all food systems and transitioning from a linear production-to-disposal model to a closed loop, where biological resources are conserved and reintegrated as products, processes and services into a circular bio-economy. Food, non-food organic waste and wastewater generated across the urban-rural space can be cycled back as productive materials and resources for use within or outside food systems. NENA countries may take stock of Jordan's experience in addressing water scarcity where the country has made, among others, significant achievements in the reuse of treated wastewater and biosolids.²³

36. There is an increasing international debate about repurposing of agricultural incentives, including subsidies, away from those that have potentially negative environmental and social impacts to those with positive impacts. Paying producers for the ecosystems they provide through sustainable management approaches and practices is one way to reward conservation efforts. Benefits to producers can be increased with incentive mechanisms such as certification and the adoption of Payment of Ecosystem Services (PES).

37. Greening agriculture requires rewarding the uptake of good and innovative agricultural practices with the right incentives, better prices and a market ready to purchase better products. There is a need to raise awareness of the opportunities of implementing green and climate-resilient agricultural practices. Green and climate-resilient agriculture employs agricultural practices, technologies and innovations that enhance productivity in a sustainable manner, increase resilience and food security, reduce greenhouse gas emissions and ensure higher incomes for small-scale producers. These include practices such as climate-smart agriculture, biotechnology and agroecological approaches, sustainable forest, fisheries and soil management, disaster risk management, and others.²⁴

38. Response actions 1: Enhancing sustainability of agrifood systems (SDG targets 2.4 and 14.4):

²² IPBES. 2021. Tackling Biodiversity & Climate Crises Together and Their Combined Social Impacts. <https://www.ipbes.net/sites/default/files/2021-06/20210606%20Media%20Release%20EMBARGO%203pm%20CEST%2010%20June.pdf>

²³ Breulmann M., Müller R.A., Al-Subeh A., Subah A. and van Afferden M. (2019) Reuse of Treated Wastewater and Biosolids in Jordan – Nationwide Evaluation. Published by the Helmholtz Centre for Environmental Research – UFZ with support from the Ministry of Water and Irrigation; Amman – Leipzig.

²⁴ FAO. 2021. Green and Climate-Resilient Agriculture <https://www.fao.org/3/cb6978en/cb6978en.pdf>

- a) Assess the urban-rural interface and the changes in the food systems as driven by the growing urbanization in the region and, with support from FAO, design appropriate policies and actions in line with these changes and with the FAO Green Cities Initiative.
 - b) Design agrifood systems that take into consideration climate risk, biodiversity loss, resource depletion, digital and technological innovations adaptable to market and consumer demands. These include sustainable intensification and diversification of agricultural production systems, adoption of nutrition-sensitive agricultural systems, species and varieties and support improved research for crops better adapted to drought, heat and salinity to withstand climate change.
 - c) Adopt ecosystems-based approaches with low or organic inputs such as Agroecology, agro-pastoral systems, agroforestry, protected agriculture, conservation agriculture, integrated pest and weed management systems, practices that emphasize crop rotation, improved soil fertility and improved crop, livestock, forest and aquaculture diversity that also promote positive social transformations towards improved human health, equity and natural resource governance.
 - d) build economically viable green value chains that provide resilient livelihoods and build resilient food systems.
39. Response actions 2: Halting land and water degradation and biodiversity loss (SDG target 15.3):
- a) Consider the use of freely-accessible geospatial applications to support monitoring of land and water use, land use/land cover changes, land degradation, ground water extraction, evapotranspiration and water use efficiency and land and water spatial planning, including the planning of area-based conservation measures.
 - b) Promote the adoption of Payment of Ecosystem Services (PES) and other incentives to support the conservation and sustainable management and restoration of natural resources and ecosystem services.
 - c) Enhance the governance of land and water resources and support sustainable natural resources management, access and tenure through promoting guidelines such as the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests (VGGT) and their subsidiary guidelines.
 - d) Continue work on biodiversity mainstreaming and, among others, promote the adoption of the International Code of Conduct for the Sustainable Use and Management of Fertilizers and the International Code of Conduct on Pesticide Management.
 - e) Promote sustainable soil, water and land management practices including the use of mulching and organic fertilizers.
 - f) Capitalize on the opportunities provided by the UN Decade on Ecosystem Restoration to scale up restoration actions.
40. Response actions 3: Halting depletion of aquatic and marine resources (SDG target 14.2):
- a) Some countries in subtropical and mid-latitude regions could benefit from a geographical redistribution of stocks, which could create a supplementary opportunity for some net export countries (e.g., Mauritania) to further foster their industrial capacities and exports.
 - b) Consider scaling up the integration of sustainable freshwater aquaculture with crop and livestock production and investing in modern technologies to sustainably produce freshwater, brackish water and marine species in harsh desert environments.
41. Response actions 3: Promoting Integrated Water Resources Management (SDG targets 6.4 and 6.5):
- a) Promote efficient water allocation mechanisms that consider higher productivity and efficiency while governed by resources sustainability.
 - b) Consider the economic valuation of irrigation water through establishment of proper costing and water pricing mechanisms to disincentivize overuse of water and encourage water rationing.

Together with these demand management directions, water supply augmentation methods need to take into consideration non-conventional water resources like treated wastewater, desalinated water and innovations as well as technologies in micro level community managed water harvesting approaches.

- c) Strengthen water institutional arrangements to address data gaps in terms of quantity, quality, access and dissemination of information. In this regard, adoption of water accounting methodologies are imperative for sustainable management of water resources.
- d) Support better integration of water, food and climate change nexus, including the implementation of integrated water resources management, through regional cooperation, including through engaging in regional coordination mechanisms established by the League of Arab States on water, agriculture and climate change, especially the 2019 Cairo Declaration.²⁵

42. Response actions 4: Promoting climate change adaptation and mitigation actions (SDG target 13.2):

- a) Promote sustainable agricultural practices that enhance the mitigation and adaptation of agricultural sectors, such as climate-smart agriculture, Agroecology, ecosystem- and nature-based solutions, and implementing integrated crop-livestock management practices.
- b) Strengthen the development and implementation of agriculture-related priorities in NDCs and NAPs, national climate change and sectoral strategies, including climate related negotiations.
- c) Build an enabling environment and capacities for agricultural sectors to assess and monitor adaptation and mitigation goals (including GHG emissions/removals) in the agriculture, forestry and land use sectors and improve countries' access to climate finance.

IV. Accelerators and cross-cutting issues

43. Innovation and technologies, especially the digital technologies offer opportunities of great importance to avoid, reduce, and restore degraded land in addition to the use of digitalization to disseminate good practices, and facilitate access to data on land holdings and types of cultivated crops and their pricing, competitiveness and markets that can accelerate the transformation of food systems. The use of drones with their advanced sensors has allowed production of granular data points for monitoring soil conditions, detailed atmospheric information, water availability, and pest infestations. For example, drones are used by Desert Locust control teams in locating green vegetation, locust infestations and to search for habitats conducive to hosting the Desert Locust.

44. A range of freely accessed geospatial applications can support the monitoring and assessment of land and water use, land use/land cover changes, land degradation, ground water extraction, evapotranspiration and water use efficiency, as well as model these changes under climate change scenarios. Other web-based tools supporting landscape management are also freely accessible online for a range of stakeholders involved in land use planning, forest management, livestock management, fishers in adopting an ecosystem-based approach, agroecological practices and climate change, thus contributing to more sustainable food systems.

45. Farmer-based applications offer real-time and up-to-date information for decision making as well as collect data for planning in a way that reduces time and error. For example, mobile tablets are widely used to record collected field data which is sent on a daily basis to a central depository for analysis, thus reducing the burden of filling paper forms.

²⁵ The 2019 Cairo Declaration aimed to establish a coordination mechanism between the water and agriculture sectors, and was adopted by 18 Arab countries during the 2019 FAO Land and Water Days during a meeting of the Joint Ministerial Council (JMC). The JMC was convened under the auspices of the League of Arab States (LAS), the Arab Ministerial Water Council and Ministers of Agriculture that serve as the governing board of the Arab Organization for Agricultural Development (AOAD).

46. Gender inequalities represent an additional constraint to greening agriculture in the NENA region. Despite their important role in agriculture and natural resource management, rural women face severe challenges in their access to assets, productive resources and services, which in turn limit their opportunities to adopt climate-smart and environmentally-friendly technologies and practices. Accelerating efforts to achieve sustainable agriculture in the region requires bold and coordinated action to address these gender-based constraints by fostering a gender-responsive policy and legal environment, which ensure women's equal entitlements and access to key productive and natural resources (such as land). It also requires increasing investments in gender-transformative agricultural programmes, aimed at promoting women's uptake of innovative practices and technologies, and at enhancing their decision making in relevant governance mechanisms and rural organizations.

47. Environmental sustainability must go hand in hand with social and economic inclusion. Green technologies and sustainable agriculture have the potential to create decent and green jobs and important livelihoods for young men and women and the most vulnerable populations including migrants or Indigenous Peoples. It is necessary to include communities including youth, women, and vulnerable groups into the design, implementation and monitoring of nature-based solutions and greener rural value chains.