Food and Agriculture Organization of the United Nations

The multi-faced role of soil in the Near East and North Africa

GLOBAL SOIL PARTNERSHIP

POLICY BRIEF

1

2019

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The multi-faced role of soil in the Near East and North Africa (NENA)

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Food and Agriculture Organization of the United Nations
Rome, 2019

Required citation

FAO. 2019. *The Multi-Faced role of Soil in the Near East and North Africa Region – Policy Brief.* Rome. 36 pp.
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Photo cover: pxhere.com
Layout design: Matteo Sala, FAO

Contents

Executive summary

The world's soils are rapidly deteriorating due to soil erosion, nutrient depletion, loss of soil organic carbon, soil sealing and other threats, but this trend can be reversed provided countries take the lead in promoting sustainable management practices and the use of appropriate technologies.

Several scientific reports highlighted in this brief have shown the extent to which soil degradation is threatening food security and water availability, increasing social economic inequality and depleting ecosystems in the NENA region, particularly through desertification. Soil degradation is driven by multiple and complex variables. For this reason, Sustainable Soil Management (SSM) practices and the policies that support them need to fit within a broader natural resource management agenda, one that integrates water security, climate change adaptation, and domestic crop production priorities.

A harmonized soil management approach strengthened by policy is vital to creating a coherent framework towards the achievement of this goal. This document supports the aim of all NENA countries to protect soils and demonstrates the value of coordinated and targeted action to safeguard the conservation of soils within the region towards the achievement of the Sustainable Development Goals (SDGs).

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HEALTHY SOILS ARE CRUCIAL TO ACHIEVING MANY OF THE SDGs
produce sufficient and nutritious food
2 ZERO HUNGER
ensure healthy life by combating soil pollution and contamination
3 GOOD HEALTH AND WELL-BEING
reduce land abandonment, forced migration and poverty
1 NO POVERTY
enhance water purification and access to clean water for all
6 CLEAN WATER AND SANITATION
joint efforts and global partnerships will contribute to keeping our soils healthy
17 PARTNERSHIPS FOR THE GOALS
contribute to stimulating productivity of the poorest
8 DECENT WORK AND ECONOMIC GROWTH
prevent and reduce marine pollution
14 LIFE BELOW WATER

Key messages

OUR GOAL

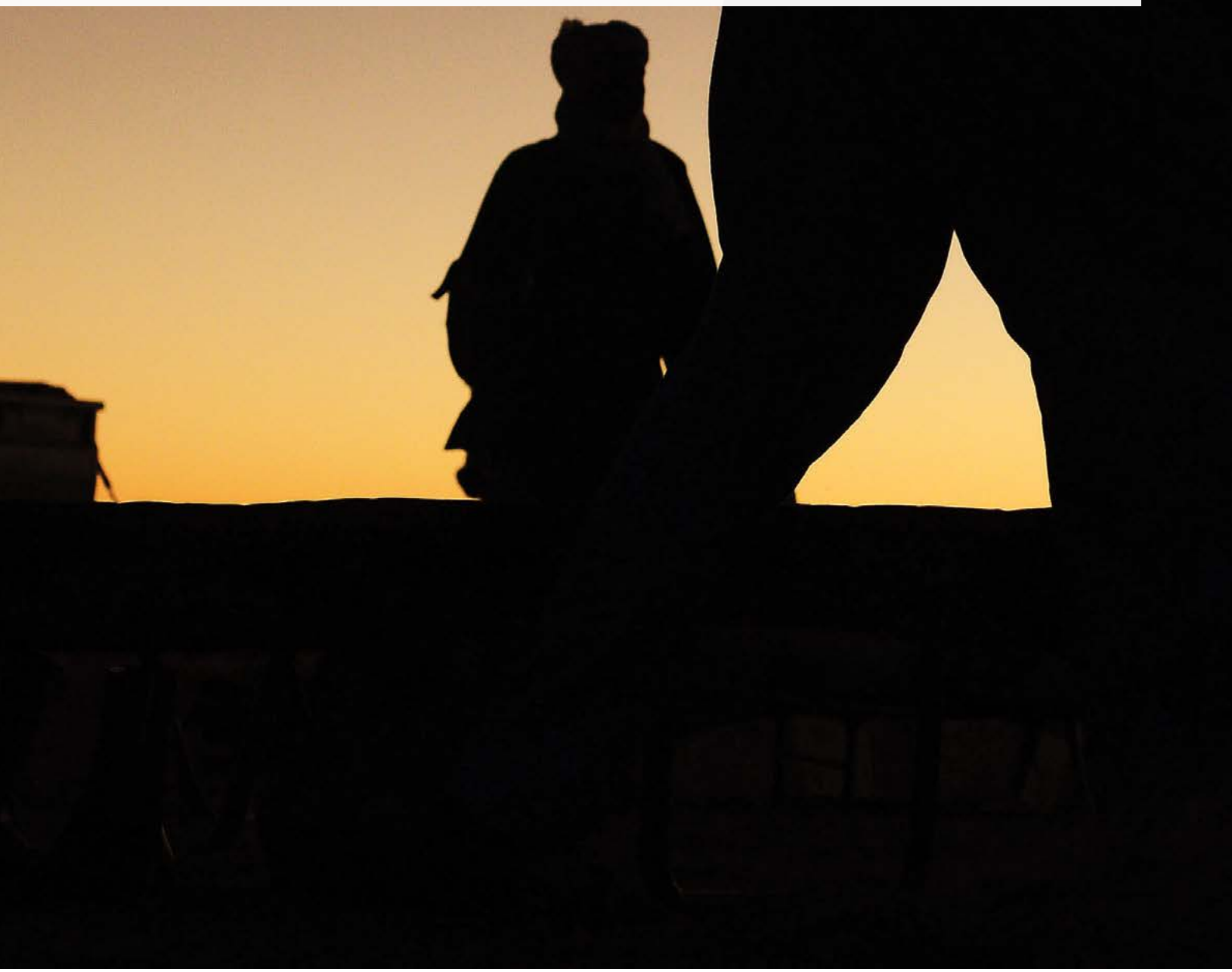
Raise awareness and trigger policy action on the added value of soil resources. By promoting and implementing Sustainable Soil Management (SSM), we can jointly ensure food security and nutrition, prevent water scarcity, mitigate and adapt to climate change, and support poverty reduction in the NENA region.

HEALTHY SOILS FOR FOOD SECURITY AND NUTRITION

- Within the dimensions of food security and nutrition, the availability of food greatly depends on healthy and productive soils;
- Soil health greatly determines the quantity and quality (nutrient content) of crop yield;
- Soil degradation causes a decrease in the quality and commercial value of agricultural products;
- The economic cost of land degradation in the NENA region is estimated at USD 9 billion per year;
- Climatic conditions directly affect the availability of arable land, while soil management practices affect their quality;
- Soil degradation is one of the biggest causes of a decrease in cropland productivity.

SOIL HEALTH AND WATER SCARCITY

- Water scarcity is a major problem in the NENA region, increasing water use efficiency in agriculture is fundamental (FAO, 2018);
- The water contained in soil (green water) depends on the soil's structure and organic matter content. Soils could contribute to surface water stocks and rainfall retention/infiltration;
- Crops grown on healthy soils may not need irrigation or rainfall as often;
- Soil Organic Matter (SOM) content can be increased by managing crop residues, using forage by grazing rather than harvesting, practising organic farming, applying carbon-rich wastes, and covering the soil;
- Water use efficiency applied to the soil can be maximized through irrigation with drippers or micro sprinklers, irrigation scheduling, and monitoring of soil moisture or loss of water via evapotranspiration;
- The practice of SSM can help to increase the soil's capacity to filter pollutants and clean water impacted by human activities.



HEALTHY SOILS FOR CLIMATE CHANGE MITIGATION AND ADAPTATION

- Soils are a major carbon reservoir containing more carbon than the atmosphere and terrestrial vegetation combined. Carbon maintenance and sequestration in soils remains essential to enhance climate change resilience by offsetting the amount of CO_2 in the atmosphere and increasing ecosystem resilience to extreme climatic events;
- The impact of climate change and its variability on crop growth and yields is largely determined by its impact on soil health (and the capacity of crop varieties to adjust to changing climate and weather patterns);
- Climate change has a significant impact on agricultural production in the region - the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) worst-case scenario (RCP 8.5) projects a ten to 20 percent reduction in NENA crop yields by 2050;
- Maintaining and increasing soil organic carbon stocks is critical not only to reduce greenhouse gas emissions and remove CO_2 from the atmosphere, but also essential to improve soil health and fertility and increase its water holding capacity;
- The co-benefits arising from effective and sustainable management of soil resources are cross-cutting and directly related to climate change and food security priorities.

SUSTAINABLE SOIL MANAGEMENT TO PREVENT INVOLUNTARY MIGRATION

- High migration rates from non-conflict zone countries are influenced by environmental resource depletion or degradation;
- When soils – the basis for food production- are degraded and not able to provide functions like crop production and water retention, users have no option but to migrate to other more productive soils/sources of livelihood;
- Reduced agricultural yields due to poor soils and lack of water contribute to permanent migration away from affected areas;
- Food price shocks and shortages can lead to conflict-induced migration.

SUMMARY OF RECOMMENDATIONS

- Use internationally recognized tools like the Voluntary Guidelines for Sustainable Soil Management (VGSSM) to formulate, revise and implement policies and actions towards healthy soils for sustainable agriculture and sustainable development;
- Create an enabling environment for promoting SSM by securing land tenure, launching effective education programmes, strengthening extension services, establishing national soil information systems, and fostering international technical and scientific collaboration;
- Promote the wide use of SSM practices by farmers and other land users through concrete and targeted government strategies;
- Ensure that SSM is included in the development/implementation of integrated government investment strategies especially related to water scarcity and climate change adaptation in the region.

1. Introduction

The Near East and North Africa (NENA) region is considered one of the richest in the world in terms of fossil fuel natural resources (Diop *et al.*, 2012). By holding more than 60 percent of the world's proven oil reserves and nearly half of global gas reserves, several countries in the region like Qatar, Kuwait, United Arab Emirates, Saudi Arabia, Bahrain, and Oman are among the richest in the world (Harrington, 2018; Martin, 2018). Despite this, the NENA population is among the most vulnerable in the world; food security in the NENA region is fast deteriorating, driven by conflict and leading to a widening gap in well-being between conflict and non-conflict countries (FAO, 2017b).

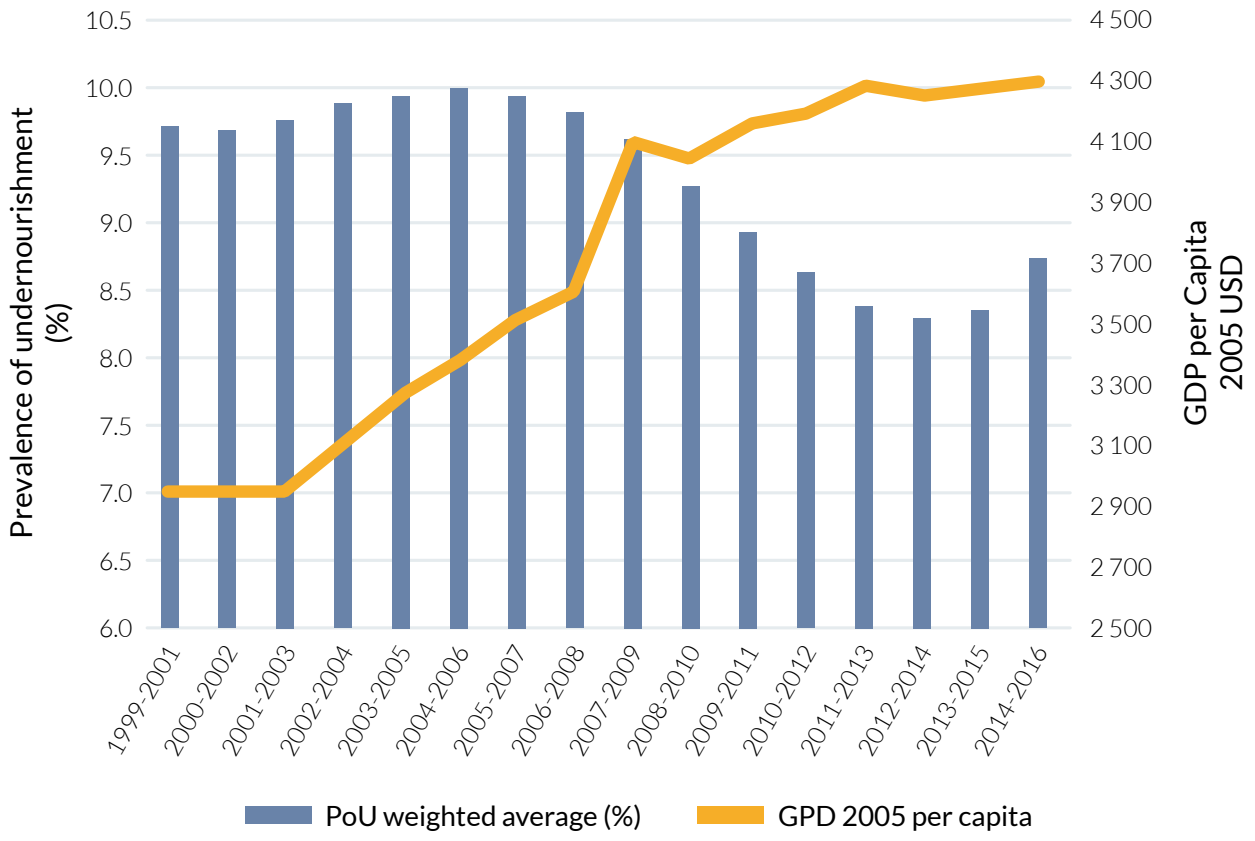
As one of the world's most water-scarce and dry regions, governments and international organizations have made major investments in water management to ensure water availability and food security (FAO, 2017a). But, is this enough? This document aims to uncover the multiple roles of soil in achieving food security, addressing water scarcity, climate change and involuntary migration. Extreme climate events spreading across the region for longer periods are affecting crop productivity and water resources; this increases the risk of migration and conflict (World Bank, 2018a). The role of soil in climate change adaption and mitigation can no longer be ignored as regional climate projections show that significant warming and decreased rainfall are expected to occur in the coming years (Bucchignani *et al.*, 2018).

Since the establishment of the Global Soil Partnership (GSP) in 2012, the celebration of the International Year of Soils in 2015 and the endorsement of the Voluntary Guidelines for Sustainable Soil Management (VGSSM) in 2016, soils are acquiring increasing international attention. The SDGs highlight the importance of preserving soil resources from degradation and restoring degraded soils (UN, 2015). At the twenty-third Conference of the Parties (COP23) of the United Nations Framework Convention on Climate Change (UNFCCC), the Koronivia Decision also declared soil health key to combating climate change (UNFCCC, 2018). Furthermore, the gap between science and policy must be closed at the national level, where concrete decisions are to be made and actions are to be taken. Raising awareness of policymakers on the added value of soil resources and their implications on livelihoods and socio-economic systems can have concrete impacts on the endorsement of soil protection legal frameworks, increased investment in Sustainable Soil Management and the restoration of degraded soils, as well as research and capacity development activities.

2. Healthy soils for food security and nutrition

Since 1999, the gross domestic product (GDP) per capita of the region increased and the Prevalence of Undernourishment (PoU) decreased (see Figure 1). However, even non-conflict NENA countries still suffer from a high average prevalence of severe food insecurity, see Table 1, (FAO, 2017b).

Figure 1. Prevalence of undernourishment and GDP per capita (in 2005 USD) in NENA countries, 1999-2001 to 2014-16. Source: FAO, 2017b.



NOTE: GDP PER CAPITA REFERS TO THE MIDPOINT OF EACH THREE-YEAR AVERAGE.

Table 1. Regional overview of food insecurity and undernourishment in NENA for the period 2014-2016. Source: FAO, 2017b

	WEIGHTED AVERAGE PREVALENCE OF UNDERNOURISHMENT (%)	WEIGHTED AVERAGE PREVALENCE OF SEVERE FOOD INSECURITY IN THE POPULATION (%)	COUNTRIES IN THE CATEGORY
ALL NENA	10.2	12.0	ALGERIA, BAHRAIN, EGYPT, IRAN (ISLAMIC REPUBLIC OF), IRAQ, JORDAN, KUWAIT, LEBANON, LIBYA, MAURITANIA, MOROCCO, OMAN, QATAR, SAUDI ARABIA, SUDAN, SYRIAN ARAB REPUBLIC, UNITED ARAB EMIRATES, TUNISIA, YEMEN, PALESTINE
CONFLICT COUNTRIES	27.2	19.0	YEMEN, IRAQ, SUDAN, SYRIAN ARAB REPUBLIC, LIBYA
NON-CONFLICT COUNTRIES	4.6	9.8	ALGERIA, BAHRAIN, EGYPT, IRAN (ISLAMIC REPUBLIC OF), JORDAN, KUWAIT, LEBANON, MAURITANIA, MOROCCO, OMAN, QATAR, SAUDI ARABIA, UNITED ARAB EMIRATES, TUNISIA, PALESTINE

Within the dimensions of food security and nutrition, the availability of food greatly depends on healthy and productive soils that are suitable for agriculture. Because of extreme climatic conditions throughout the NENA region, only 13.7 percent of the total agricultural land area is arable (FAO, 2014a) and the land per capita (hectares of arable land per person) is less than the world average of 0.23 ha (World Bank, 2015). Under these conditions, the risks posed by soil degradation to food security and nutrition are even greater. As reported in FAO and ITPS (2015), the Arab Centre for the Study of Arid Zones and Dry Lands estimated that land degradation affects:

- 49 percent of farmland in the eastern sub-region;
- 29 percent in the Nile Valley of Egypt;
- 17 percent in North Africa;
- 9 percent in the Gulf Cooperation Council Countries.

Overall, about 73 percent of the cropland area in NENA (22 million ha) is estimated to be degraded (FAO and ITPS, 2015). The accumulation of salts (salinization), the loss of soil by water and wind (erosion), the loss of vegetation cover and soil physical degradation (including compaction and surface crusting) are major threats to agricultural soils in NENA (FAO and ITPS, 2015).

By decreasing root depth and available water and nutrient reserves, soil degradation not only influences the quantity of the yield but also its quality in terms of nutrient content and the size and shape of the fruits. In this regard, in addition to a reduction in production, soil degradation also causes a decrease in the commercial value of agricultural products, which can look undersize and/or deformed. The economic cost of land degradation in the region is estimated at USD 9 billion per year (2.1-7.4 percent of GDP) (FAO and ITPS, 2015).

If on one hand, the lack of basic nutrients leads to the underdevelopment of plants and a decrease in yields and crop nutritional value, the excess of nutrients has environmental consequences that are cross sectoral. The excess nutrients from agricultural fields to surface water bodies causes eutrophication and deterioration of water quality; nutrient leaching into aquifers used for human consumption has potential impacts on human health, and their release in the atmosphere as greenhouse gases exacerbates climate change. In this context, it is important to preserve and improve natural soil fertility and natural nutrient cycles and to ensure that plants efficiently use all nutrients applied to the soil. This can be done through soil conservation practices including crop rotations with legumes, green- and animal manures, and cover crops in combination with reduced- or no-tillage. Crop-livestock or crop-livestock-forest systems also help to optimize nutrient cycles (FAO and ITPS, 2015; FAO and ITPS, 2017).

To cope with a growing population, cities are expanding into agricultural lands so that more food has to be produced on less land. In Algeria, 150 000 ha of arable land and 10 000 ha of irrigated lands were converted into urban areas since 1962 (FAO, 2018b). In Jordan, it is estimated that approximately 88 400 ha of rainfed land was lost due to urbanization between 1975 and 2000 (FAO, 2008). In Egypt, total prime agricultural land lost to urban expansion between 1952 and 2002 amounts to about 121 500 acres (Catalani *et al.*, 2018), while Morocco has reached its limit expanding agriculture horizontally (FAO, 2018b). The Gulf countries' food import bill will exceed USD 53bn by 2020, with imports accounting for as much as 90 percent of food consumption (Oxford Business Group, 2019). If measures to preserve soils from degradation and land take are not taken, crop yields are expected to decrease by the year 2050: rice yields by 11 percent; soybean yields by 28 percent; maize yields by 19 percent; and barley yields by 20 percent (FAO and ITPS, 2015). With more than 80 percent of the land in 17 out of

20 NENA countries and territories already suffering low productivity, the prospect of a further decrease in the production is of major concern in NENA (FAO, 2014a).

3. Soil health and water scarcity

NENA is the most arid region in the world and the availability of per capita renewable freshwater is less than 10 percent of the world average (FAO, 2017a). In 2010, Mauritania and Iraq were the only countries to have per capita water resources higher than 2 000 cubic meters per person. In presence of a shortage of water, competition for the use of this resource between sectors (industrial, municipal and agricultural) is increasing. Although in 2009, 78 percent of the 4 509 billion cubic meters of water withdrawal in the region was used for agriculture, population growth is increasing the share of water used for municipal purposes. Under these conditions, it is critical to increase water use efficiency in agriculture to ensure higher returns per volume of water used (FAO, 2014a). According to the World Bank (2018b), the inadequate supply of water and sanitation is costing the NENA region around USD 21 billion per year in economic losses.

Traditionally, some countries, such as Libya, Oman, Saudi Arabia, and United Arab Emirates rely heavily on fossil groundwater; Egypt, Iraq, Syria, and Sudan depend directly on surface water sources, often sharing with other countries. Morocco, Algeria, and Iran rely on a mix of both surface and groundwater. Still, Bahrain, Kuwait, and others in the Arabian Peninsula rely increasingly on desalinated water, treated wastewater, and virtual water in food imports, which are subject to price fluctuations (Zawahri, 2017). Reduced rates of rainfall are greatly contributing to groundwater stress, which is listed as the primary threat to water security in Iran (the Islamic Republic of), Saudi Arabia, Libya, Morocco, Yemen, and Algeria respectively (IWMI, 2007; FAO, 2016). As aquifers grow increasingly depleted in the NENA region (World Bank, 2009), renewable surface water resources will become essential. Rainfall is the leading source of surface water and is of critical importance to crops. Not only is it stored in rivers, lakes and reservoirs but also as soil moisture in the most fragile topsoil layer or root zone. As **soils contribute to surface water stocks and rainfall retention**, the water they contain is often referred to as green water (Sood *et al.*, 2014). **Crops grown on healthy soils may not need irrigation or rainfall as often**.

The ability to absorb water, store moisture, and the speed by which water is lost or used, strongly depend on the proportions of clay, silt, and sand in the soil. Whatever the soil type, the practice of SSM can increase the soil's water holding capacity by improving the soil's physical condition. Soil organic matter (SOM) plays a critical role in this. Besides releasing plant's available nutrients, reducing crusting and surface soil loss by water and/or wind erosion, and performing other functions, SOM improves the ability of the soil to absorb and store water (FAO, 2005). SOM ultimately acts like a sponge that allows plants to better tolerate drought conditions. An increase in the SOM content from 0.5 to 3 percent can more than double the available water capacity (Hudson, 1994).

Green water has so far not been included in national water budgets as countries focused their water resources management and planning on blue water (FAO, 2015). However, if the NENA region continues to be impacted by the long-term warming trend already observed throughout the eastern Mediterranean (Lewis and Monem, 2018), **investing in green water can be an effective strategy for countries to lower their agricultural production costs and sustainably increase production per unit of water consumed per unit of land**. By monitoring and preserving soil health, a larger amount of groundwater could also

be transferred from agriculture to essential drinking water supplies. This proposal implies the restructuring of a pre-existing network of investments in water security strategies, which should include soil management considerations.

In the region, SOM content can be increased by managing crop residues, using forage by grazing rather than harvesting, practising organic farming, applying integrated soil fertility management and integrated pest management, applying animal manure or other carbon-rich wastes, using compost and green manure, and applying mulches or providing the soil with a permanent cover. In order to maximize water use efficiency, these practices should be paired with improved surface irrigation, irrigation with drippers or micro sprinklers, irrigation scheduling, and monitoring of soil moisture or loss of water via evapotranspiration (FAO and ITPS, 2017).

Because of decades of policies that neglected to consider long-term water sustainability, the region's hydrological systems, transboundary rivers, and aquifers are polluted and endangered. Municipal and industrial dumping into rivers and lakes, solid waste deposits, seepage from landfills, seawater intrusion into aquifers, and contamination by agricultural runoff are all threatening the water quality throughout the region (Zawahri, 2017). A rarely acknowledged fact about **healthy soils is that their structure and molecular makeup allows them to act as a natural filter for pollutants** (Blum, 2005). Healthy soils can provide much of the filtration needed by water that has been impacted by human activities but its power to remove pollution can be greatly enhanced through SSM.

4. Healthy soils for climate change mitigation and adaptation

In addition to rapid population growth and increasing urbanization, scarce and fragile soil and water resources are endangered by climate change, which is having a significant impact on agricultural production around the region. Changes in temperature, precipitation and sea level, and extreme climatic events may result in increased water scarcity, soil degradation, crop failures, loss of rangeland and other vegetation covers, increased vulnerability to weed competition, insect pests, and diseases, death of livestock, and reduced fisheries production (Soltani *et al.* 2012; Alboghdady and El-Hendawy, 2016; Lewis and Monem, 2018; Verma, 2018).

Most of the land area of the NENA region falls in the hyper-arid, arid and semi-arid climatic zones. With three-quarters of arable land already receiving less than 400 mm of annual precipitation and natural grazing lands receiving less than 200 mm of rainfall per year, climate change is expected to exacerbate drought and the scarcity of water. The region is greatly affected by average temperature change in comparison to other global regions; higher climatic temperatures could lead to an increase in evaporation by 25 percent. This means that rainwater availability could fall by 50 percent worsening the water crisis (Lewis and Monem, 2018). These warming trends are expected to rapidly increase in parallel with an increase in extreme weather events such as droughts, floods, and storms (Desanker, 2002; Wodon *et al.*, 2014). The impact of climate change and its variability on crop growth and yields is largely determined by its impact on soil health and the capacity of crop varieties to adjust to changing climate and weather patterns (Brevik, 2013). Alboghdady and El-Hendawy (2016) demonstrated that a 1 percent increase in temperature during winter resulted in a 1.12 percent decrease in

agricultural production. The IPCC AR5 worst-case scenario (RCP 8.5) projects a ten to 20 percent reduction in NENA crop yields by 2050 (Lewis *et al.*, 2018).

According to the Intergovernmental Panel on Climate Change (IPCC) (2014), 24 percent of the greenhouse gas emissions fostering climate change can be attributed to agriculture, forestry, and other land-use, non-fossil based practices that create emissions by releasing carbon from soil and forest stocks. This is because soils represent the largest terrestrial organic carbon reservoir (FAO, 2017c). Depending on local geology, climatic conditions and land use and management (among other environmental factors), soils hold different amounts of soil organic carbon (SOC), the major component of soil organic matter (SOM) (FAO, 2017c). In dry and hot regions, vegetation cover is naturally scarce and only very little carbon enters the soil. This is why most soils in the NENA region contain 1 percent of SOC, and frequently less than 0.5 percent (Darwich and al., 2018). However, SOC in drylands accounts for more than one-third of the global stock, mainly due to their large surface area and the fact that the soil is not degraded, rather than due to vegetation cover (FAO, 2017c).

In order to reduce carbon emission to the atmosphere, it is fundamental to preserve soil resources from degradation and to increase soil capacity to sequester carbon dioxide (Lal, 2004). The process of carbon sequestration through soil-healthy agricultural practices creates manifold benefits in terms of food production, as there is a direct relation between the SOC content and soil fertility (Lal *et al.*, 2014). Investment in preserving SOC implies working on preserving the structural integrity of the soil and enhancing SOM content. In addition to the recommendations provided in the Voluntary Guidelines for Sustainable Soil Management (VGSSM) (FAO and ITPS, 2017), a list of sustainable soil management practices for enhanced soil carbon uptake and storage is reported in table 2 (Robert, 2001). These can also enhance crop resistance to temperature fluctuations and soil resistance to erosion processes induced by climate change.

Table 2. SSM for enhanced soil carbon uptake and storage. Source: Robert (2001) adapted by the NENA Soil Partnership 2019

PRACTICE	CONNECTION TO SOC UPTAKE AND STORAGE
INCREASING BIOMASS INPUTS USING ORGANIC FERTILIZERS	FERTILIZERS ENHANCE SOIL STRUCTURE, CREATING THE ABILITY TO CAPTURE AND STORE NUTRIENTS; ORGANIC FERTILIZERS ENHANCE THE MICROBIAL COMMUNITIES IN SOIL, INCREASING THEIR ATMOSPHERIC CARBON DIOXIDE SEQUESTRATION ACTIVITIES
INCREASE CROP RESIDUES, MULCH FARMING	MULCHING INCREASES SOIL COVER, PROTECTING NUTRIENTS WITHIN THE SOIL FROM BEING RELEASED
ZERO OR MINIMUM TILLAGE	KEEPS SOIL STRUCTURE AND COVER INTACT TO MAINTAIN STRUCTURE AND PREVENT THE LOSS OF NUTRIENTS
INTERCROPPING SYSTEMS	INCREASING THE BIODIVERSITY OF PLANTS GROWING IN THE SOIL WILL INCREASE THE BIODIVERSITY OF NUTRIENTS AND MICROBIAL SPECIES IN SOIL
EFFICIENT IRRIGATION SYSTEMS	INCREASED EFFICIENCY OF IRRIGATION WILL SIMILARLY ENHANCE SOIL STRUCTURE AND MICROBIAL HEALTH
CROP ROTATION	MAINTAINS SOIL HEALTH BY REDUCING THE INCIDENCE OF PEST DISEASES, INCREASE SOIL FERTILITY AND INCREASE SOIL MICROBIAL ACTIVITIES
FORESTATION	FOCUSING ON THE SUSTAINABLE MANAGEMENT OF LAND, WATER AND VEGETATION, RANGELANDS, FORESTS, BIODIVERSITY AND CARBON SEQUESTRATION

5. Sustainable Soil Management to prevent involuntary migration

Migration rates in 12 out of 20 NENA countries have increased significantly since 2010. Additional research has shown that in Morocco, Tunisia, Lebanon, Syria, and Palestine, migrants make up over 10 percent of the total population. High migration rates from non-conflict zone countries have been influenced by environmental resource depletion or degradation (Fargues, 2017), see Table 3.

Table 3. Soil threats in the NENA region. Source: national focal points to the NENA Soil Partnership

COUNTRIES	SOIL EROSION	SOIL SALINIZATION	DROUGHT, RAINFALL AND CLIMATE CHANGE	FERTILITY DEPLETION/SOIL ORGANIC MATTER (SOM)	SOIL POLLUTION
ALGERIA	WATER EROSION AFFECTS 45% OF NORTHERN AREAS DUE TO: OVERGRAZING, FOREST FIRE AND UNSUITABLE FARMING PRACTICES	AFFECTS NEARLY 1 MILLION HA. (10-15% OF ARABLE LAND)	RAINFALL FLUCTUATIONS AFFECT RAIN-FED CEREAL PRODUCTION OVER TIME AND SPACE MAINLY IN THE HIGH LANDS (HAUTS PLATEAUX)	21% OF LAND IS NUTRIENT DEPLETED DUE TO OVER-CULTIVATION	-
BAHRAIN	-	-	ANNUAL AVERAGE RAINFALL IS ABOUT 72 MM, MUCH BELOW 650 MM NEEDED TO GROW WHEAT	-	-
EGYPT	AFFECTS 29% OF FARMLAND IN THE NILE VALLEY OF EGYPT	YIELD REDUCTION DUE TO SALINIZATION AMOUNTS TO 25%. AFFECTED AREAS HAVE BEEN ABANDONED DUE TO SOIL PRODUCTIVITY LOSS.	-	-	-

COUNTRIES	SOIL EROSION	SOIL SALINIZATION	DROUGHT, RAINFALL AND CLIMATE CHANGE	FERTILITY DEPLETION/SOIL ORGANIC MATTER (SOM)	SOIL POLLUTION
IRAN (ISLAMIC REPUBLIC OF)	WATER AND WIND EROSION AFFECT FERTILE SOILS DUE TO UNSUITABLE SOIL AND WATER MANAGEMENT, LAND USE CHANGE AND UNSUITABLE AGRICULTURAL PRACTICES	MORE THAN 4 MILLION HA (AROUND 28% OF TOTAL ARABLE LAND) IS AFFECTED BY SALINITY	THE MEAN ANNUAL PRECIPITATION IS AROUND 230 MM AND MEAN ANNUAL EVAPORATION IS AROUND 2500 MM. MORE THAN 90% OF CROP PRODUCTION IS FROM IRRIGATED AGRICULTURE	AROUND 50% OF AGRICULTURAL SOILS ARE FACING DEFICIENCY OF MORE THAN ONE ESSENTIAL NUTRIENT SOC CONTENT IS LESS THAN 1% IN AROUND 60% OF AGRICULTURAL SOILS	-
IRAQ	- WIND EROSION 1. LIGHT – MEDIUM: 1 431 000 HA (3.37%) 2. STRONG: 635 000 HA (1.49%) - WATER EROSION: 1. LIGHT – MEDIUM: 4 691 000 HA (11.06%) 2. STRONG: 5 007 000 HA (11.86%)	MORE THAN 70 % OF IRRIGATED AGRICULTURAL LANDS IN CENTRAL AND SOUTHERN IRAQ IS AFFECTED BY THE PROCESS OF SALINIZATION	DROUGHT AND SHORTAGE OF IRRIGATION WATER IN SUMMER.	ORGANIC CARBON CONTENT: -LOWER MESOPOTAMIAN PLAIN: LOW - ARID SOIL: ABSENT - RIVER PLAIN: LOWER THAN 0.5% - NATURAL FERTILITY IS LOW IN BOTH THE PLAIN AND THE LOWER MESOPOTAMIAN PLAIN	HIGH FROM OIL PRODUCTION
JORDAN	PHYSICAL DEGRADATION BY WATER AND WIND EROSION AFFECTS 25% OF THE EASTERN AND NORTH-EASTERN PART OF THE COUNTRY SOIL STRUCTURE AND COMPACTION AFFECT THE NORTHERN PART OF JORDAN AND THE CENTRAL HIGHLANDS BIOLOGICAL DEGRADATION, THE LOSS OF ORGANIC MATTER AND VEGETATION COVER AFFECTS 35% OF THE COUNTRY	AFFECTS 35% OF LAND: MAINLY INCREASING IN THE HIGHLANDS AND IN THE SOUTH OF THE JORDAN VALLEY	MORE THAN 91% OF THE COUNTRY HAS AN ARID CLIMATE. LACK OF WATER AND IRREGULAR RAINFALL HAVE FURTHER NEGATIVELY IMPACTED THE AGRO AND NATURAL ECOSYSTEMS IN JORDAN LEADING TO LAND DEGRADATION AND DESERTIFICATION	IRRATIONAL USE OF FERTILIZERS AND PESTICIDES HAS POLLUTED SOIL AND GROUNDWATER RESOURCES THE ABSENCE OF LEGISLATION HAS LED TO THE FAILURE OF MANY PROJECTS AIMED AT IMPROVING AGRICULTURAL PRODUCTIVITY	-
KUWAIT	-	-	-	-	HIGH FROM OIL PRODUCTION

COUNTRIES	SOIL EROSION	SOIL SALINIZATION	DROUGHT, RAINFALL AND CLIMATE CHANGE	FERTILITY DEPLETION/SOIL ORGANIC MATTER (SOM)	SOIL POLLUTION
LEBANON	MORE THAN 60% OF MOUNTAIN SOILS ARE SUBJECTED TO LOW AND MEDIUM WATER EROSION, WITH A REDUCTION OF VEGETATION COVER FROM 37% TO 24%.	SOIL SALINITY DEVELOPS IN LIMITED AREAS IN NORTH-EAST LEBANON DUE TO UNSUSTAINABLE AGRICULTURAL PRACTICES AND OVER IRRIGATION. THE SOIL OF THE COASTAL AREA IS AFFECTED BY SECONDARY SOIL SALINITY DUE TO IRRIGATION WITH WATER AFFECTED BY SEAWATER INTRUSION	THE AVERAGE NATIONAL PRECIPITATION RATE IS 890 MM WITH LARGE MOUNTAIN AREAS COVERED BY SNOW FOR FOUR MONTHS AND RESTRICTED AREA RECEIVING LESS THAN 300 MM. THE SUPPLEMENTARY IRRIGATED WHEAT AND RAIN FED CEREALS ARE AFFECTED BY RAINFALL VARIABILITY	THE AVERAGE ORGANIC CARBON (OC) CONTENT IN THE SOILS VARIES BETWEEN 1 % IN SEMI-ARID AREAS AND 2% IN CULTIVATED SOILS OF DRY SUB-HUMID AREAS. THE CONTENT OF OC IS DECREASING IN MOUNTAIN SOILS SUBJECT TO WATER EROSION AND IN ARABLE SOILS DUE TO FREQUENT CULTIVATION AND PLOWING AND LIMITED ORGANIC COMPOST APPLICATION	THE SOURCES OF CONTAMINATION OF SOIL AND WATER RESOURCES VARY BETWEEN INDUSTRY, TRANSPORTATION, ENERGY PRODUCTION, AGRICULTURE, AND SOLID AND LIQUID WASTES. ANALYSES SHOWED BACTERIOLOGICAL AND LIMITED CHEMICAL CONTAMINATION OF WATER RESOURCES AND LOCALIZED ACCUMULATION OF NI AND CR IN SOME SOILS.
LIBYA	-	-	-	-	-
MAURITANIA	-	-	-	-	-
MOROCCO	> 3 000 TON KM-2 YEAR^{-1}	AFFECTS NEARLY 0.75 MILLION HA MAINLY IN IRRIGATED AREAS	MORE THAN 80% OF NATIONAL LAND IS UNDER AN ARID CLIMATE	DECREASE IN SOIL NUTRIENT CONTENT LEADING TO INCREASED USE OF FERTILIZERS. EVERY 10 YEARS, 15 TO 30 % OF SOIL ORGANIC CARBON (SOC) IS LOST	-
OMAN	SOIL EROSION HIGHLIGHTED AS PRIMARY THREAT ESPECIALLY ON THE BANKS OF WADI DAYQAH DAM DUE TO HIGH RAINFALL EVENTS	SECONDARY SOIL SALINITY	AVERAGE ANNUAL RAINFALL DOES NOT EXCEED 100 MM, THEREFORE AGRICULTURE DEPENDS ENTIRELY ON GROUNDWATER	DESERTIFICATION / LOW SOIL PRODUCTIVITY (LOW FERTILITY, LOW ORGANIC MATTER)	-
QATAR	-	-	-	-	-
SAUDI ARABIA	SOIL EROSION HIGHLIGHTED AS PRIMARY THREAT	54 % OF CULTIVATED AREA SUFFERS FROM MODERATE SALINIZATION	SOIL DRYNESS AND HARDNESS FROM LACK OF WATER LOCAL PRODUCTION OF MANY AGRICULTURAL PRODUCTS IS UNSUSTAINABLE	-	HIGH FROM OIL PRODUCTION

COUNTRIES	SOIL EROSION	SOIL SALINIZATION	DROUGHT, RAINFALL AND CLIMATE CHANGE	FERTILITY DEPLETION/SOIL ORGANIC MATTER (SOM)	SOIL POLLUTION
SUDAN	IN THE LAST 35 YEARS 46 MILLION HA IN THE SEMI-ARID ZONE OF THE COUNTRY WERE SEVERELY DEGRADED	-	-	DECREASE IN BASE SATURATION PERCENTAGE BY 25 TO 42% BECAUSE THE IRRIGATION WATER LEACHES SOLUBLE ANIONS AND CATIONS (THUS THESE MOVE DOWN INTO THE SOIL PROFILE)	-
SYRIAN ARAB REPUBLIC	SOIL EROSION MENTIONED AS PRIMARY THREAT	MOST OF THE IRRIGATED LAND IN THE EUPHRATES BASIN IS THREATENED WITH SALINIZATION DUE TO THE DESTRUCTION OF IRRIGATION SYSTEMS	DESERTIFICATION MENTIONED AS SECONDARY THREAT	SOIL NUTRIENT MANAGEMENT (CRISIS LEADS TO FERTILIZER SHORTAGE)	SOIL POLLUTION BY HEAVY METALS, PETROLEUM, OLIVE MILL WASTE WATER (OMWW), SEWAGE, ETC.
TUNISIA	WATER EROSION AFFECTS AN AREA OF 8.5 MILLION HA EROSION RATE 3.5 TONNES/HA/YR	ABOUT 1 500 000 HA (10% OF THE TOTAL SURFACE AREA OF THE COUNTRY) ARE AFFECTED BY SALINITY. OUT OF 450 000 HA OF LAND UNDER IRRIGATION, 100 000 HA ARE SALT AFFECTED	SOIL CONTENTS IN ORGANIC MATTER ARE LESS THAN 2% WITH SOME EXCEPTIONS FROM THE FERTILE SOILS OF THE NORTH-WEST WHERE VALUES HIGHER THAN 3% CAN BE FOUND	-	-
UNITED ARAB EMIRATES	-	33.6% OF THE AREA IS SALINIZED	-	-	HIGH FROM OIL PRODUCTION
YEMEN	-	-	-	-	-
PALESTINE	SOIL EROSION, MAINLY IN THE EASTERN SLOPES NOTED AS PRIMARY THREAT	SALINIZATION MAINLY IN JORDAN VALLEY AND SOME INTENSIVE IRRIGATED LAND (GREEN HOUSES)	LOW SOIL AND CROP PRODUCTIVITY DUE TO RAINFALL DELAY, IRREGULAR AND SHORTAGE HIGH DECOMPOSITION OF ORGANIC MATTER DUE TO MULTI PLOWING	DECLINE OF SOIL FERTILITY AND ORGANIC MATTER DUE TO INTENSIVE AGRICULTURE SOIL PLOWING	SOIL POLLUTION BY PESTICIDES, CHEMICAL FERTILIZERS, UNTREATED WATER, AND WASTE WATER

Climate-related changes behind environmental causes for migration are difficult to empirically prove, due to the difficulty of distinguishing between variable weather trends and overall climate patterns. Nevertheless, the link between climate factors and migration rates has been demonstrated through multiple studies (UNFCCC, 2018b; Abel *et al.*, 2019; Antonopoulos, 2019). In areas affected by climate change, analysis suggests that climate factors may account for between one-tenth and one-fifth of today's level of migration, a rate that is expected to increase as our climate deteriorates. Regression results for a five-country sample (Algeria, Egypt, Morocco, Syria, and Yemen) suggest that poor climate and extreme weather events lead to a higher migration probability, especially from rural parts of the country. The impact of weather shocks on changing structural conditions, including reduced agricultural yields due to poor soils and lack of water, has been proven to contribute to permanent migration away from affected rural areas (Wodon and Liverani, 2014). In this regard, food price shocks and shortages can lead to conflict-induced migration (Goldenberg, 2014).

Severe constraints on arable land and water, coupled with a growing population and rising incomes, make the region inherently dependent on imports to meet rising demand for food, particularly cereals. In this regard, the NENA region is the largest grain-importing region in the world. These imports became increasingly expensive in recent years as world market prices for cereals were high and erratic, forcing governments to approach new strategies to decrease dependency on imports (Sadler and Magnan, 2011). Because food import rates and risks of domestic price shocks are intrinsically related (OECD, 2018), dependency on cereal imports is especially risky. Shifting production trends in the agricultural sector and increasing import rates create a future risk of domestic food shortages in the case of a rise in global commodity prices (Wodon *et al.*, 2014). The geopolitical risk of food price shocks should add a sense of urgency to the development of investment strategies for food system resilience. NENA countries must adopt best management practices throughout their agricultural sectors that increase crop yields, and safeguard soil health and water security to ensure those yields are sustainable. As NENA populations grow, the consumption of crops grows with them, at faster rates than domestic production and food import rates are steadily increasing.

As family farmers produce more than 80 percent of the world's food and control 75 percent of all agricultural resources, they can play a role in preserving soil resources in NENA (FAO, 2014b). As mentioned previously, if migration from rural areas in the region is not driven by conflict, it is driven by weather shocks or environmental degradation (IFAD, 2018). Investing in soil management strategies that incorporate support for smallholder-farming operations will preserve agricultural resource stocks while reducing rural migration rates. Experts agree that lack of investment in the agricultural sector has weakened domestic food production, preventing food growers from accessing essential knowledge of best management practices and essential inputs/equipment (Rakotoarisoa *et al.*, 2011). Natural resource limitations and disease are huge determinants of low productivity in the NENA region, but a slow pace of transfer and adoption of the most demonstrably efficient current soil management practices also hold the NENA region back from achieving utmost efficiency in its agricultural sector. The field of soil health is developing at a rapid pace, and the most optimal strategies in holistic soil management, like the FAO Voluntary Guidelines for Sustainable Soil Management (VGSSM), are frequently being developed and updated by the Food and Agriculture Organization of the United Nations (FAO) and other institutions. These strategies hold huge potential gains for NENA agricultural systems.

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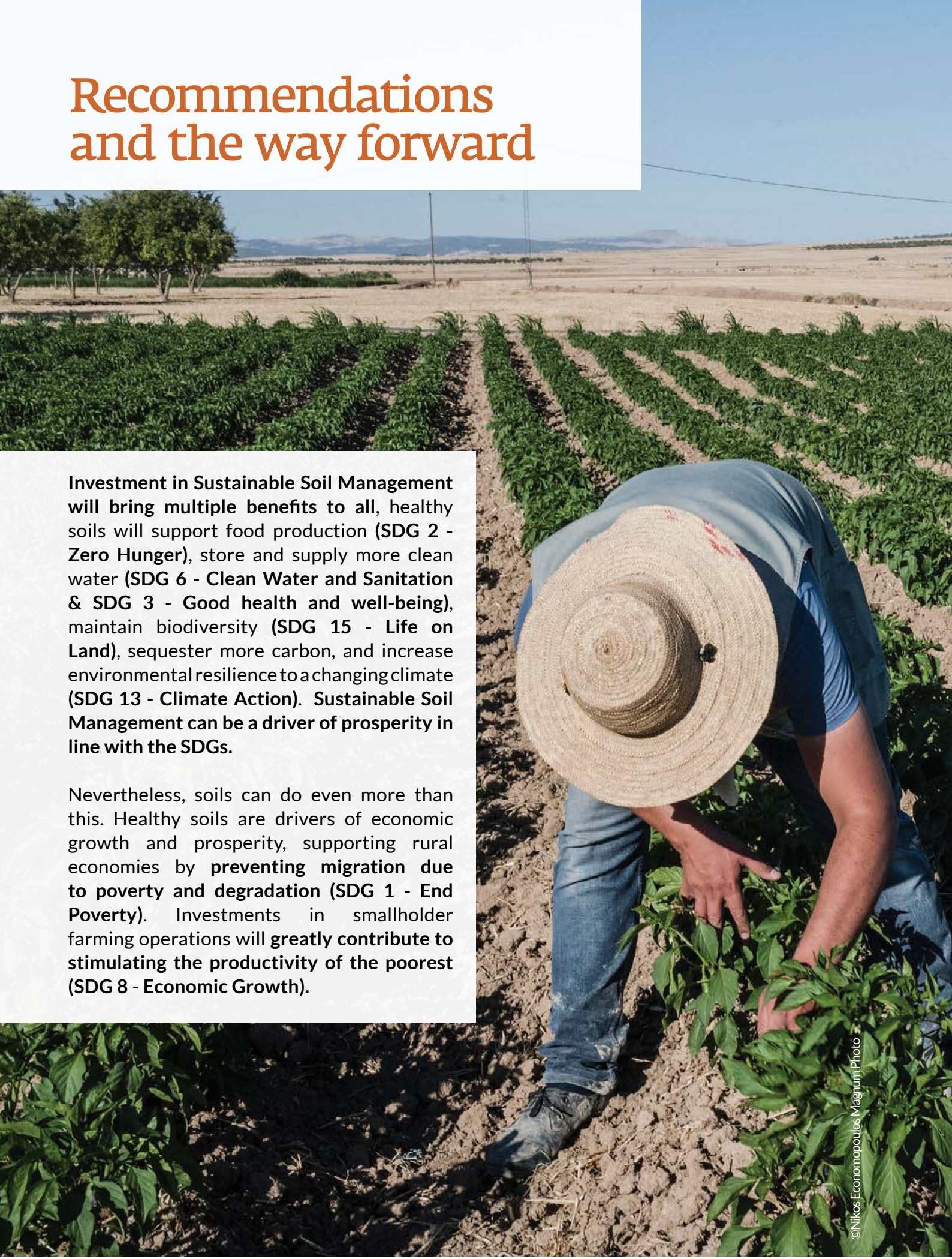
Recommendations and the way forward

Investment in Sustainable Soil Management will bring multiple benefits to all, healthy soils will support food production **(SDG 2 - Zero Hunger)**, store and supply more clean water **(SDG 6 - Clean Water and Sanitation & SDG 3 - Good health and well-being)**, maintain biodiversity **(SDG 15 - Life on Land)**, sequester more carbon, and increase environmental resilience to a changing climate **(SDG 13 - Climate Action)**. **Sustainable Soil Management can be a driver of prosperity in line with the SDGs.**

Nevertheless, soils can do even more than this. Healthy soils are drivers of economic growth and prosperity, supporting rural economies by **preventing migration due to poverty and degradation (SDG 1 - End Poverty)**. Investments in smallholder farming operations will **greatly contribute to stimulating the productivity of the poorest (SDG 8 - Economic Growth).**



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KEY AREAS OF INTERVENTION

- Inclusive agricultural/environmental policies that include Sustainable Soil Management (SSM) need to fit within a broader natural resource management agenda, one that integrates water security, climate change adaptation and domestic crop production priorities;
- Inclusion of SSM in water scarcity programmes as soils could help in storing rainwater;
- Responsible investment and positive incentives aimed at promoting SSM - in the long run, unsustainable soil management practices have higher social and private costs than SSM practices;
- Promotion of secure land tenure rights - the Voluntary Guidelines on Tenure can assist in the process;
- Targeted soil research;
- Promotion of effective capacity development programmes;
- Adequate inclusion of SSM in extension services;
- Establishment/strengthening of national soil information systems including monitoring of soil health;
- Establishment of core integrated programmes related to the main soil degradation issues, including soil salinity, water scarcity, soil erosion by wind and water, and dust storms;
- Implementation of normative tools such as the Voluntary Guidelines for Sustainable Soil Management and the International Code of Conduct for the Sustainable Use and Management of Fertilizers at national level;
- Advocate for the development of national soil legal frameworks to guide the development of policies, programmes and actions towards healthy soils.

FUTURE PRIORITIES FOR THE GSP

- Continue to work closely with NENA partners as well as with other Government Departments with an interest in soil policy in the NENA region;
- Support NENA member countries in promoting and implementing sustainable soil management activities;
- Advocate for increasing investment in sustainable soil management at national level in order to improve soil functions;
- Support countries in establishing national soil information and monitoring systems.

Glossary

Blue water
The water in lakes, rivers, and aquifers. Blue water occurs in two different forms: surface runoff in surface water bodies and renewable groundwater runoff in the aquifers. Liquid water moving above and below the ground and includes surface water and ground-water.[1]

Climate change
Refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity.[2]

Eutrophication
A process in which a water body becomes rich in dissolved nutrients, often leading to algal blooms, low dissolved oxygen, and changes in the composition of plants and animals in the water body. This occurs naturally but can be exacerbated by human activity which increases nutrient inputs to the water body.[1]

Food security
Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.[3]

Green water
Water that comes from precipitation and is stored in the unsaturated soil.[1]

Integrated pest management
An ecosystem approach to crop production and protection that combines different management strategies and practices to grow healthy crops and minimize the use of pesticides.[4]

Integrated soil fertility management
The application of soil fertility management practices and the knowledge to adapt these to local conditions, which optimize fertilizer and organic resource use efficiency and crop productivity.[1]

Land
The UN defines land as "a delineable area of the earth's terrestrial surface, encompassing all attributes of the biosphere immediately above or below this surface including those of the near-surface climate, the soil and terrain forms, the surface hydrology (including shallow lakes, rivers, marshes and swamps), the near-surface sedimentary layers and associated groundwater reserve, the plant and animal populations, the human settlement pattern and physical results of past and present human activities." [5]

Mulching
A protective covering, usually of organic matter such as leaves, straw, or peat, placed around plants to prevent the evaporation of moisture, the freezing of roots, and the growth of weeds.[1]

Organic farming or organic agriculture
A holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfill any specific function within the system.[6]

Policy
A set of orientations and principles of actions adopted by public authorities in harmony with national policies in a given country to guide future decisions in relation to the management, use, and conservation of their resources for the benefit of society.[7]

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1 FAO TERM PORTAL: HTTP://WWW.FAO.ORG/FAOTERM/EN/
2 HTTPS://UNFCCC.INT/FILES/PRESS/BACKGROUNDERS/APPLICATION/PDF/PRESS_FACTSH_SCIENCE.PDF
3 HTTP://WWW.FAO.ORG/FILEADMIN/TEMPLATES/FAOITALY/DOCUMENTS/PDF/PDF_FOOD_SECURITY_COCEPT_NOTE.PDF
4 HTTP://WWW.FAO.ORG/AGRICULTURE/CROPS/THEMATIC-SITEMAP/THEME/PESTS/IPM/EN/
5 HTTP://WWW.FAO.ORG/LAND-WATER/LAND/EN/
6 FAO/WHO CODEX ALIMENTARIUS COMMISSION, 1999: HTTP://WWW.FAO.ORG/ORGANICAG/OA-FAQ/OA-FAQ1/EN/
7 HTTP://WWW.FAO.ORG/3/A-AM665E.PDF

Soil
The natural medium for the growth of plants. Soil has also been defined as a natural body consisting of layers (soil horizons) that are composed of weathered mineral materials, organic material, air and water.[8]

Soil compaction
Increase in density and a decline of macro-porosity in a soil that results from pressure being applied at the soil surface. Compaction impairs the functions of both the top- and subsoil, and impedes roots penetration and water and gaseous exchanges.[9]

Soil degradation
Change in the soil health status resulting in a diminished capacity of the ecosystem to provide goods and services for its beneficiaries.[10]

Soil health
The capacity of the soil to function as a living system.[1]

Soil moisture
The percentage of water in the soil (by weight). It is normally taken as the water amount in the soil between wilting point and field capacity.[1]

Soil organic carbon (SOC)
Carbon that remains in the soil after partial decomposition of any material produced by living organisms. It constitutes a key element of the global carbon cycle through the atmosphere, vegetation, soil, rivers, and the ocean. SOC is the main component of soil organic matter (SOM) and as such constitutes the fuel of any soil. SOM supports key soil functions as it is critical for the stabilization of soil structure, retention and release of plant nutrients, and allowing water infiltration and storage in soil. It is therefore essential to ensuring soil health, fertility, and food production. The loss of SOC indicates a certain degree of soil degradation.[11]

Soil organic matter (SOM)
Term used to describe the organic constituents in the soil in various staged of decomposition such as tissues from dead plants and animals, materials less than 2 mm in size, and soil organisms.[10]

Surface crusting
A surface layer of the soil, ranging in thickness from a few millimeters to a few centimeters, which is much more compact than the material beneath. The import of external materials is not involved in the formation of the crust.[12]

Sustainable Soil Management (SSM)
Soil management is sustainable if the supporting, provisioning, regulating, and cultural services provided by soil are maintained or enhanced without significantly impairing either the soil functions that enable those services or biodiversity. The balance between the supporting and provisioning services for plant production and the regulating services the soil provides for water quality and availability and for atmospheric greenhouse gas composition is a particular concern.[13]

Water holding capacity
Quantity of water retained by soil that can be absorbed by plants, between the times of full saturation and when at it is the lowest amount. WHC is usually measured within the topsoil, up until a depth of around 30cm.[11]

Water stress
Water stress is the symptomatic consequence of water scarcity, which may manifest itself as increasing conflict over sectoral usage, a decline in service levels, crop failure, food insecurity etc. This term is analogous to the common use of the term drought.[11]

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8 HTTP://WWW.FAO.ORG/SOILS-PORTAL/ABOUT/ALL-DEFINITIONS/EN/
9 FAO AND ITPS, 2015
10 HTTP://WWW.FAO.ORG/SOILS-PORTAL/SOIL-DEGRADATION-RESTORATION/EN/
11 FAO, 2017C
12 HTTP://WWW.FAO.ORG/DOCREP/T1696E/T1696E06.HTM
13 FAO AND ITPS, 2017


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The **Global Soil Partnership (GSP)** is a globally recognized mechanism established in 2012. Our mission is to position soils in the Sustainable Development Agenda, improve soil governance and promote Sustainable Soil Management (SSM) to guarantee healthy and productive soils and support essential ecosystem services through awareness raising activities, capacity strengthening and knowledge exchange.

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THANKS TO THE FINANCIAL SUPPORT OF

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Ministry of Economic Affairs of the Netherlands

CA3803EN/1/03.19