FOOD SECURITY IN A CHANGING ARAB ENVIRONMENT

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I. INTRODUCTION

The Arab region has the largest food deficit in the world, due to the strained natural resource base and vulnerabilities to climate change implications, which put tremendous pressure on achieving food security. During the last ten years a number of Arab countries have been facing challenges in environmental changes and political instability in the region. These changes and developments include high rate of population growth; natural resource degradation; serious climate change implications; wars and civil strife; and migration.

These developments negatively impact sustainable agricultural growth and food security. The Arab world is the only region in the world that is currently experiencing an increase in hunger (FAO, 2015). The number of hungry people in the region has doubled from 16.5 million people between 1990 and 1992, to 33 million people between 2014 and 2016. The proportion of undernourished people has also increased from 6.6 to 7.5 percent during this same period, and the number of stunted children is high in countries like Egypt, Iraq, Sudan and Yemen. In the region as a whole, anemia affects one third of the population, particularly children, pregnant women and women of childbearing age. The rate of obesity in Kuwait and Egypt is among the highest in the world.

Considering their diversity in economic terms and in agro-ecologies, the Arab countries have different adaptive capacity to cope with various challenges to enhance sustainable agricultural development and food security (World Bank, 2014). Despite this diversity, the Arab world has substantial potential to enhance food security at the regional level and to considerably reduce the growing gap between food production and consumption through the exploitation of agricultural potential and regional collaboration.

II. CHANGES IN POPULATION GROWTH

The total population of the Arab world was estimated at 391 million in 2014 compared to 316.8 million in 2005, with a significant variation in the size of the population among the Arab countries (AOAD, 2015). In 2016, Arab population would have surpassed 400 million. The increase in the population during this period was 23.4 percent (about 2.3 percent annually). The population increase rate in the Arab world is higher than the world average, where the average rate of developed countries is around 0.8 percent, and 1.9 percent in developing countries. This high population growth is the result of sustained high fertility rates, successful efforts in improving public health and lowering mortality rates combined

TABLE 1 **TOTAL RURAL AND URBAN POPULATION IN ALL THE ARAB COUNTRIES FROM 2005 TO 2014**

Year	Total Population (in thousands)	Rural Population (in thousands)	Urban Population (in thousands)	% of Rural Population	% of Urban Population
2005	316,789	142,486	174,304	45.0	55.0
2006	324,826	145,592	179,234	44.8	55.2
2007	333,179	146,184	186,995	43.9	56.1
2008	345,604	151,906	193,698	44.0	56.0
2009	352,801	154,087	198,714	43.7	56.3
2010	360,880	156,878	204,002	43.5	56.5
2011	362,163	156,173	205,990	43.1	56.9
2012	371,035	156,740	214,295	42.2	57.8
2013	381,646	158,033	223,613	41.4	58.6
2014	391,042	159,220	231,823	40.7	59.3

Source: AOAD, 2016

with young communities. However, this increase has produced problems such as food insecurity, unemployment, migration, and a decline in the level of education.

The rural population in Arab countries in 2014 was estimated by the Arab Organization for Agricultural Development (AOAD) in 2016 to be 159.2 million, representing 40.7 percent of the total population, compared to 45 percent in 2005 (Table 1). During the period 2005-2014, the rural population increased by 16.7 million and the urban population increased by 57.5 million. This decline in the rural population is due to the continuing migration from rural to urban areas and due to the weak economic structure in rural areas, inadequate infrastructure, adverse climate change impacts on agriculture and unemployment and inequality per capita income of the agricultural sector compared to those in other sectors. Migration from rural to urban areas has negative implications on achieving sustainable agricultural development and food security.

III. ENVIRONMENTAL CHANGES SINCE 2006

A. Changes in Natural Resources and the Implications of Climate Change

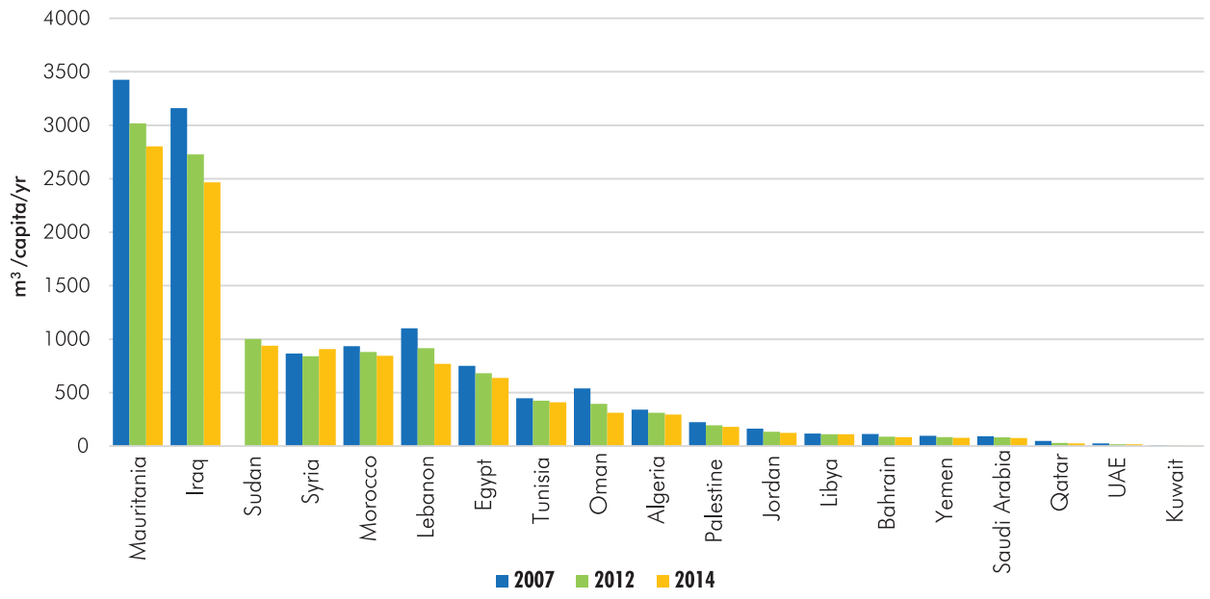
i. Changes in Water Resources

The Arab countries account for more than 5 percent of the world's population, but less than 1 percent of global water resources. Arab countries face serious challenges in managing their scarce water resources. The extremely arid Gulf countries have adapted by relying on desalination. Egypt, Iraq and Syria have hastened to develop renewable, mostly transnational, water resources. Countries with limited renewable water resources and weak financial capability, such as Jordan, have pursued water reuse, water harvesting and demand management initiatives (UNDP, 2013).

Several countries now draw heavily on non-renewable fossil aquifers to offset the negative water balance. Most Arab countries have already exhausted their water supply development potential. The per capita availability of renewable water resources in 13 Arab countries is less than 500 m^3 per year, which is far below the water poverty level of 1000 m^3 and the world average of 7000 m^3.

Arab countries rely on both conventional water resources (surface water and groundwater) and nonconventional (desalinated water, treated wastewater, irrigation drainage water, water harvesting and cloud seeding). All Arab countries are using more treated wastewater, and desalinated water is a rising share of water budgets in Gulf Cooperation Council (GCC) countries. Renewable water resources per capita have been decreasing considerably between 2007 and 2014 (Figure 1) and it is expected that this decreasing trend will continue until 2017 and beyond, considering the poor water management and the serious implications of climate change in the Middle East and North Africa (UNDP, 2013). In the last ten years, water scarcity threatened development in the Arab region, coupled by the serious climate change implications.

FIGURE 1 **TOTAL RENEWABLE WATER RESOUCES PER CAPITA (2007-2014) IN ARAB COUNTRIES**



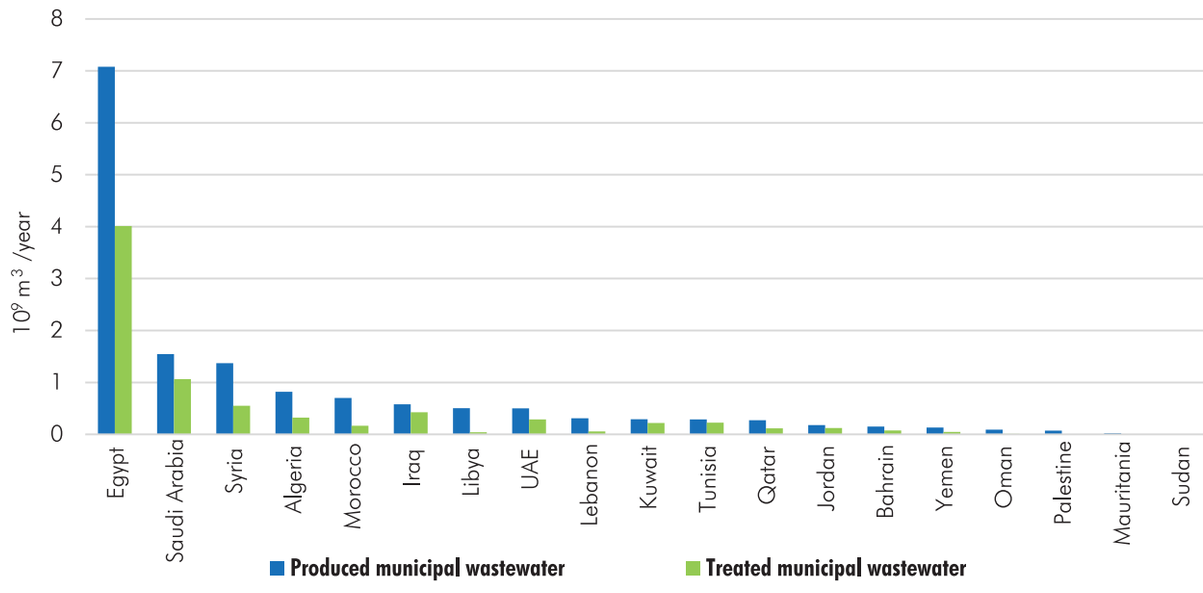
Source: Aquastat, 2017

Most of the agricultural area in the Arab countries is rainfed, and a large portion of the region's agricultural production is based on dryland farming systems, with a variable annual rainfall in the range of 200 to 600 millimeters (Solh, 2016). Most of the region is classified as arid or semi-arid (desert), receiving less than 250 millimeters of rainfall annually. Higher rainfall is only received in southern Sudan, the Atlantic and Mediterranean coastlines and the southwestern Arabian Peninsula (Jagannathan et al. 2009).

The rainfall trend in the last ten years, between 2006 and 2016, can be assessed meaningfully at the sub-regional level as indicated based on similar agro-ecologies: North Africa or Maghreb countries; West Asia or Mashreq countries and the Gulf countries. In West Asia drought prevailed from the 2005/06 to the 2013/14 seasons (Biradar et al., 2016; NASA, 2016). In North Africa drought became much more frequent and Morocco has experienced the worst drought in the 2015/16 season (Biradar et al., 2016).

a. **Groundwater resources** is the Arab region's second major conventional water resource. Shallow and deep groundwater resources, within or across national boundaries, are recharged by precipitation and by rivers. In Bahrain, Jordan, Lebanon, Oman, Tunisia, United Arab Emirates and Yemen, groundwater contributes to more than 50 percent of total water withdrawals. In the Arabian Peninsula, it accounts for 84 percent. Even countries fairly rich in surface water are relying more on groundwater to meet steadily rising demand. There is no systematic quantitative data on the loss of groundwater resources in the last ten years. However, there is clear overexploitation of groundwater resources in almost all Arab countries, especially in the Arabian Peninsula and the Maghreb region. In the last ten years, the levels of groundwater are decreasing by one to two meters annually, depending on rainfall. Groundwater overexploitation and depletion mostly used for agriculture have also had severe environmental impacts due to the deterioration of water quality. Water salinization has dried natural springs and degraded or destroyed their surrounding habitats and ecosystems as well as negatively affecting food security. Taking

FIGURE 2 PRODUCED AND TREATED MUNICIPAL WASTEWATER (2009-2013)



into consideration the serious implications of excessive exploitation of non-renewable water resources, Saudi Arabia passed a policy decision in 2008 to phase out intensive wheat production using non-renewable water resources by 2016, and has since moved from being a large wheat exporter to a large wheat importer.

With demand for water rising and supplies dwindling, Arab countries have relied heavily in the last ten years on nonconventional water sources, including desalinated water, treated wastewater and other sources such as rainwater harvesting, cloud seeding and use of irrigation drainage water.

b. **Desalinized water** is becoming very important in Arab countries, particularly the Gulf countries, with more than half the world's desalination capacity. The Arab region leads the world in desalination, although desalinated water contributes to only 1.8 percent of the total water supply. Desalination plants in Arab countries have a cumulative capacity of about 24 million cubic meters a day. Growth is expected to remain high for the next decade to meet escalating domestic water demand. Desalinated water will expand from comprising 1.8 percent of the region's total water supply to an estimated 8.5 percent by 2025. Most of the anticipated increase in capacity will be concentrated in the region's high-income, energy-exporting countries, such as the Gulf countries. More recently solar energy is being tapped to provide a good part of the energy required for desalinization.

c. **Brackish water and biosaline agriculture** is given more emphasis particularly in the Gulf countries where almost all the underground water resources have a good level of salinity. Research on bio-saline agriculture is led by the International Center for Biosaline Agriculture (ICBA) and good results were demonstrated in Arab countries on the use of brackish water in agricultural production particularly in forage production.

d. **Treated wastewater:** Arab countries produce about 14.9 billion cubic meters of wastewater a year and treated about 52

percent of it in 2014, which is an increase from previous figures of 40 percent in 2007 (AQUASTA, 2017). Thus in the last ten years, Arab countries are using more treated municipal wastewater to meet escalating water demand in urban areas. Treated wastewater is estimated at 4.7 billion cubic meters a year and is rising further. Figure 2 presents the volumes of produced and treated wastewater in some Arab countries in 2010. While most of the region has programs for reusing treated wastewater in irrigation (fodder crops, cereals, alfalfa, and olive and fruit trees are irrigated mostly with treated water), few countries have institutional guidelines for regulating the use of treated wastewater. Many factors prevent the expansion of treated wastewater reuse, such as social barriers, technical obstacles and institutional and political constraints. Nevertheless, these factors are expected to be resolved with advanced technology and more efforts in public awareness.

e. **Use of drainage water:** The Arab region also draws heavily on reused irrigation drainage water. Among Arab countries, Egypt and Syria use the most nonconventional irrigation water: Egypt uses about 7.5 billion cubic meters a year of reused agricultural drainage water, and Syria uses 2.3 billion. Egypt adopted a national policy for drainage reuse in 1975 to enhance water use efficiency and increase cultivated area. The amount of drainage water reused for irrigation is expected to reach 8.7 billion cubic meters a year by 2017.

ii.Changes in Land Degradation/ Desertification

Land studies on land degradation refer to the UN Convention to Combat Desertification (UNCCD, 1994), which defines desertification as land degradation affecting drylands. This process includes a change in soil properties, vegetation, or/and climate (D'Odorico et al. 2013). Desertification transforms a dryland ecosystem into a non-productive ecosystem with loss of vegetation cover, soil erosion, dust storms, salinization, and a decrease in soil productivity, loss of biodiversity, poverty, reduced human wellbeing, and migration (Bayram and Öztürk 2014; D'Odorico et al., 2013). Desertification

TABLE 2 **DESERTIFICATION AREA AND THE AREA THREATENED BY DESERTIFICATION AS ASSESSED IN 2012**

Country	Total Area (Thousand km²)	Desertified Area in 2012 (Thousand km²)	Percentage of Total Area (%)	Area threatened by desertification in 2012	
				Thousand km²	Percentage %
Mauritania	1031	636	62	343	33.3
Morocco	711	455	64	195	27.4
Algeria	2382	1970	83	230	9.7
Tunisia	164	-	-	105	64.0
Libya	1807	1589	88	381	21.1
Sudan	2506	725	29	650	25.9
Yemen	566	405	72	90	15.9
Kuwait	18	5	28	4	22.2
Qatar	11	11	100	-	-
Saudi Arabia	2150	1182	55	860	40.0
Total	**11346**	**6978**	**62**	**2858**	**25.2**

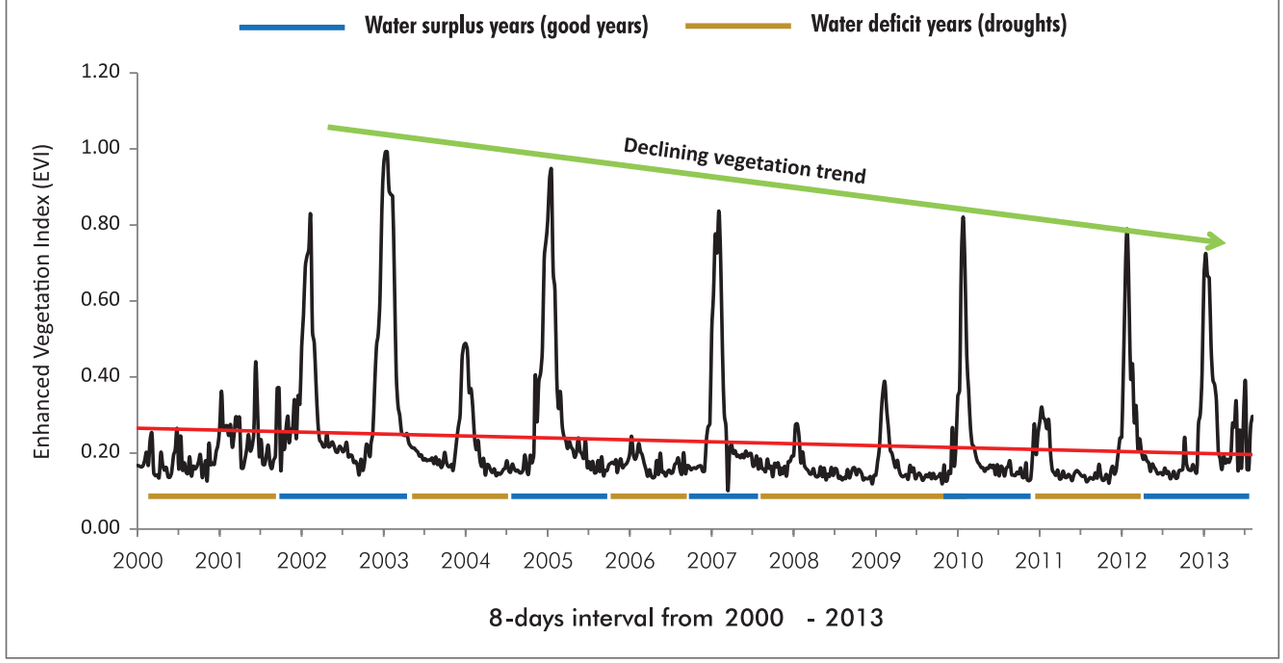
Source: Unified Arab Economic Report, 2016 (Arab Monetary Fund)

or land degradation is caused by variations in climate and natural disasters (e.g. climate change, drought, soil erosion by wind and water, diseases and insect pests' epidemics such as desert locust and dust storms) and human activities including overgrazing, deforestation, non-sustainable intensification of agricultural production systems, salinization, pollution, inadequate policies to protect natural resources and conflict.

When we assess these factors in the last ten years we can clearly conclude that land degradation or desertification is on the increase in Arab countries. According to the Joint Arab Economic Report 2016 (AMF, 2016), the area threatened by desertification ranges from 9.7 percent in Algeria to 64 percent in Tunisia based on the assessment made in 2012 in ten Arab countries (Table 2). Urbanization of rural areas, besides the problem of salinization, is eating up the highly fertile Egyptian Delta. Overgrazing by high livestock stocking rate has been seriously affecting rangelands in all Arab countries, particularly in Jordan, Syria and Iraq. Rangelands used to provide 80 to 85 percent of the sources of feed for livestock in marginal land but as a result of overgrazing, they now provide only 15 to 20 percent of the sources of feed. Conflicts in Syria, Iraq, Libya and Yemen that started in 2011 are contributing greatly to land degradation since the agricultural sector has declined in many rural areas. All these factors have been contributing to the current widening gap in food insecurity in Arab countries.

Salinization is a serious problem that contributes to land degradation or desertification in Arab countries. There is no quantitative data about the land affected by salinity in the last ten years. However, salinization, which is caused by several factors mostly related to poor water management, is becoming a serious problem in almost all Arab countries. Currently 50 percent of irrigated areas in Iraq are affected by salinity due to faulty irrigation by high-salt drainage water coming from the Euphrates and Tigris. A similar situation can be found in the Jordan River and in the Nile (World Bank, 2014). Faulty irrigation is caused by lack of consideration of salt-leaching requirement in the amount of irrigation water applied and the required drainage. In coastal areas, the intensive extraction of groundwater leads to

FIGURE 3 MODIS TIME SERIES SPECTRAL PROFILES OF RANGELANDS IN MUWAQQAR, JORDAN FROM 2000 TO 2013 USING THE VEGETATION INDEX (EVI)



seawater intrusion into the aquifers, causing severe salinization. This process is accelerated by climate-change-induced sea-level rise (Carneiro et al., 2009). The Nile Delta, which is home to more than 35 million people and provides 63 percent of the agricultural production of Egypt, is seriously affected by salinity and is especially vulnerable to salinization under changing climate conditions due to seawater intrusion as a result of higher sea level (Hereher, 2010).

iii. Changes in Biodiversity

The highest density of biodiversity in the MENA region is in the Fertile Crescent, which extends over Palestine, Lebanon, Northern Syria, southern Turkey and northern Iraq. Other high-density areas of biodiversity are found in northern parts of Morocco, Algeria and Tunisia. However, biodiversity losses in these countries are caused by many factors, presented in their order of importance: grazing pressure of rangelands, drought, new varieties and species replacing landraces, overuse, land reclamation, urbanization, wars and civil strife.

The eco-geographic/botanic surveys since 2000 show increasing trends in the loss of biodiversity (data taken from 73 sites in Jordan, Lebanon, Palestine, Syria) with grazing pressure followed by land reclamation for agricultural and urbanization purposes and recurrent droughts being major threats to range and forest biodiversity. The use of remote sensing time series spectral profiles in Muwaqqar rangeland areas in Jordan confirms the decreasing trend of biodiversity over the last ten years, due mainly to overgrazing and droughts (Figure 3). As mentioned earlier, biodiversity loss in rangelands is most serious since it was the major source of feed of sheep, goats and camels in Arab countries. Considering that sheep and goats are important for food security and better livelihoods in marginal lands or rangelands, it is apparent that loss of biodiversity due to overgrazing has a direct serious negative effect on food security in the vast marginal lands in the Arab world.

B. Implications of Climate Change

It is apparent that changes in the climate of the MENA region have several implications that

influenced sustainable agricultural production in the last ten years as indicated below:

- Changes towards less precipitation in both total quantity and distribution, and more frequent and higher intensity droughts;
- More extreme temperatures with higher temperatures in spring and summer and much lower temperature in winter with higher mean temperature on average;
- Changes in length of growing season, mostly shorter growing season by about two weeks in the Eastern Mediterranean region;
- Changes in agro-climatic zones;
- Newly emerging diseases and insect pests that threaten food production stability and quality;
- Rise in sea levels and salt-water intrusion in coastal areas.

The impact of climate change on water resources with respect to less rainfall and more frequent drought has been already covered in the previous section on Natural Resources. Other implications of climate change include the following:

i. Change in Temperature Extremes

According to the World Bank (2014), the region recorded a 0.2°C temperature increase per decade between 1960 and 1990 and later on the rate of increase in average temperature was the highest recorded in the last ten years. In 2010, temperatures in winter were higher by 3 to 4°C in West Asia, and as a result new virulent races of diseases and insect pests emerged. Furthermore, the increase in temperature is geographically projected to be the highest in the Mediterranean coast compared to other coastal areas in various parts of the world. Inland temperature is projected to increase by 3°C in Algeria, Libya and large parts of Egypt with a world average temperature increase scenario of 2°C (World Bank, 2014). According to the World Bank studies (2016), with a scenario of world average temperature increase of 4°C, summer temperatures are expected to increase by 8°C inlands by the end of the century in Algeria, Saudi Arabia and Iraq.

Global warming will have serious implications on agricultural productivity in the MENA region. According to the World Bank (2014), crop yields are expected to drop by 30 percent with a 1.5 to 2.5°C increase in temperature and by 60 percent with a 3-4°C increase, with geographical variation and without considering adaptation (World Bank, 2014).

ii. Changes in Agro-Climatic Zones and the Length of Growing Season

Reduced precipitation and warmer temperatures have resulted in a shift of agro-climatic zones in the MENA region towards drier areas. In Syria, the consecutive droughts from 2005 to 2014 resulted in moving rainfall stability zones towards drier, less stable rainfall zones. According to the World Bank (2014), at a scenario of a 4°C increase in temperature the lower rainfall and warmer drier climate will shift vegetation and agricultural zones northward by 75 kilometers by the end of the century. This will shorten the growing period in large parts of the region by two weeks by the middle of the century. The growing season has become shorter by about two weeks in the eastern part of the Mediterranean region as a result of the shift in agro-climatic zones to drier climate, terminal droughts and increase in temperature.

iii. Emergence of Diseases and Insect Pests as a Result of Climate Change

Higher temperatures caused by climate change already led to the emergence and spread of new diseases and insect pests that affect both crop and livestock production and consequently food security. This will raise the possibility of diseases and insect pest epidemics that could cause drastic losses in food production. For example, West Asia has experienced a stripe or yellow rust disease epidemic in wheat in the 2009/10 season, causing widespread damage to wheat crop – the staple food crop – although the prevailing improved wheat varieties were resistant to stripe rust. Some wheat farmers in northern Syria experienced 40-80 percent wheat yield losses due to the emergence of a more aggressive new wheat rust disease race that has broken the resistant genes that were prevailing in wheat varieties. This development was due to the increase of 3-4°C in the

temperature of the winter of 2010. Another example on the impact of the increase in the winter temperature due to climate change is the large-scale infestations in 2008/09 of the barley stem gall midge, which caused serious economic losses in barley, the main source of livestock feed. The barley stem gall midge was a minor insect pest on barley with no economic loses in barley in the past.

iv. Rise in Sea Levels and Salt-Water Intrusion in Coastal Areas

The level of the Mediterranean Sea rose an average of 1.1 to 1.3 mm per year in the 20th century, which is lower than the world average of 1.8 mm (World Bank, 2014). However, the variation in the raise in the Mediterranean Sea was apparent and with slow and gradual rise from 1960 to 1990, and with a rise above average thereafter in the last ten years. This resulted in seawater intrusion, which is becoming a serious challenge in the coastlines of several Arab countries. Projections show that Egypt, Tunisia, Morocco and Libya have been identified as the most exposed African countries in terms of total population that will be affected by sea level rise (World Bank, 2014). The Delta of Egypt, as mentioned earlier, provides 63 percent of agriculture in the country. 35 percent of the population is already seriously affected and highly vulnerable to salinization as a result of the rise in the Mediterranean Sea and the absence of the annual Nile River flood since the Aswan High Dam was built. Assuming no protection or adaptation to the seawater rise in Egypt, annual damages have been projected in the range of USD 5 billion by 2100 for a 1.26 meter sea level rise (Hinkel et al., 2012).

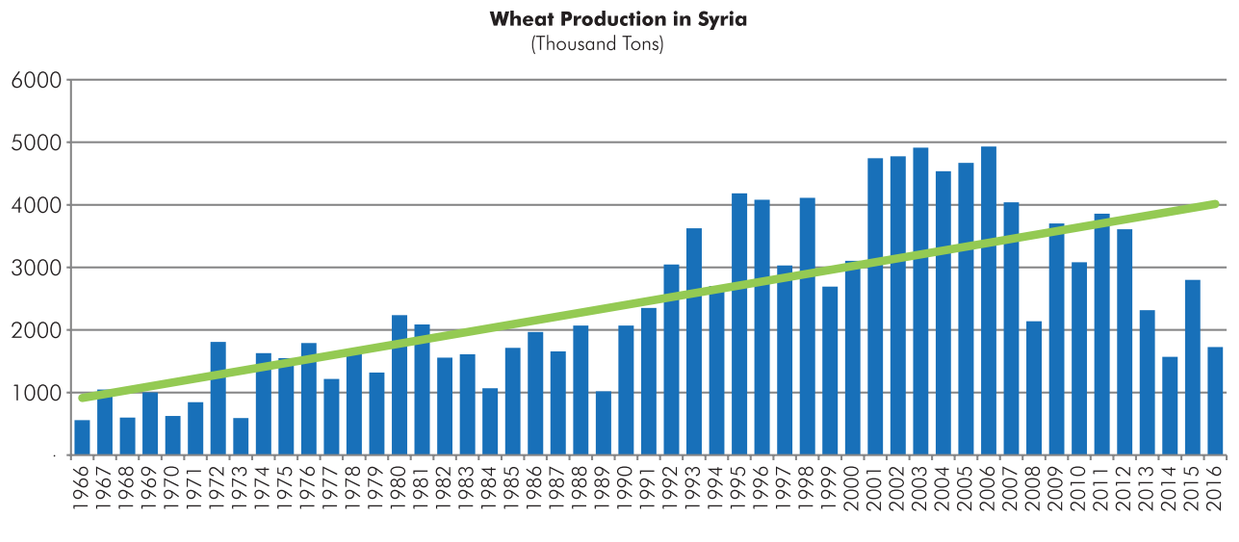
C. Changes in the Geo-Political and Security Situation

The MENA region is geopolitically a volatile region affected by political instability. The Iraqi war in 2003 and the revolutions and civil conflicts flamed by external intervention that started in 2010 have seriously affected development in Iraq, Tunisia, Egypt, Libya, Syria and Yemen. Although most Arab countries were previously on track towards achieving the Millennium Development Goals (MDGs) by the 2015 deadline, the wars and conflicts reversed progress in achieving the MDGs (IFPRI, 2016). The least developed countries (LDCs) in the region (in particular Comoros, Djibouti, Mauritania, Somalia, Sudan, and Yemen) were not expected to achieve most of the MDGs on schedule. As the International Food Policy Research Institute (IFPRI) indicated in its 2016 annual report, the intensified conflicts in Iraq, Libya, Syria, and Yemen have and continue to have spillover effects in Egypt, Jordan, Lebanon, and Tunisia while the Gaza Strip has not yet recovered from the destruction of its infrastructure in July 2014. The rest of the region was also affected by the unrest mobilized by various reasons; and thus the security concerns became the top priority at the expense of sustainable development, including enhancing food security.

The above developments affected mostly the achievement of MDG 1 and 2 on reducing poverty, hunger, and malnutrition (IFPRI, 2016). MENA is the only region in the world where poverty increased between 2011 and 2016; and poverty is projected to increase further by 2030 (World Bank, 2014). In 2016, the number of food-insecure people who needed urgent action was 14.1 million in Yemen, 7 million in Syria, 1.5 million in Iraq and 1.1 in Somalia (FSIN, 2017). An estimated 50 million people are still undernourished and the region is far behind on meeting the target of halving undernourishment according to the MDGs (IFPRI, 2016). The outlook for 2017 for countries that are at risk for famine include Yemen (17 million) and Somalia (2.9 million) as indicated by the Global Report on Food Crises (FSIN, 2017).

The report of the Crop and Food Security Assessment Mission (CFSAM, 2016) conducted in Syria by FAO and WFP found that many farmers have lost the ability to cope with the difficulties created by five years of conflict. Serious consecutive droughts in Syria and West Asia between 2006 and 2014 aggravated the situation further. As a result, wheat was grown on 900,000 hectares in the 2015/16 cropping season compared to an average of 1.5 million hectares before the Syrian crisis. As shown in Figure 4, wheat production declined from an average of 3.4 million tons, which meets Syrian domestic

FIGURE 4 CHANGES IN WHEAT PRODUCTION IN SYRIA FROM 1966 TO 2016



consumption needs, to 1.5 million tons. Syria was the only self-sufficient Arab country in major staple food crops. In good rainy years before drought and civil war, Syria produced about 4.8 million tons of wheat and exported about one million tons. The key findings of the recent FAO report "Counting the Cost: Agriculture after six years of crisis" (FAO 2017), are presented in Box 1.

Similarly, Iraq is another Arab country with high agriculture potential that achieved a high level of food security before the 2003 war started despite the embargo because of relatively better political stability. However, after the 2003 war, civil conflicts and violence caused massive population displacement and migration as well as serious deterioration in food and nutritional security.

D. Rural to Urban and Overseas Migration

According to the World Bank (2014), there are several interrelated drivers to migration including **political drivers** such as discrimination/persecution, corruption and injustice, poor governance and political instability; **environmental and physical drivers** including climate change implications such drought, resource depletion and exposure to risk; **economic drivers** including poverty and loss of livelihoods; **social drivers** including poverty, marginalization and lack of education opportunities; and demographic pressure.

Globally in 2015 there were about 65.3 million forcibly displaced people, 21.3 million refugees and 10 million stateless, according the 2016 statistics of UNHCR. According to the same source, 53 percent of the global refugees come from three countries; namely Syria (4.9 million), Afghanistan (2.7 million) and Somalia (1.1 million). The number of displaced people in 2016 in Syria is 4.8 million, in Yemen 3.2 million, 3.1 million in Iraq and 2.1 million in Somalia.

The civil strife, insecurity, serious consecutive droughts, food insecurity and the high level of unemployment contributed to the massive displacement of populations, rural to urban, and overseas migration. The economies and the pressure on services affected several Arab countries like Lebanon, Jordan and Egypt by the large number of refugees hosted from the Arab countries where civil strife escalated.

E. Policy and Institutional Changes Relevant to Agriculture

After the food crisis in 2008, the Arab

BOX 1

SUMMARY OF FAO REPORT
"COUNTING THE COST: AGRICULTURE IN SYRIA AFTER SIX YEARS OF CRISIS"

Agriculture in Syria is by far the most important sector of the economy. In 2001, agriculture made up as much as 27 percent of the GDP, and despite falling to 19 percent of GDP in 2011, it still made up more than twice the share of manufacturing. In the same year, the rural population of was just under 50 percent and agriculture employed 26 percent of the economically active population. To date, a clear picture of the impact of the six-year crisis on agriculture has been lacking. The latest study, which was conducted by FAO mission in 2017, could be summarized as follows:

1- The most striking impact of the crisis is the internal displacement of a third of the population – over six million people – in 2016.

2- There has been a very significant decrease in net income in the rural community due to higher production and marketing costs, and very constrained purchasing power as the index of food consumer prices increased by 800 percent between 2010 and 2016.

3- Vast areas of agricultural land with orchards or crops have been destroyed and farmers are facing shortages of agricultural inputs (seeds, fertilizers, fuel to power irrigation pumps, etc.) or are unable to afford them due to soaring prices. The livestock subsector accounted for the highest proportion of damage (value of livestock deaths) followed by perennial crops (value of destroyed trees).

4- The overall financial cost of damage and loss in the agriculture sector over the 2011–2016 period is estimated to be at least USD 16 billion, which is equivalent to just under one third of Syria's GDP in 2016.

5- More than 25 percent of households overall reported lacking seeds, and more than 50 percent lack access to fertilizers, while 35 percent do not use fertilizers at all. Pesticides are now mainly sourced from informal markets, resulting in the use of poor quality and sometimes dangerous products. Pests and diseases were reported as being of particular concern for perennial crop production.

6- The cost of damage in different sectors is estimated:

Irrigation systems and other kinds of agricultural infrastructure, such as buildings, are estimated at USD 3.2 billion.

a. Loss for perennial crops is estimated at about USD 1.5 billion
b. The livestock sector suffered high damage and loss amounting to USD 5.5 billion.
c. The total damage to agricultural infrastructure and assets is estimated at USD 3.2 billion, accounting for almost half of the total damage to the agriculture sector.

7- The FAO study assessment estimates that the costs of meeting the agricultural recovery over a three-year period would be of the order of USD 11 billion at 2016 prices. Due to an assumed partial return of rural migrants from urban areas and abroad, this total increases to USD 14.9 billion under a "partial return to peace" scenario, and to USD 17.1 billion under a "transition to peace" scenario.

8- An important consideration for recovery of the agriculture sector is the question of production incentives, and the linked issues of irrigation and climate smart agriculture, and to tackle this effectively, the water management approach will need to include the following elements:

- Adaptation of crop selection patterns to maintain economic profitability – this could mean a movement away from high water intensity crops to more water-efficient or drought-tolerant crops such as vegetables, pulses and spices;
- Adoption of conservation agriculture methods to reduce needs in water and fertilizers, including landscape-based approaches.
- Improved efficiency of irrigation systems.

countries focused much more on agricultural policies as one of the most important tools for the development of the agricultural sector and sectors affecting performance in agricultural development, in order to deal with the food deficit and achieve Arab food security on a sound economic basis. When the sudden jump in food prices in 2008 further culminated in 2011, many Arab countries put agriculture and food security at the top of their national agenda. This was driven particularly by the high food import bills paid by Arab countries since the Arab world is the largest food-deficit region in the world as well as the largest food-importing region globally. The fact that several factors were behind the increase in food prices, it was apparent that prices of major food commodities would never go back to the levels prior to the 2008 food crisis.

During the food crisis several major food-exporting countries put embargo on exports of major food commodities like rice, preventing food-deficit countries that have financial resources from buying certain food commodities from the global market. To cope with this situation, policy makers of Arab countries at the highest level adopted the Kuwait Declaration in 2011. Entitled "Elevating the Standard of Living for Arab Citizens" and declared at the Arab Economic Summit in Kuwait in 2011, it underlines the importance of raising living standards in Arab countries in three major areas including food security:

- The Arab leaders called for launching an emergency Arab food security program.
- On water security, they tasked the Council of Arab Water Ministers with preparing a strategy for water security in the Arab region to face challenges and requirements for sustainable development.
- As for poverty, they called for implementing the Arab program for combating poverty and financing its programs for four years, while inviting Arab finance institutions to contribute to financing them.

In line with the Kuwait Declaration, several Arab countries invested more in sustainable agricultural development to enhance food security and a number of countries formed national food security programs. Besides investment in the national agricultural sector, a number of countries, particularly those in the Gulf with very limited agriculture potential, made considerable foreign investment in Sub-Saharan Africa and Central Asian countries to contribute to their national food security. The Arab African Economic Forum in Kuwait in early November 2013 developed the "Third Africa-Arab Summit: Kuwait Declaration", which adopted a recommendation to: "Strengthen cooperation on issues concerning Rural Development, Agricultural Development and Food Security".

The Gulf countries in particular made good use of these recommendations and made considerable investments in agricultural projects in Sub-Saharan Africa (SSA) to enhance their food security. However, Arab countries still have a very long way to realize the underutilized agricultural potential in the Arab world that could enhance food security at both national and regional levels. It is essential for Arab countries to enhance regional cooperation to promote agricultural production based on complementarities and their comparative advantages to achieve regional food security and reduce the unwarranted food import bills.

Due to the ongoing conflicts, violence and insecurity over the last five years, most countries of the region were distracted from implementing policies for critical sustainable development priorities. Egypt, however, was an exception to this trend. According to IFPRI (2014/2016), the Egyptian government continued its effort to reform subsidies on major food items and fuel which are environmentally and socially detrimental. Steps were taken towards national economic and distributional gains (Breisinger, et.al., 2014). Furthermore, Saudi Arabia and the United Arab Emirates started reforms by lifting subsidies on important commodities, water resources and services.

IV. TRENDS AND CHANGES IN NATIONAL AGRICULTURAL RESEARCH SYSTEMS

Egypt ranked highest in agricultural R&D spending and Morocco ranked second. Total agricultural R&D in the ten countries grew by

TABLE 3 **TOTAL AGRICULTURAL R&D SPENDING IN ARAB COUNTRIES, 2009 AND 2012**

Country	Total spending, 2009 (in million 2005 PPP dollars)	Total spending, 2012 (in million 2005 PPM dollars)	Spending as a share of Ag GDP (%), 2012
Algeria	68.6	81.7	0.21
Egypt	379.3	471.0	0.44
Jordan	34.0	32.3	1.84
Lebanon	21.7	34.1	0.95
Mauritania	11.2	8.9	0.80
Morocco	127.4	131.2	0.49
Oman	81.4	97.0	6.51
Sudan	52.4	30.0	0.19
Tunisia	49.4	55.9	0.64
Yemen	47.6	34.5	0.56

Source: Stads, 2015

8 percent between 2009 and 2012. Lebanon had the highest increase (more than 50 percent) in investments in infrastructure and equipment. Algeria and Egypt also had largely increased their agricultural R&D spending, driven by salary-related increases. The Omani government promoted a considerable increase in public funding to support agricultural R&D. On the other contrary, Sudan and Yemen experienced a sharp decline in their agricultural R&D spending levels between 2009 and 2012 (Stads, 2015).

Table 3 presents the total agricultural R&D spending between 2009 and 2012 in a number of Arab countries. One main observation is that, despite their great agricultural potential, Algeria and Sudan seriously underinvest in agricultural R&D, each spending only 0.2 percent of their GDP on agricultural research, which is insufficient given the importance of agriculture in national economics. In contrast, Oman's intensity ratio reached 6.5 percent in 2012, which is one of the highest shares in the world.

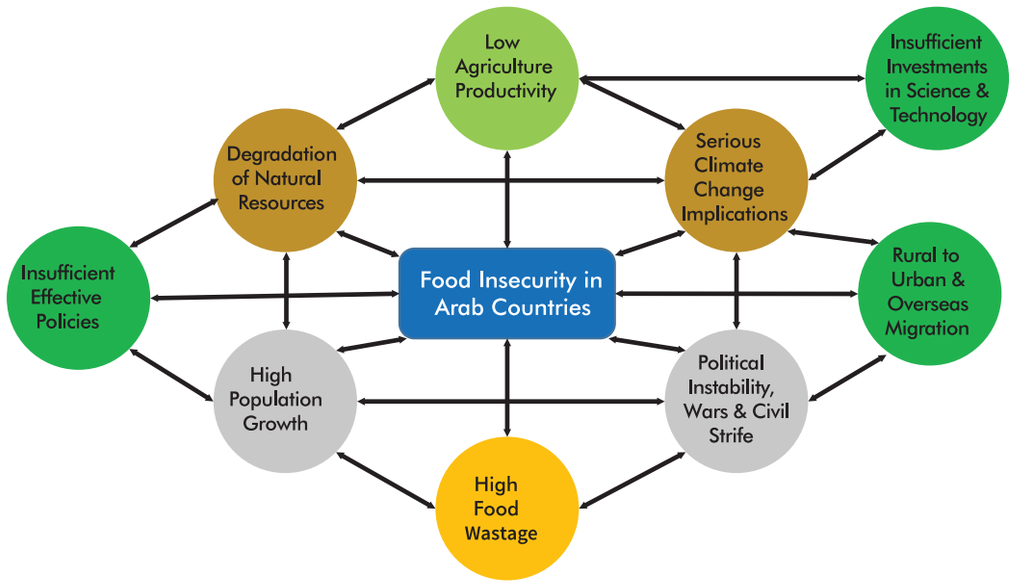
Research focus in Arab countries is predominantly commodity-oriented, in favor of crops, fisheries and livestock. National Agricultural Research Systems allocate their resources priorities and commodities of national significance following underlying national thematic priorities. Roughly half of the time of the researchers in Egypt, Jordan, Oman and Yemen was allocated for crops, mainly wheat, fruits, vegetables, and olives. Livestock research accounted for 10-30 percent of full time equivalent (FTE) researchers in Algeria, Egypt, Jordan, Lebanon, Mauritania, Morocco, Oman, Sudan, Tunisia, and Yemen (Stads, 2015). Fisheries research is given high priority in Mauritania, Morocco and Oman.

Given chronic water scarcity in the region and the fact that the agricultural sector consumes more than 80 percent of the scarce water resources, improving water-use efficiency in agriculture should be a major research priority in the region, although current resources allocation for water research does not necessarily reflect this priority. Only 7-10 percent of researchers are allocated for research on natural resources (Stads, 2015).

The number of agricultural researchers increased in Arab countries between 2009 and 2012, either modestly as in both Jordan and Sudan or considerably as in Egypt and Lebanon. Egypt's agricultural R&D system increased its researchers from 6,490 to 8,420 between 2009 and 2012. Egypt's agricultural R&D system is among the world's largest in terms of human resource capacity. With the exception of Jordan, the number of PhD-qualified researchers increased during 2009-2012 in all countries (Stads, 2015).

As a result of scientific research, many improved technologies were locally developed, and some found their way to the hands of farmers and

FIGURE 5 **FACTORS CONTRIBUTING TO FOOD AND NUTRITIONAL INSECURITY IN THE LAST TEN YEARS IN THE ARAB WORLD**



made substantial impact. However, many more technologies were restricted to laboratories, which requires more investment in technology transfer and strengthening the extension systems.

V. CHANGES IN FOOD SECURITY IN ARAB COUNTRIES SINCE 2006

According to the World Food Summit held in Rome in 1996, "food security exists when all people, at all times, have physical, social and economic access to sufficient, safe, and nutritious food which meets their dietary needs and food preferences for an active and healthy life".

To achieve food and nutritional security, the following four dimensions must be considered:

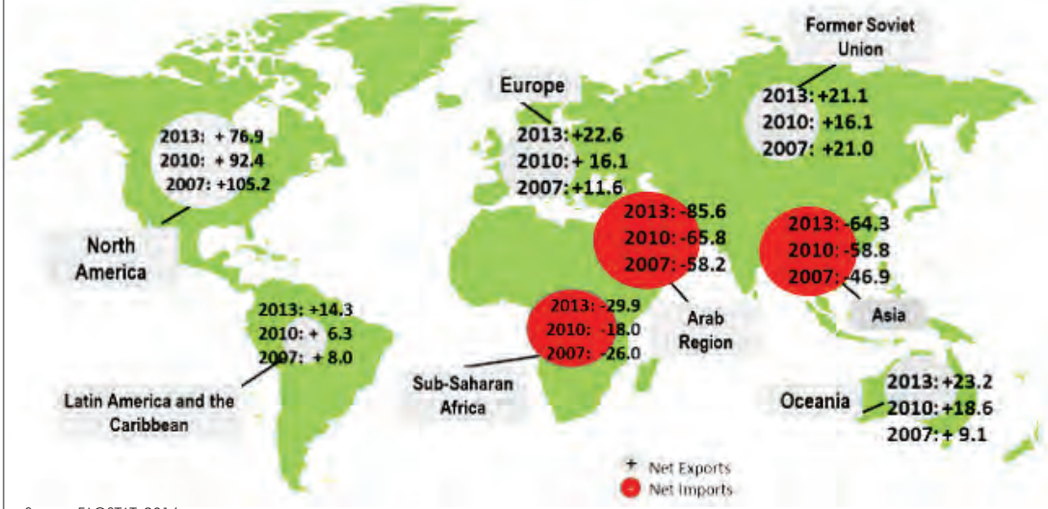
- Food availability, related to domestic production & market availability;
- Food access, related to affordability to people as food producers and/or consumers;
- Stability, no or minimum fluctuation in production and in market prices related to affordability;
- Utilization, food nutritional quality and food safety.

Agricultural productivity in all Arab countries except Egypt is already way below the global average because of insufficient enabling policy environment, insufficient investment in agricultural research and development and the lack of improved technologies in the hands of farmers. Thus, in most countries advanced agricultural technologies were not available to farmers, particularly the resource-poor farmers that contribute to more than 80 percent of national agricultural production in these countries. However, ICARDA, based on ground-field experience over the last 40 years, has demonstrated that agricultural productivity in all Arab countries can be increased substantially despite the limitation in natural resources (El Solh, 2014). It is essential to upscale successful case studies to ensure large impact towards food security.

A. The Gap Between Consumption and Production is Growing Wider

In the last ten years, from 2006 to 2016, the food and nutritional security has deteriorated further in several Arab countries despite bright spots in certain countries. Based on the earlier sections of this chapter, there are several factors that affected food and nutritional security in Arab countries as indicated in Figure 5.

FIGURE 6 **GLOBAL CEREAL TRADE: CEREAL IMPORTS AND EXPORTS (IN MILLION MT) IN DIFFERENT PARTS OF THE WORLD IN 2007, 2010 AND 2013**



Source: FAOSTAT, 2016

The gap between food production and consumption has been growing over the years in Arab countries. Cereals imports in Arab region, which are already the highest in the world, have grown from 58.2 million tons in 2007 to 65.8 million tons in 2010 to 85.6 million tons in 2013 (Figure 6).

In monetary terms the total Arab food gap has increased to very high values: from USD 18 billion in 2005 to about USD 29 billion in 2010, and to about USD 34 billion in 2014. The average annual increase in the gap was 7.3 percent during the period 2005-2014, as shown in Table 4. This is a clear indicator of the inefficiency of the implementation of Arab agricultural development plans to reduce the food gap. It is apparent that the deficit is widening in all food commodities with gap increases of 6.5 to 12.5 percent between 2005 and 2014 except in the case of vegetables and fruits recording a surplus of 13 percent, 8 percent and 2 percent, respectively (Table 5). There is an improvement in the production of milk and dairy products where the deficit has been reduced by 7 percent.

The food gap differs greatly among the Arab countries based on their populations, levels of income and patterns of consumer habits, in addition to the availability of natural and agricultural resources and the efficiency of their use. This is in addition to the difference in their investment and agricultural research, development and technology transfer to farmers. However, five Arab countries (Saudi Arabia, Egypt, UAE, Algeria, and Kuwait) represented about 67.9 percent of the total value of Arab food gap in 2014 (AOAD, 2015).

Self-sufficiency rates continue to be at low levels for the staple food commodities as shown in Table 5 for the same reasons stated in food shortage. Table 3 shows sufficiency ratios for three groups at regional level as follows:

- The first group includes commodities where surplus or close to self-sufficiency ratio have been achieved and this includes vegetables, fruits, potatoes and fish.
- The second group includes food commodities in which moderate sufficiency has been achieved. These include dairy products, meat, legumes, and rice.
- The third group includes food-deficit goods, which include cereal, flour, wheat, sugar, and vegetable oils.

Food self-sufficiency at the country and sub-regional levels vary widely in the Arab world. At country level, it ranged between about 10 percent in Qatar and 87 percent

TABLE 4 THE FOOD SECURITY GAP (IN MILLION USD) IN THE ARAB WORLD FOR THE GROUPS OF MAIN COMMODITIES

	Food security gap (in million USD)			% change in food gap value	% of food Self-sufficiency		
Year	**2005**	**2010**	**2014**	**2005-2014**	**2005**	**2010**	**2014**
Total	18060	29409	34183	7.3			
Cereals and flours	9661	17479	22441	9.8	49.7	44.6	52.6
Wheat and flours	4497	7981	9429	8.6	49.9	42.8	51.5
Barley	1400	2299	4039	12.5	32.4	40.7	40.6
Rice	1470	3095	3996	11.7	70.6	55.9	62.5
Maize	2098	3643	4841	9.7	36.2	30.9	30.8
Potatoes	104	-22	-170	surplus	100.6	101.2	105.4
Sugar	1359	2989	2430	6.7	38.5	33.4	35.7
Legumes	414	507	730	6.5	56.2	55.5	65.2
Oils	1960	3987	4469	9.6	28.1	36.8	35.1
Vegetables	-66	-2007	-2892	surplus	100.1	102.7	113.1
Fruits	448	-1136	-1160	surplus	95.9	97.5	107.9
Meat	2610	6018	7429	12.3	80.9	75.5	77.5
Milk and its product	2856	2088	1471	-7.1	71.4	77.7	82.2
Eggs	57	5	94	5.7	95.9	95.6	97.5
Fish	-1343	-499	-659	-7.6	103.1	100.7	102.2

Source: Arab Monetary Fund; Unified Arab Economic Report for 2016 based on AOAD publication on situation of Arabian food security.

in Sudan, and at the sub-regional level, the ratio ranged between 30 percent in the Gulf Cooperation Council (GCC) countries and 81 percent in the Nile Valley countries in 2011 (Table 5).

B. Classification of Food Security Risk in Arab Countries

A conceptual framework links food security to economic and social development to base the overall food insecurity risk in Arab countries (Breisinger, et.al. 2014). Following this concept, the countries are categorized by assessing two major indicators: a macro-economic level and a micro-household nutritional and health status level as measures of food insecurity (Breisinger, et.al. 2014). The macro-level indicator is defined according to Breisinger et.al. (2014) as the share of food imports divided by total exports plus net remittance inflows (food imports / [total exports + net remittance inflows]). This definition reflects the ability of a country to finance food imports through exports of goods and the revenues from services and the remittances received. The micro-level indicator classifies Arab countries based on the prevalence of child undernutrition (expressed as a percentage) and is used as a micro-level food-insecurity indicator.

Combining both indicators, macro and micro food security measures of economic growth and malnutrition reflected in the number of stunted children, Figure 7 shows that the food insecurity risk is extremely alarming in Yemen, Comoros, Sudan, and Mauritania. This risk is serious in Algeria, Egypt, Morocco, Jordan, Lebanon and Syria. It is moderate in Libya and Tunisia while it is low in the Gulf countries.

However, all these assessments do not take into consideration the agricultural potential of Arab countries. This potential should be well explored to increase domestic food production

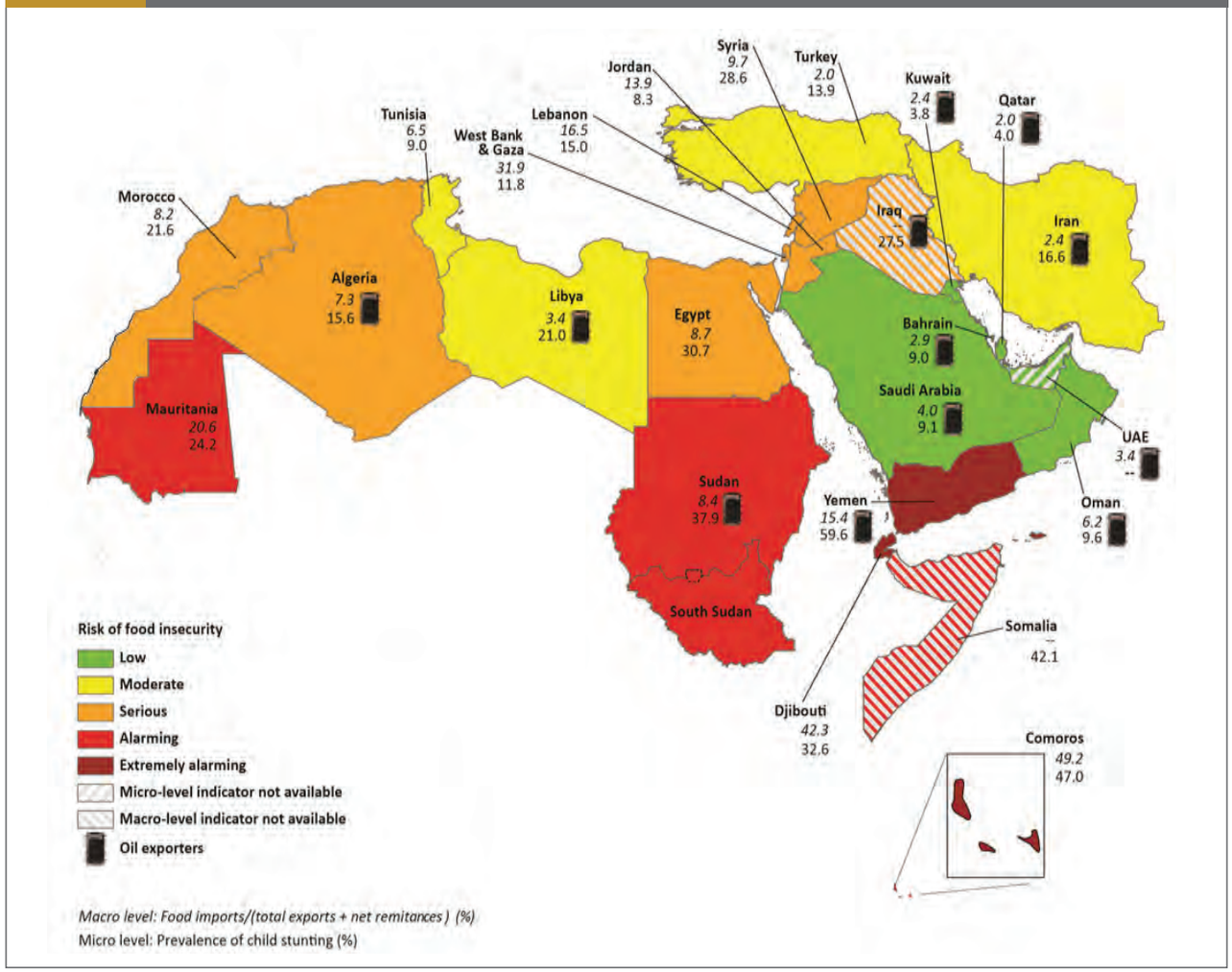
TABLE 5 **SELF-SUFFICIENCY RATIO IN TOTAL FOOD COMMODITIES AND CEREALS IN VARIOUS ARAB COUNTRIES**

	Food Self-Sufficiency Ratio (%)					
Country/Sub-Region	**Total Food**			**Cereals**		
	2005	2011	2014*	2005	2011	2014**
Bahrain	12.96	12.81	19.0	0	0	0
Kuwait	28.38	21.68	25.0	3.88	2.56	3.84
Oman	45.21	34.52	49.4	1.17	9.22	2.30
Qatar	12.18	9.90	15.8	3.12	0.37	0.42
Saudi Arabia	44.52	34.49	32.7	26.75	11.15	4.58
United Arab Emirates	21.13	18.66	21.3	0.85	1.06	2.05
GCC	37.40	29.45	29.9	20.25	9.12	3.97
Yemen	51.53	31.45	63.2	22.59	10.92	17.45
Arabian Peninsula	39.74	29.74	34.4	20.54	9.46	6.46
Iraq	75.34	82.84	90.5	55.51	95.42	97.20
Jordan	56.26	53.09	66.6	5.05	3.66	3.70
Lebanon	73.23	61.03	74.7	18.05	10.96	13.80
Syria	85.23	80.62	84.3	74.00	57.98	47.86
Palestine	81.55	72.26	79.3	19.69	10.00	9.48
West Asia	77.20	75.52	82.6	54.86	56.48	56.08
Egypt	83.68	78.96	88.0	69.63	56.30	66.04
Sudan	91.15	86.84	94.4	75.74	70.59	60.72
Nile Valley	85.51	80.8	86.4	70.74	59.09	65.42
Algeria	53.48	70.04	75.2	29.88	31.96	21.65
Libya	44.95	43.09	38.3	10.79	7.06	9.49
Mauritania	68.49	70.03	88.0	19.17	36.04	47.86
Morocco	89.60	80.40	100.0	46.09	58.91	68.00
Tunisia	71.78	68.49	89.5	47.82	46.79	42.42
North Africa	66.87	71.58	88.6	35.75	43.19	30.35
Comoros	-	-		-	-	
Djibouti	4.04	2.00	10.1	0	0	0
Somalia	69.17	74.26	96.0	32.89	33.00	31.23
African Horn	64.80	63.52	90.7	28.46	26.70	25.42
Arab Countries	70.48	71.69	84.4	49.74	45.55	45.16

Source: Abdul-Karim Sadik. 2014. The State of Food Security and Agricultural Resources. AFED
* Compiled by the authors based on data in AOAD, 2015.
** AOAD. 2015. Arab Agricultural Statistics Yearbook, Vol 35.

and reduce food imports. ICARDA's 40 years of field experience in agricultural research for development demonstrates that food security can be enhanced in most Arab countries through modernization of agriculture production systems and the transfer of improved technologies to farmers. This has already been done by bridging the yield gap

FIGURE 7 COMBINED MACRO AND MICRO FOOD INSECURITY RISK BASED ON 2011 ASSESSMENT



between actual farmers' production and the potential production, which can be up to 147 percent (El Solh, 2016).

Arab countries differ in their agricultural potential to enhance food security. Table 6 shows the cultivated areas which include the arable and permanent cropland and total renewal water resources, irrigated area and the area that potentially can be put under irrigation. All these factors provide important elements for agricultural potential, which could be exploited to enhance food security. However, except for Sudan, Arab countries have limited horizontal potential to expand agriculture. Nevertheless, there is great potential to increase agricultural productivity vertically considering that agricultural productivity in most Arab countries is way below the global average.

A project by ICARDA titled Enhancing Food Security in Arab Countries provided an important example on realizing the agricultural potential by bridging the yield gap in wheat. In an average of six seasons (2010/2011-2015/2016) targeting whole provinces in nine Arab countries, wheat productivity yield gap was increased by up to 124 percent under irrigated conditions in Sudan, up to 96 percent under supplemental irrigation in Yemen and up to 84 percent under rainfed conditions in Syria (Table 7). At the national level, there are clear examples that both Syria and Iraq were the only Arab countries that managed to achieve self-

TABLE 6 **ARAB COUNTRIES' POTENTIAL FOR EXPANSION IN AGRICULTURE CLASSIFIED ON THE COMBINATION OF CULTIVATED AREA AVAILABLE AND AVAILABILITY OF RENEWABLE WATER RESOURCES (AQUASTAT 1999-2014)**

Country	Total area of the country (1000 ha)	Arable land area (1000 ha)	Cultivated area (arable land + permanent crops) (1000 ha)	Total renewable water resources (10^9 m^3/year)	Area equipped for irrigation: actually irrigated (1000 ha)	Irrigation potential (1000 ha)
Sudan	187,936	19,823	19,991	37.80		
Morocco	44,655	8,130	9,592	29.00	1448	1664
Algeria	238,174	7,469	8,439	11.67	1065	1300
Syria	18,518	4,662	5,733	16.80	1210	
Iraq	43,505	5,034	5,269	89.86		5554
Egypt	100,145	2,670	3,745	58.30	3422	4420
Tunisia	16,361	2900	5,232	4.62	405	560
Saudi Arabia	214,969	3,502	3,647	2.40	1191	
Yemen	52,797	1,248	1,546	2.10		
Mauritania	103,070	450	461	11.40	23	250
Libya	175,954	1,720	2,050	0.70	316	40
Jordan	8,932	238	322	0.94	76	85
Lebanon	1,045	132	258	4.50	90	178
Palestine	602	64	148	0.84		
UAE	8,360	38	773	0.15	76	
Oman	30,950	38	69	1.40		
Kuwait	1,782	10	16	0.02	10	25
Qatar	1,161	13	16	0.06	6	52
Bahrain	77	2	5	0.12	4	4

High Potential **Medium Potential** **Limited Potential** **Extremely Limited Potential**

sufficiency in staple food crops before the wars and civil strife started in these countries. Food security deteriorated drastically after the war in Iraq in 2003 and after the disturbances in Syria in 2011. So there is no reason why Arab countries could not exploit their agricultural potential to enhance food security.

Based on their potential, Arab countries can be categorized into four groups to enhance food security both horizontally and vertically (Figure 8):

- **Group A, High Potential Countries:** Algeria, Egypt, Iraq, Morocco, Sudan and Syria.
- **Group B, Medium Potential Countries:** Mauritania, Saudi Arabia, Tunisia and Yemen.
- **Group C, Limited Potential Countries:** Jordan, Lebanon and Libya.
- **Group D, Extremely Low Potential Countries:** Bahrain, Kuwait, Oman, Qatar, United Arab Emirates.

Despite the high arable area in Libya, it was characterized as a limited potential country because of very limited renewal water resources. Data is not available for Comoros Islands, Djibouti and Somalia.

Considering the different potentials for enhancing food security in Arab countries, it is apparent that regional collaboration can enhance agricultural productivity, both horizontally and

TABLE 7 **GRAIN WHEAT YIELD (T/HA) AS AN AVERAGE OF SIX SEASONS (2010/2011-2015/2016) IN THE FARMERS' DEMONSTRATION FIELDS VERSUS FARMERS' TRADITIONAL FIELDS**

Country	Egypt	Iraq ****	Jordan *	Morocco		Palestine ***	Sudan	Syria		Tunisia		Yemen **	Overall mean
Production system *****	I	I	R	R	SI	R	I	R	SI	R	SI	SI	
Participating Farmers	8.51	5.50	2.52	3.63	6.56	2.48	3.89	2.33	5.40	3.14	5.35	3.36	4.39
Non-Participating Farmers	6.87	4.30	2.03	3.17	5.20	2.09	2.44	1.75	4.84	2.49	4.11	2.31	3.47
Average increase (%)	24	28	24	15	26	19	59	33	12	26	30	45	28
Maximum yield	10.29	6.20	3.64	5.15	7.98	2.97	5.48	3.23	7.39	4.40	7.39	4.53	5.72
Potential max increase %	50	44	79	63	53	42	124	84	53	76	80	96	70

* Av of 2012-2016 seasons; ** Av of 2013-2016 seasons; *** Av of 2014-2016 seasons; **** Av of 2016 season; *****
R: Rainfed, SI: Supplemental Irrigation, I: Full irrigation

Source: Enhancing Food Security in the Arab Countries, ICARDA/National Programs Project (2011 to present) Unpublished data provided by the courtesy of Dr. Habib Halila, ICARDA Project Manager.

vertically, to achieve food security at the regional level. This collaboration should be based on the complementarities and comparative advantages between Arab countries.

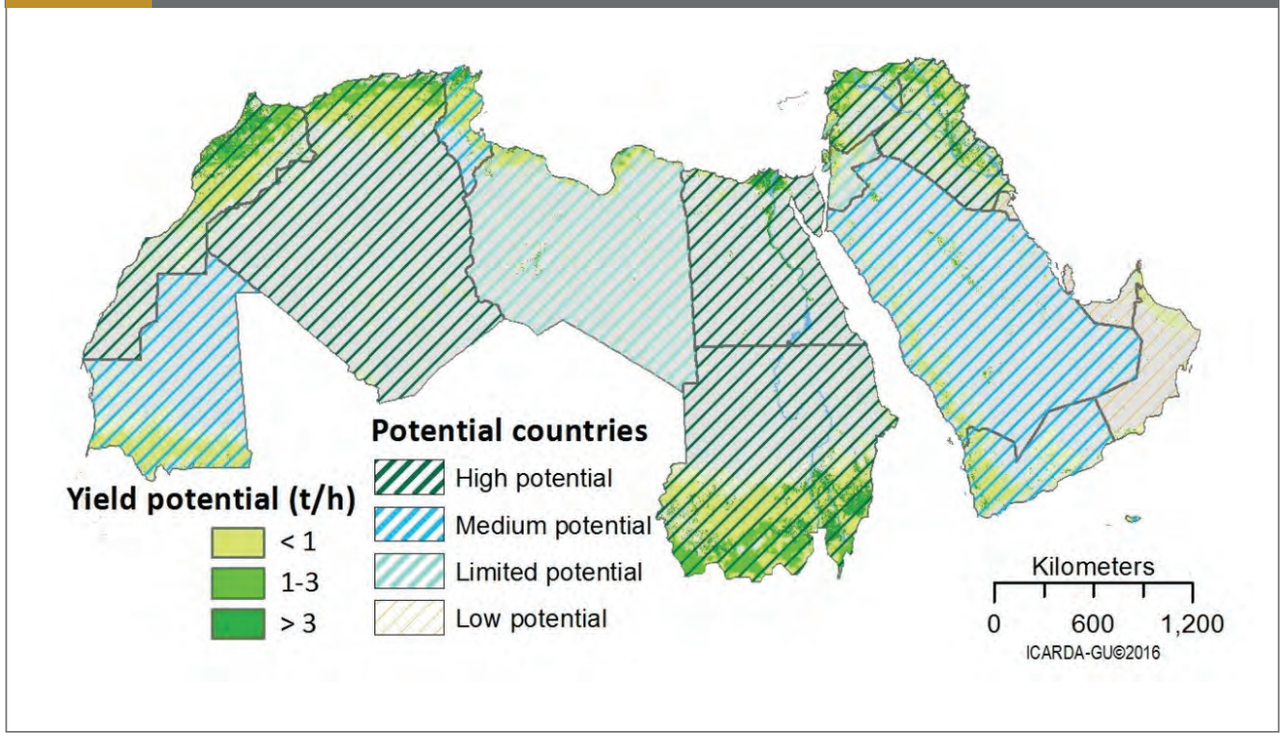
VI. CONCLUSION AND RECOMMENDATIONS

Before the upheavals that started late in 2010 in Arab countries, most Arab countries were making good progress to achieve the Millennium Development Goals (MDGs) including MDGs 1 and 2 on poverty and hunger. However, after the upheavals, which are still escalating in several countries including Iraq, Syria, Libya and Yemen, this progress has been halted and even reversed not only in these countries but in almost all Arab countries because of the spillover effects of violence. Thus sustainable development, including enhancing food security, slipped down as a first priority in most Arab countries. What added to these developments is the 50 percent drop in oil prices in 2015, which also negatively affected the development plans in the oil rich countries, including the Gulf countries and Algeria. Of the countries that were affected by the upheavals, Egypt was the exception since the Egyptian government continued its effort to reform subsidies, including cutting environmentally and socially detrimental fuel subsidies (IFPRI, 2016).

In the last ten years, the gap between food production and consumption has widened further in the Arab world, due to several factors including high population growth, the degradations of natural resources (water resources, land and biodiversity), serious implication of climate change and low investment in science and technology. These factors added to higher risks for food insecurity, on top of the recent upheavals in a number of countries with high agricultural potential. With respect to their vulnerability to food insecurity, Arab countries were classified using three indicators: macro-economic, micro-household nutritional and health and agricultural potential indicators. Arab countries should work together to exploit their agricultural potential based on their complementarities and comparative advantages to achieve food and nutritional security.

Considering the changes in the region over the last ten years, the following three areas are high priorities for policy intervention to improve food and nutrition security in Arab countries:

FIGURE 8 **POTENTIAL OF ARAB COUNTRIES TO ENHANCE FOOD SECURITY BASED ON AGRICULTURAL POTENTIAL**



- In conflict areas, peace-building through investment in sustainable development including reducing poverty and enhancing food and nutritional security activities at local and national levels.
- Outside conflict areas, strengthen education and adopt subsidy reforms to improve food and nutritional security.
- Attention is essential in enhancing both macro and micro food security as well as the utilizing the agricultural potential of Arab countries to enhance food and nutritional security through science and technology.

Considering the potential of various Arab countries for enhancing food security, regional collaboration is essential to utilize agriculture potential effectively, both horizontally and vertically, to achieve food security at the regional level. This collaboration should be based on the complementarities and comparative advantages of each of the Arab countries and the following are important considerations:

- Based on agricultural potential, increasing food production vertically by bridging yield gaps in staple crops and whenever possible expanding production horizontally;
- Building food reserves and stocks;
- Reducing food losses at all stages of the food chain including at the consumption stage;
- Promoting financial mechanisms to absorb shocks against food price fluctuations;
- Ensure long-term procurement sources of cereals as the staple food for protection against the sudden banning of food exports in case of a global food crisis.

In order to insure the aforementioned consideration there is an urgent need for effective policies and mechanisms to enhance regional cooperation to ensure national and regional food and nutritional security.

More investment is needed in scientific innovation is to make a difference to bridge the growing gap between production and consumption.

Innovative research outputs and advanced technologies can help both farmers and pastoralists to overcome or minimize the negative impacts of climate change implications on agriculture.

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