

## Chapter 2. The Middle East and North Africa: Prospects and challenges

*This chapter reviews the prospects and challenges facing the agricultural sector in the Middle East and North Africa (MENA) region. A dominant concern in the MENA region is its high and growing dependence on international markets for key staple food products, as arable land and water grows scarcer. Policies in the region support grain production and consumption, with the result that 65% of cropland is planted with water-thirsty cereals, in particular wheat which accounts for a large share of calorie intake. The outlook for the MENA region projects slow growth in food consumption, gradual changes in diet to include higher livestock consumption, continued water use at unsustainable rates, and continued and increasing reliance on world markets. An alternative approach to food security would reorient policies towards rural development, poverty reduction, and support for production of higher-value horticulture products. Such a change would contribute to more diversified and healthier diets, but would require building the capacity of farmers to minimise risk while raising higher value crops*

## Introduction

The Middle East and North Africa (MENA) region<sup>1</sup> consists of a heterogeneous group of countries ranging from the high-income oil-exporting countries in the Gulf, to middle-income and lower middle income countries as well as least developed countries such as Sudan, Yemen and Mauritania (Table 2.1, col. 1). As one of the largest global net food importing regions, it faces considerable uncertainties on both the supply side and the demand side. The former include limitations on, and sustainability of, the production base. Demand side concerns include the impact of ongoing geopolitical conflict, instability in global oil markets which provide the primary source of economic wealth in the region, and rising diet and nutritional issues.

A dominant concern in the MENA region is its high and growing dependence on international markets for key staple food products. This concern has led to a suite of policies which appear strikingly inappropriate given the region's resources. For example, while MENA is one of the most land and water constrained regions of the world, it has the lowest water tariffs in the world and it heavily subsidises water consumption at about 2% of its GDP. As a result, the productivity of water use is only half the world average (World Bank, 2018). Cropping patterns in the region are also difficult to reconcile with the degree of water scarcity. While fruits and vegetables both consume less water and provide higher economic returns per drop, about 60% of harvested land remains in water-thirsty cereals, despite the fact that most countries in the region have a comparative advantage in the export of fruits and vegetables. A key reason for the seeming inconsistency between policy and water scarcity is a vision of food security that aims to reduce dependence on imports, particularly for cereals. At the same time, many countries subsidise the consumption of basic foodstuffs, which in conjunction with rising incomes is contributing to excess consumption of starches and sugars leading to dietary and health concerns such as obesity (FAO, 2017c).

This chapter first considers some of the principal characteristics of agriculture and fish in the MENA region, and reviews performance in terms of resources, production, consumption and trade. The chapter then presents medium-term projections (2018-27) for the agriculture and fish sectors, and then concludes with a discussion of how market balances may evolve, and key risks and uncertainties that may affect this assessment.

## The context

Despite their heterogeneity, countries in the MENA region share a number of characteristics, highlighted in Table 2.1. Growth in the region has underperformed, with GDP per capita growing at only 1.6% per year from 2001 to 2016, while middle income countries overall grew by 4.3% p.a. over the same period (col. 2). This is partly due to relatively high population growth in the region which was still over 2% p.a. in the last decade, higher than the global average growth rate of middle income countries during that time of 1.3% p.a. The region also suffers from severe land constraints. Less than 5% of land is arable in two-thirds of the countries of the region, while many countries (Saudi Arabia, Lebanon, Tunisia, Morocco, Yemen, Mauritania and Syria) have huge desert pastures for livestock grazing. The region is the most water-stressed in the world, and two-thirds of countries continue to use groundwater at rates exceeding renewable internal freshwater resources (col. 4).<sup>2</sup> Yet the region has the lowest water prices in the world, spends massive resources on water subsidies (about 2% of GDP) and has total water productivity of only half the world average (World Bank, 2018).

**Table 2.1. Contextual indicators for the Middle East and North Africa, 2014**

GDP per capita		Agricultural land	Arable land	Renewable internal freshwater resources	Annual freshwater withdrawals	Exports (2014)	Imports (2013)	
Current USD*	Growth in % per year, 2000-16	% of total land area (2014)		(2014) billion m3		Share of mineral fuels, lubricants and chemical products (%)	Self-sufficiency ratio (%)	
(1)	(2)	(3)		(4)		(5)	(6)	
Qatar	86 853	0.6	6	1	0.06	0.44	87	3
United Arab Emirates	44 450	-2.1	5	0	0.15	4.00	38	
Kuwait	42 996	0.1	9	1	0.0	0.9	94	
Bahrain	24 983	-0.1	11	2	0.0040	0.3574	48	
Saudi Arabia	24 575	1.2	81	2	2	24	90	33
Oman	20 458	-0.2	5	0	1.40	1.32	79	5
Lebanon	8 537	0.4	64	13	4.8	1.3	13	41
Iraq	6 703	2.7	21	12	35	66	95	54
Libya	5 603	-2.4	9	1	0.7	5.8	77	
Iran, Islamic Rep.	5 541	2.5	28	9	129	93	77	85
Algeria	5 466	2.0	17	3	11	8	98	64
Tunisia	4 270	2.3	65	19	4	3	14	75
Jordan	4 067	1.1	12	3	0.7	0.9	32	38
Egypt, Arab Rep.	3 328	2.2	4	3	2	78	31	72
Morocco	3 155	3.0	69	18	29	10	16	80
Palestinian Authority	2 961	0.6	50	11	0.81	0.42	6	16
Sudan	2 177	4.2	29	8	4	27	64	85
Syrian Arab Republic	2 058	2.1	76	25	7	17	24	
Yemen, Rep.	1 647	-2.4	45	2	2	4	41	50
Mauritania	1 327	1.4	39	0.4	0.4	1.4	4	

*Note:* All GDP per capita estimates are for 2014, except for Libya (2011) and Syria (2007), for which conflict affected availability of reliable data. GDP per capita growth for Syria is 2000-2007, and for Libya, 2000-11. Arable land includes land under temporary crops, temporary meadows, kitchen gardens and land temporarily fallow. Agricultural land includes arable land, as well as land under permanent crops, and under permanent pastures. The self-sufficiency ratio for Table 2.1 is in value terms: (value of gross agricultural production in current US dollars)\*100/(value of gross agricultural production in current US dollars + value of imports in current US dollars – value of exports in current US dollars).

*Source:* World Bank (2018); UNCTAD (2018); FAO (2018a, 2018b).

The scope of merchandise exports from the region remains limited, with over two-thirds of exports consisting of mineral fuels, lubricants and chemical products (col. 5). This narrow range of products makes exports from the MENA region nearly ten times more concentrated than in the rest of the world. Whereas the concentration index of exports in the world was 0.06 in 2014, the index was 0.44 in the MENA region (UNCTAD, 2018).<sup>3</sup> However, there is a great diversity in the reliance on petroleum exports in the region. Such countries as Iraq, Algeria, Saudi Arabia, Qatar and Kuwait export little else but mineral products, lubricants and chemicals, while Mauritania, the Palestinian Authority, Lebanon, and Morocco export very few of such products.

Finally, though the region has dramatically increased its participation in global agricultural markets as a share of GDP in the past 50 years, this surge was predominantly

due to rising imports. In 2013, domestic agricultural production accounted for 65% of the value of agricultural products consumed domestically, though this share varied from 3% in Qatar to 85% in Sudan and Iran (col. 6). The remaining agricultural products were supplied from imports.

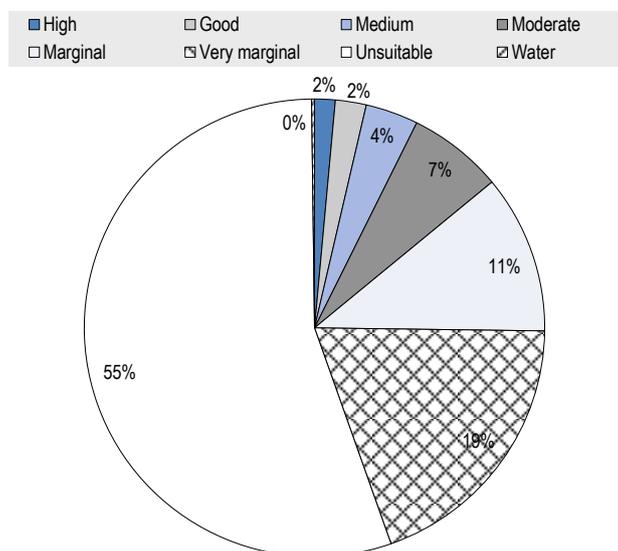
### Agricultural use of natural resources in the MENA region

The MENA region is a difficult environment for agriculture. Land and water are scarce, and both rain-fed and irrigated land in use suffer from ongoing degradation caused by wind and water erosion and unsustainable farming practices. In most countries, farms are quite small and hence subject to the challenges experienced by smallholders everywhere. Furthermore, the region is predicted to become hotter and drier in the future due to climate change.

#### *Only a small share of land in the region is arable*

Of the total land area of the MENA region, only one-third is agricultural land (cropland and pastures), while only 5% is arable (cropland) (Table 2.1). The rest of the land is either urban or dry desert. Due to the dry climate, about 40% of cropped area in the region requires irrigation (FAO, 2018a, 2018b). Figure 2.1 shows that only 4% of land in the region has soils judged of high or good suitability for rain-fed cereal cultivation and 55% is unsuitable.

**Figure 2.1. North Africa and West Asia crop suitability index (class) for low-input rain-fed cereals, 1961-1990**



Source: FAO (2018c).

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In addition to the dearth of suitable land for cultivation, soils currently used for farming are severely degraded to the point where their productivity is estimated to have been reduced by up to 30 to 35% of potential productivity (Box 2.1). Soil degradation in rain-fed systems is caused by wind and water erosion, while in irrigated systems the farming practices themselves are responsible for soil salinity and sodicity.<sup>4</sup> Three-quarters of the region's 30 million ha of rain-fed cropland are estimated to be degraded. Recent studies have estimated the economic cost of land degradation in the region at USD 9 billion each year (between 2% and 7% of individual countries' GDP). Losses from salinity alone across the region are estimated at USD 1 billion annually, or USD 1 600 to USD 2 750 per ha of affected lands (ESCWA and FAO, 2018).

### Box 2.1. Initiatives to address land quality issues in the MENA region

*Zero tillage.* Ploughing up soil can have many deleterious effects, such as loss of moisture and organic matter, which increase the vulnerability to wind and water erosion. Farming with zero or minimum tillage can avoid these problems by eliminating ploughing, leaving the soil undisturbed. Roots left from the previous crop stabilise the soil, hence protecting against erosion, while the organic matter above ground adds to the fertility and water holding capacity of the soil. Seed drills are used to insert seeds and fertiliser directly into the soil without ploughing. However, seed drills are expensive, and most smallholder farms are not able to afford the cost of about USD 30 000. A recent project by ICARDA and the Australian government has addressed this problem. Working with local farmers and craftsmen, the project has produced and distributed almost 200 affordable seed drills which are now being used across the Syrian Arab Republic, Iraq, Lebanon, Jordan, Algeria, Tunisia and Morocco.

*Soil maps.* Soil data is important for farmers and policymakers. However, soil maps are often outdated, of low resolution and not easily understandable. The Amman-based Institute of Digital Soil Mapping is serving as a regional hub for a global consortium of scientists and researchers. The consortium is developing GlobalSoilMap.net, which can combine data from several sources and present it in a user-friendly format for a broad range of audiences. The data can include soil pH, water storage electrical conductivity and carbon content data derived from remote sensing, near- and mid-infrared spectroscopy and field sampling. The initiative can also make use of the Global Soil Partnership system of the International Network for Soil Information Institutes. In addition, the European Union, the African Union and FAO have recently published a Soil Atlas of Africa (Jones et al., 2013).

*Sources:* [www.icarda.org/conservation-agriculture/zero-tillage-seeders](http://www.icarda.org/conservation-agriculture/zero-tillage-seeders), cited in ESCWA and FAO (2018).

### *Land productivity is low compared to other regions*

An overall indicator of the productivity of land use is the value of gross agricultural production per ha of agricultural land, which is lower in MENA than in most areas of the world (Table 2.2).<sup>5</sup> Of the major regions, only Sub-Saharan Africa has a worse performance. The low value of production per hectare reflects the high share of arable land devoted to low-yield temperate crops, as well as the low productivity of desert pastures. Not all countries perform so poorly. Egypt, with rich soils, irrigated cereals production and virtually no pastures, produces over USD 6 000 worth of products on each hectare of agricultural land, while Bahrain, which produces only horticultural crops and livestock, produces over USD 4 000 worth of product. Jordan, Lebanon, the Palestinian Authority, the UAE and Kuwait also produce over USD 1 000 worth of product per hectare, with very little area devoted to cereals.<sup>6</sup>

Table 2.2 also allows a comparison of the growth in land productivity in the MENA region versus other developing regions. While progress was good in the 1970s, the relative performance of MENA has been less impressive in more recent decades. Since the 1980s, decade to decade growth in the MENA region has ranked at the bottom of the four developing regions in Table 2.2, indicating a relative deterioration of its performance compared to other developing regions.

**Table 2.2. Value of gross production per hectare of agricultural land  
(constant 2004-2006 prices in thousands of international dollars per year)**

	1961-70	1971-80	1981-90	1991-00	2001-14
World	189	234	286	334	449
Western Europe	1 284	1 541	1 810	1 878	1 962
North America	261	326	375	449	540
East Asia	209	269	364	518	829
Latin America and Caribbean	138	169	213	258	373
Sub-Saharan Africa	55	67	79	104	146
MENA	85	111	142	162	226

Source: FAO (2018b).

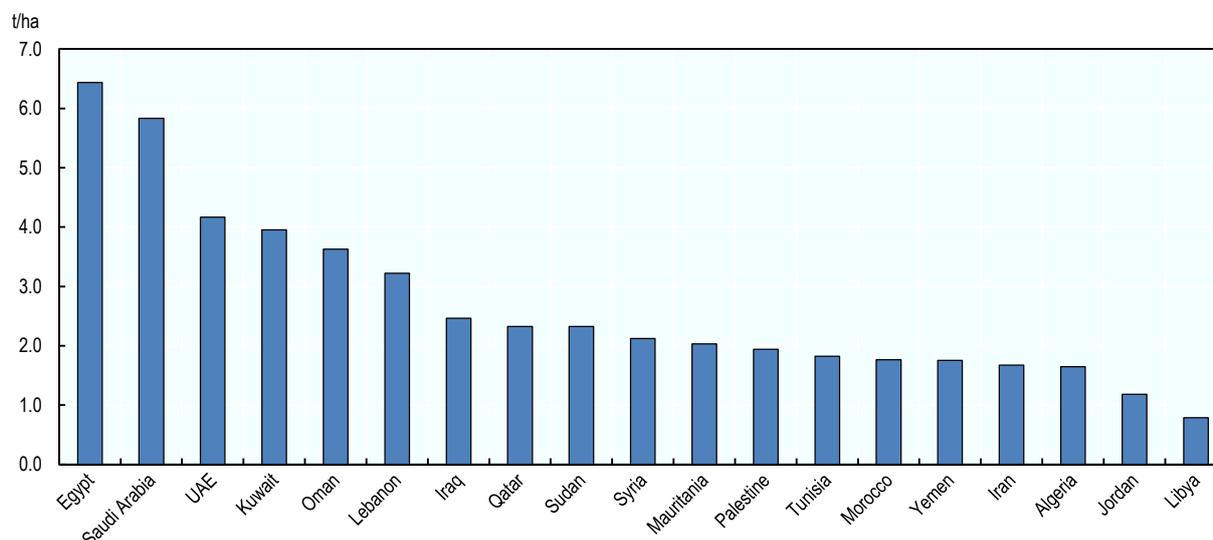
For horticultural crops (such as oranges and tomatoes) the MENA region has yields similar to the world average. However, average yields of temperate crops such as wheat and oilseeds are far below world levels (Table 2.3). This low average hides differences across countries however, as yields differ depending on irrigation and the application of fertiliser and other inputs. Egypt, Kuwait, Saudi Arabia, the UAE, Oman and Lebanon all achieved wheat yields over 3 tonnes per ha in 2010-16 (Figure 2.2). Each of these countries has irrigated wheat production and applied between 100 kg and 600 kg of fertiliser (in nutrient weight terms) per ha of arable land per year in the period 2010-15 (FAO, 2018b).

Production of horticultural crops and cereals has increased over the period 1971-2016 through both area expansion and higher yields. This is not the case for oilseeds, where production declined over time. For oranges, tomatoes and wheat, yields in MENA have grown at a slightly higher rate than the world average. Moreover, the growth in area has been stronger for horticultural crops than for temperate crops such as wheat and oilseeds (Figure 2.5).

**Table 2.3. Average yield of oranges, tomatoes, wheat and oilseeds, by region, 2010-16  
(tonnes per ha)**

	Oranges	Tomatoes	Wheat	Oilseeds
World	17.9	35.2	3.2	3.2
Western Europe	5.8	269.5	7.2	3.2
North America	28.3	91.1	3.1	2.0
East Asia	15.3	52.1	5.0	2.8
Latin America and Caribbean	19.3	38.7	3.1	4.5
Sub-Saharan Africa	17.6	7.8	2.5	1.8
MENA	17.9	37.8	2.2	0.9

Source: FAO (2018b).

**Figure 2.2. Average wheat yield in the MENA region, by country, 2010-16**

Note: Saudi Arabia was largely out of wheat production by 2015.

Source: FAO (2018b).

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**Table 2.4. World and MENA: Average annual growth in production, yield and area for oranges, tomatoes, wheat and oilseeds, 1971-2016 (%)**

	Oranges	Tomatoes	Wheat	Oilseeds
<b>World</b>				
Production	2.3	3.5	1.7	4.4
Yield	0.4	1.4	1.7	2.2
Area harvested	1.9	2.1	0.1	2.2
<b>MENA</b>				
Production	3.1	4.2	2.4	-1.0
Yield	0.6	2.5	2.2	-1.2
Area harvested	2.5	1.6	0.2	0.2

Source: FAO (2018b).

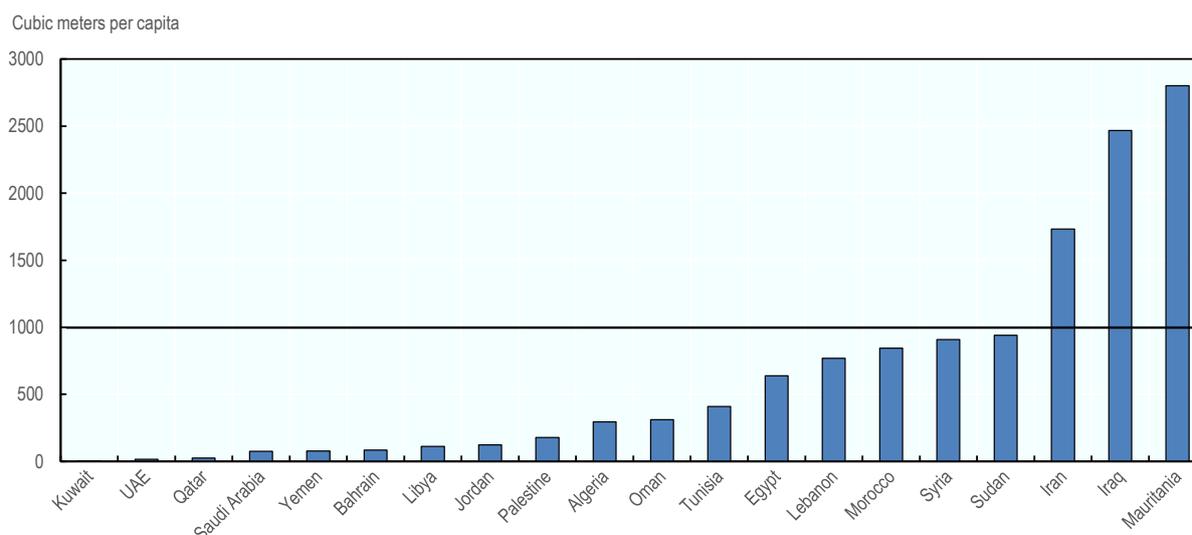
As discussed in more detail below, farms are quite small in most countries in the region, and these small farms tend not to specialise. They have a comparative advantage in labour-intensive horticultural crops, since they have plentiful household labour, but are limited in their ability to adopt new technology and access investment. Moreover, smallholders are averse to specialising in horticulture because of the higher risks involved. Horticultural crops have potentially high payoffs, but also have higher input costs; in a bad year, a farm can lose its entire investment on seeds, fertiliser and pesticides. By contrast, cereals are more robust, low-input, low-yield crops. Smallholders thus often cultivate both horticultural crops and cereals as a diversification strategy to lower their risk, ensure a minimum income and provide for direct consumption. In combination with poor natural growing conditions, the low degree of specialisation contributes to lower yields in both horticultural and cereal crops. The low productivity of smallholder farms in the MENA region is consistent with this analysis.

### *Agricultural water policies and use are increasingly unsustainable*

It is difficult to overestimate the importance of the water issue in the MENA region. Along with conflict, it is the most profound man-made threat to the region's future. The problem is not limited to scarcity, but of long-term unsustainable surface and groundwater abstraction, leading to the depletion of underground aquifers on which the Middle East depends heavily (World Bank, 2018). Out of the 20 countries/areas listed in Table 2.1, 13 withdrew more freshwater in 2014 than could be had from renewable resources. Unsustainable abstraction is supported by policy and deficient water governance. The region has the lowest water tariffs in the world, subsidises water consumption (about 2% of GDP) and has total water productivity of only half the world average (World Bank, 2018).

Most countries in the MENA region fall below the generally accepted water scarcity line of 1 000 m<sup>3</sup> per capita per annum of renewable water resources (Figure 2.3).<sup>7</sup> Agriculture is the predominant user of water in each country. In addition, improving the management of water in agriculture is key to arresting soil degradation and for adapting to climate change.

**Figure 2.3. Annual renewable water resources per capita, 2014**



Source: FAO (2018a).

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### *Water productivity is one of the main concerns in MENA agriculture*

The productivity of water used in agricultural production may be measured in two main ways.<sup>8</sup>

- *Physical water productivity* is the volume of agricultural production per unit of water consumed in the production of that output. Table 2.5 (col. 1) illustrates that in the MENA region the physical water productivity is highest for vegetables and fruits, followed by cereals, groundnuts and livestock products. There is a wide range of physical water productivities for each product, because of differences in soil fertility, plant disease, pests, and the timing of watering and planting, which all influence water productivity. The more a farmer can control these factors

(e.g. through irrigation, proper agronomic practices, fertilisation and control of plant disease and pests), the higher the physical water productivity that can be attained.

- *Economic water productivity* may be defined as the *value* of production per unit of water used. In the MENA countries, the highest value per cubic meter of water used is obtained for vegetables and fruits, followed by olives, dates, lentils, cereals, and beef (Table 2.5, col. 3).

**Table 2.5. Average water productivity for selected agricultural products in the MENA region**

	Physical water productivity, midrange value (kilograms per M3)*	Average producer price in MENA, 2010-16 (USD per kg)**	Average economic water productivity (USD per M3 of water in producing agricultural commodity)
	(1)	(2)	(1)*(2)=(3)
Tomato	12.5	0.40	4.98
Onion	6.5	0.42	2.76
Apples	3.0	0.88	2.64
Potato	5.0	0.45	2.23
Olives	2.0	0.90	1.80
Lentils	0.7	1.17	0.82
Dates	0.6	1.33	0.80
Fava beans	0.6	0.98	0.54
Maize	1.2	0.45	0.51
Rice	0.9	0.59	0.51
Bovine meat	0.1	7.48	0.49
Wheat	0.7	0.51	0.33
Groundnut	0.3	1.33	0.33

*Note:* \*Calculated as mean of minimum and maximum from Molden, et al., 2010. \*\*MENA country average, 2010-16, from FAO (2018b).

*Source:* Molden et al. (2010); FAO (2018b).

Water is not the only input in agricultural production, and other factors influence the decision of which crops or livestock to produce. Decisions on product selection also depend on the type of land available (e.g. pasture *vs.* cropland), the location of the farm (e.g. in rain-fed or irrigated areas), and farmers' attitudes towards risk. However, if other costs are similar, a farmer in the MENA region would obtain the highest payoff per drop of water by producing fruits and vegetables.

### ***Impact of climate change on production conditions varies within the region***

Climate change in the MENA region only adds to the hazards of farming in an already exceedingly dry area of the world. The MENA countries are prone to frequent droughts and face future water shortages due to unsustainable withdrawal of groundwater. In addition, mean temperatures over the past century have risen by 0.5°C, and precipitation over the past several decades has decreased by up to 10% in some parts of North Africa and Sudan. Climate change projections expect the entire region to become hotter and drier in the future, with a reduction of precipitation particularly evident in the western part of the region (Bucchignani et al., 2018). Higher temperatures and reduced

precipitation will accelerate the loss of surface water, and droughts will become more frequent. The already low average yields of rain-fed crops will decline and become more variable. By the end of the century, total agricultural production in the region could decrease by up to 21% from a 2000 base.<sup>9</sup>

While all farming systems will become increasingly arid and water scarce, rain-fed systems are most at risk.<sup>10</sup> However, some areas may benefit from warmer temperatures which extend growing seasons and increase the productivity of winter crops. In Yemen, for example, where there are summer rains, an increase in average temperatures of 2°C could be expected to extend the growing season by about six weeks (Verner and Breisinger, 2013). Furthermore, some areas are expected to receive more rainfall, which may raise yields, though they may also increase the frequency of floods. These trends have already been observed in Oman, Saudi Arabia and Yemen.

The common denominator of climate change will be a general increase in temperature in this region with varying rainfall effects across countries. However, the effects of climate change on agriculture are expected to vary by farming system (Table 2.6). In some cases, farmers can respond to changes through adaptation. In other regions, agriculture may become untenable, and rural inhabitants will need to transition to off-farm employment or relocate.

**Table 2.6. Climate change impact on farming systems in the MENA region**

Farming system	Exposure: Expected climate change-related events	Sensitivity: Likely impact on farming systems
Irrigated	Increased temperatures Reduced supply of surface irrigation water Dwindling of groundwater recharge	More water stress Increased demand for irrigation and water transfer Reduced yields when temperatures are too high Salinisation due to reduced leaching Reduction in cropping intensity
Highland mixed	Increase in aridity Greater risk of drought Possible lengthening of the growing period Reduced supply of irrigation water	Reduction in yields Reduction in cropping intensity Increased demand for irrigation
Rain-fed mixed	Increase in aridity Greater risk of drought Reduced supply of irrigation water	Reduction in yields Reduction in cropping intensity Increased demand for irrigation
Dryland mixed	Increase in aridity Greater risk of drought Reduced supply of irrigation water	A system very vulnerable to declining rainfall Some lands may revert to rangeland Increased demand for irrigation
Pastoral	Increase in aridity Greater risk of drought Reduced water for livestock and fodder	A very vulnerable system, where desertification may reduce carrying capacity significantly Non-farm activities, exit from farming, migration

## Structure and performance of agriculture, fisheries and aquaculture in the Middle East and North Africa

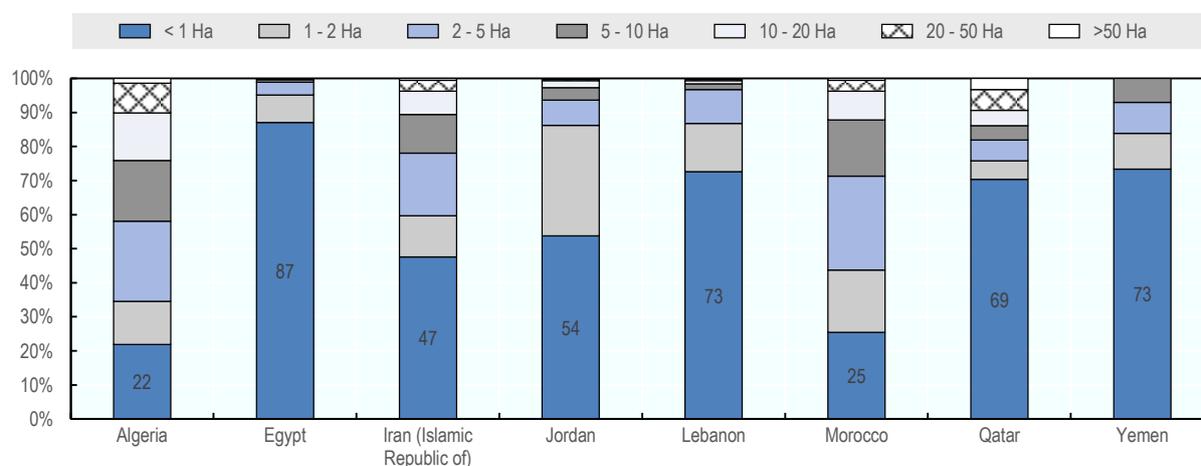
### *Uneven farm size distribution across the region*

The Middle East and North Africa has one of the most uneven farm size distributions in the world. In some of the countries in the region — Egypt, Yemen, Jordan, Lebanon and Iran — the majority of farms are smaller than one hectare (Figure 2.4). At the other end of the size spectrum are a relatively small number of large farms owned by a small number of landowners or the state (Rae, n.d.).

The inequality of landholding is illustrated in Figure 2.5 using Lorenz curves, which plot the cumulative share of farms against the cumulative share of agricultural land. The diagonal line illustrates a theoretical case in which each holding is of an equal size such that, for instance, 50% farms occupy 50% of total agricultural area. The more bowed-out the actual Lorenz curve, the more unequally holdings are distributed. For instance, 80% of farms occupy only 20% of total agricultural area in the Middle East and North African region, indicating that the overwhelming majority of farms are quite small. On the other hand, another 10% of farms holds 60% of agricultural area, implying that a small number of large farms cultivate over half of agricultural land area. Only in Latin America, the distribution of land is even more unequal: less than 10% of farms hold 80% of agricultural land area.

Two policies can be observed in the MENA region that support the concentration of farmland through supporting the development of large-scale farm enterprises. First, the predominant policy in the region for the development of rural areas is the sectoral modernisation of agriculture, which includes the promotion of large intensively cultivating corporate or private farms. Public support to agriculture and access to credit de facto favours large farms, often for sound business reasons. Due to their size, small farms are often not eligible to benefit from public support or bank loans. Sectoral “modernisation” policies have largely excluded smallholders from public support, which have left them small, technologically backward and poor. Alternative policies of rural development focused on supporting small farms through technical and business training, and small and medium rural enterprise and community development is often absent or poorly funded.

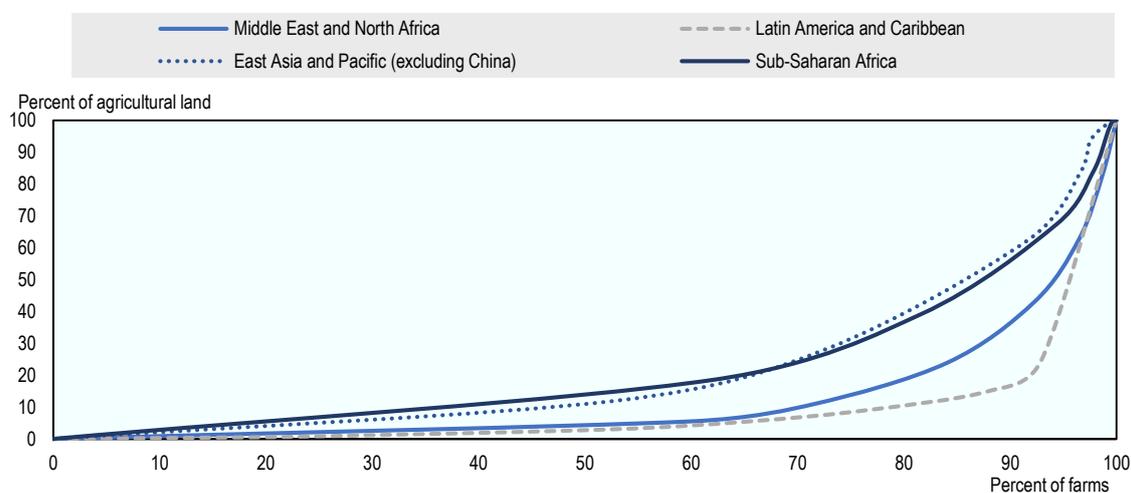
A second policy that supports the concentration of holdings in large farms is state facilitation for the large-scale acquisition of land by both domestic and foreign investors. This policy has been pursued most intensively in Sudan and Egypt, though land has also been made available in Mauritania or Morocco. In the MENA region most land acquisitions have been pursued by corporations with the support of governments and banks from water-scarce, wealthy GCC (Gulf Cooperation Council) countries with the largest dependence on food imports. Foreign land acquisition in the region developed during the 2007-2014 period of high commodity prices, and is aimed at limiting exposure to world commodity markets and ensuring access to food and feed supply in the GCC countries. Case studies from Sudan indicate that the terms of large-scale purchase or leasing contracts often lack transparency, and are reached with little or no consultation with local communities. Large tracts of communal land in Sudan were sold or leased to local or foreign investors, with little attention to the social cost and environmental impacts from turning communal pasture land into foreign owned cropland (Elhadary and Abdelatti, 2016).

**Figure 2.4. Farm size distribution in selected MENA countries, 1996-2003**

*Note:* Figures in the <1 ha portion of the bars show the share of holdings of less than 1 ha. Estimates refer to the size distribution of holdings in Algeria (2001), Egypt (1999-2000), Iran (Islamic Rep. of) (2003), Jordan (1997), Lebanon (1998), Morocco (1996), Qatar (2000-2001) and Yemen (2002). The figures in the bars indicate the share of holdings under 1 ha.

*Source:* Lowder et al. (2014).

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**Figure 2.5. Concentration of agricultural land in farm holdings: MENA in comparative perspective**

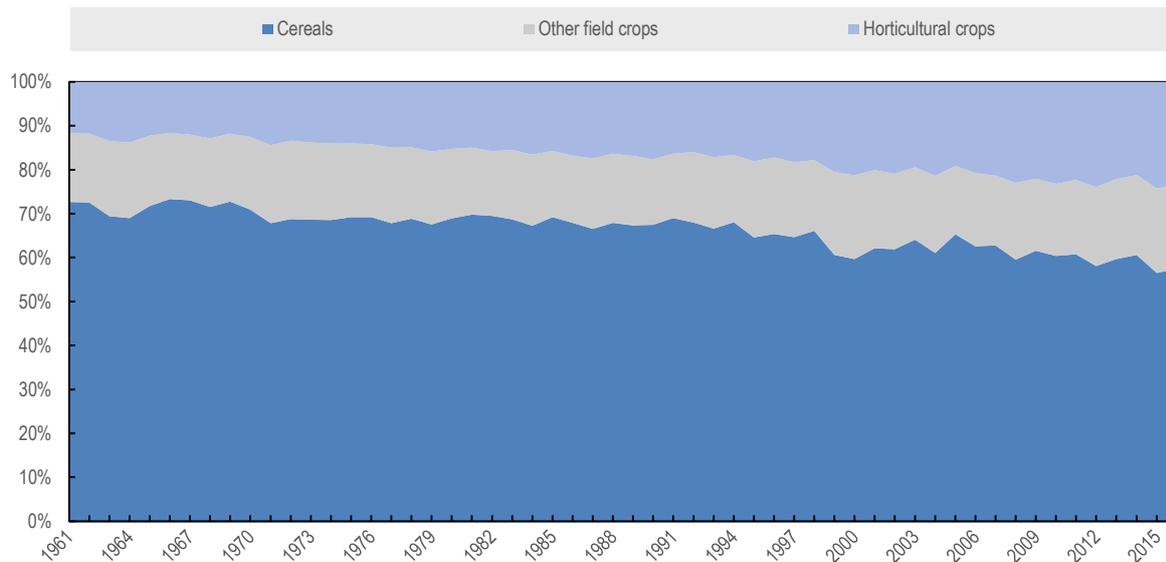
*Source:* Lowder et al. (2014).

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### *Agricultural production dominated by cereals*

The scarcity of water, the shortage of suitable land and the constraints of smallholder farming all impact on production in the MENA region by limiting yields. Low-yield agriculture in the region is characterized by low diversity such that harvested area is dominated by cereals (Figure 2.6).<sup>11</sup> Cereals occupied about 60% of the harvested land area in the region, but contributed only 15% of the value of gross agricultural production in 2014. Cereal production has been encouraged by policies to lower import dependence.

**Figure 2.6. MENA Harvested area, share by commodity type, 1961-2016**



*Note:* Horticulture includes citrus, fruits, berries, vegetables, melons, tree nuts, herbs, tea, coffee, spices, stimulants, beverage crops and olives. Other field crops include fibres, beans, peas, sugar crops, roots and tubers, pulses, and oilseeds.

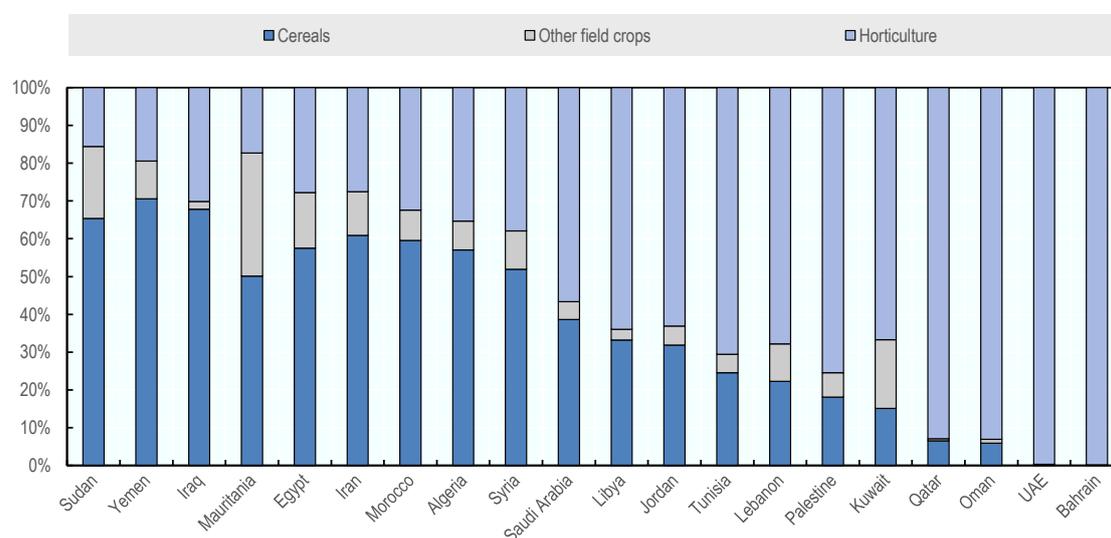
*Source:* FAO (2018b).

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Although cereals occupy about 60% of total harvested area, this share varies widely by country (Figure 2.7). The poorer countries, such as Sudan, Yemen, Iraq and Mauritania, devoted most of their land to cereals. However, other countries, including those in the GCC, Lebanon, Tunisia, Libya, the Palestinian Authority, and Jordan, devoted over 50% of harvested area to horticultural crops, and cereal production is low.<sup>12</sup>

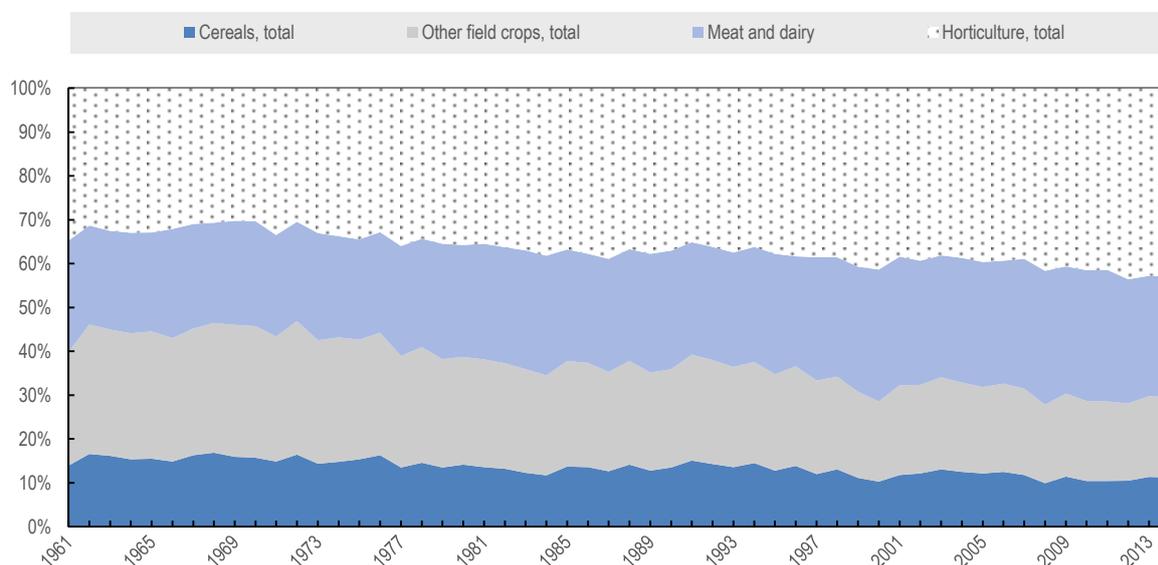
While land area in the region is dominated by cereals, most of the value of production in the region comes from horticultural crops and livestock (Figure 2.8). Generally, about 40% of the value of agricultural production now comes from horticulture.

Finally, MENA agriculture is dominated by two regional giants (Iran and Egypt), which together produce half of the total value of agricultural production (Figure 2.9). The next three producers by size are Sudan, Morocco and Algeria, which together produce 27% of agricultural production. The remaining 15 countries produce 23% of the total value of agricultural production in the MENA region.

**Figure 2.7. MENA Harvested area share, by country and crop type, 2016 (percent)**

Source: FAO (2018b).

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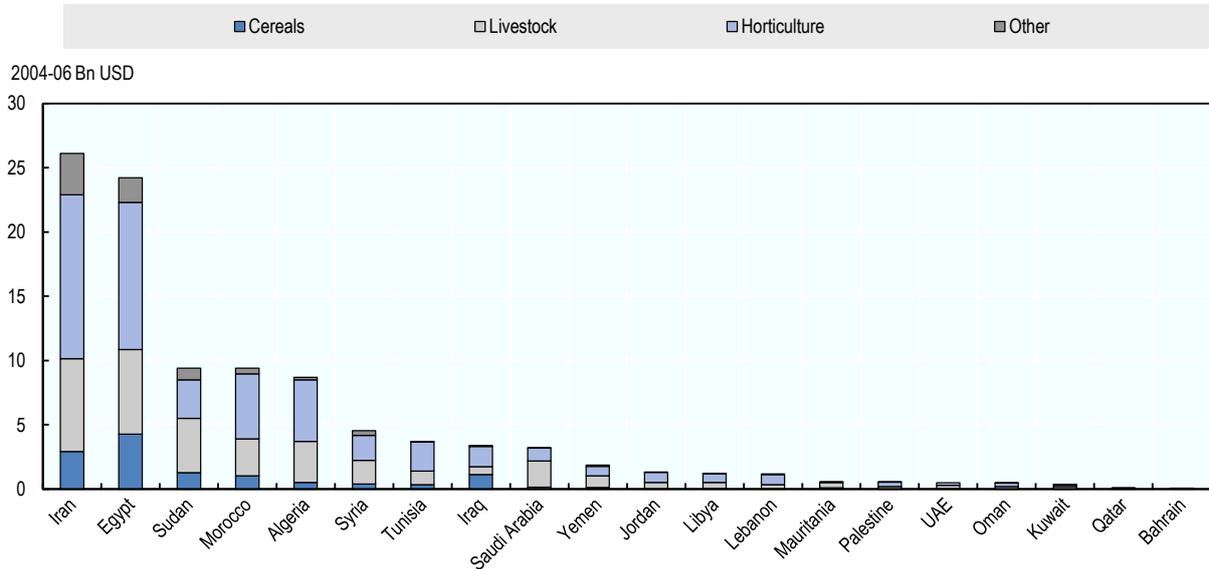
**Figure 2.8. MENA value of agricultural production, share by commodity type, 1961-2014, percent**

Note: Horticulture includes citrus, fruits, berries, vegetables, melons, tree nuts, herbs, tea, coffee, spices, stimulants, beverage crops and olives. Other field crops include fibres, roots and tubers, beans, peas, pulses, sugar crops and oilseeds.

Source: FAO (2018b).

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**Figure 2.9. The value of agricultural production in the MENA region, by country and commodity type, 2014**



Note: Data for Syria in 2014 may not be reliable.  
Source: FAO (2018b).

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### *Fisheries and aquaculture in the MENA region*

The MENA region includes diverse marine and freshwater ecosystems. Although the region is generally arid, it also encompasses major transboundary waterways such as the Euphrates, the Tigris, the Nile, and other river systems. However, overall freshwater resources remain scarce, particularly in areas away from river systems. Capture fisheries and aquaculture are important in the MENA region as providers of livelihoods and as sources of nutritious food. During the last two decades, total capture fisheries and aquaculture production increased significantly from 2.2 Mt in 1996 to 5.9 Mt in 2016. Most of the increase originated from capture fisheries (from 2.0 Mt to 4.0 Mt), but aquaculture registered strong growth as well (from 0.1 Mt to 1.9 Mt), with its share in total fish production increasing from 6% to 32% during the 1996-2016 period. Despite this increase in production, the region is dependent on imports of fish and fish products to satisfy domestic consumption.

The aquaculture and fisheries sector in the MENA region faces many challenges with marked differences among and within countries. Marine capture fisheries in the MENA coastal countries range from the large annual production of countries with long coastlines and large fleets that access highly productive upwelling systems, to the countries with smaller production, and smaller fleets. Coastal areas across the region are important for small-scale fisheries that support the livelihoods of hundreds of thousands of people and overall fisheries are overwhelmingly small scale. Biomass assessments, undertaken on only a limited number of the main stocks fished throughout the region, found that most are under pressure. Regional fisheries management organisations (RFMOs), such as the Indian Ocean Tuna Commission (IOTC) and the International Commission for the Conservation of Atlantic Tunas (ICCAT), are implementing adaptive management

measures to maintain stocks within safe biological levels and the Regional Commission for Fisheries (RECOFI) recently adopted binding recommendations for minimum fisheries and aquaculture data reporting. In addition, many countries in the region, such as Mauritania, Morocco and Oman, have worked to implement fisheries and aquaculture strategies and legislation with increased focus on ensuring the sustainability of their resources. Inland fisheries production, which amounted to 0.4 Mt in 2016, representing 7% of total production, also faces challenges with regard to their environmental management. To address this, countries such as Mauritania, Morocco, Egypt, Iran and Sudan are undertaking efforts to explore inland fisheries opportunities and address existing constraints.

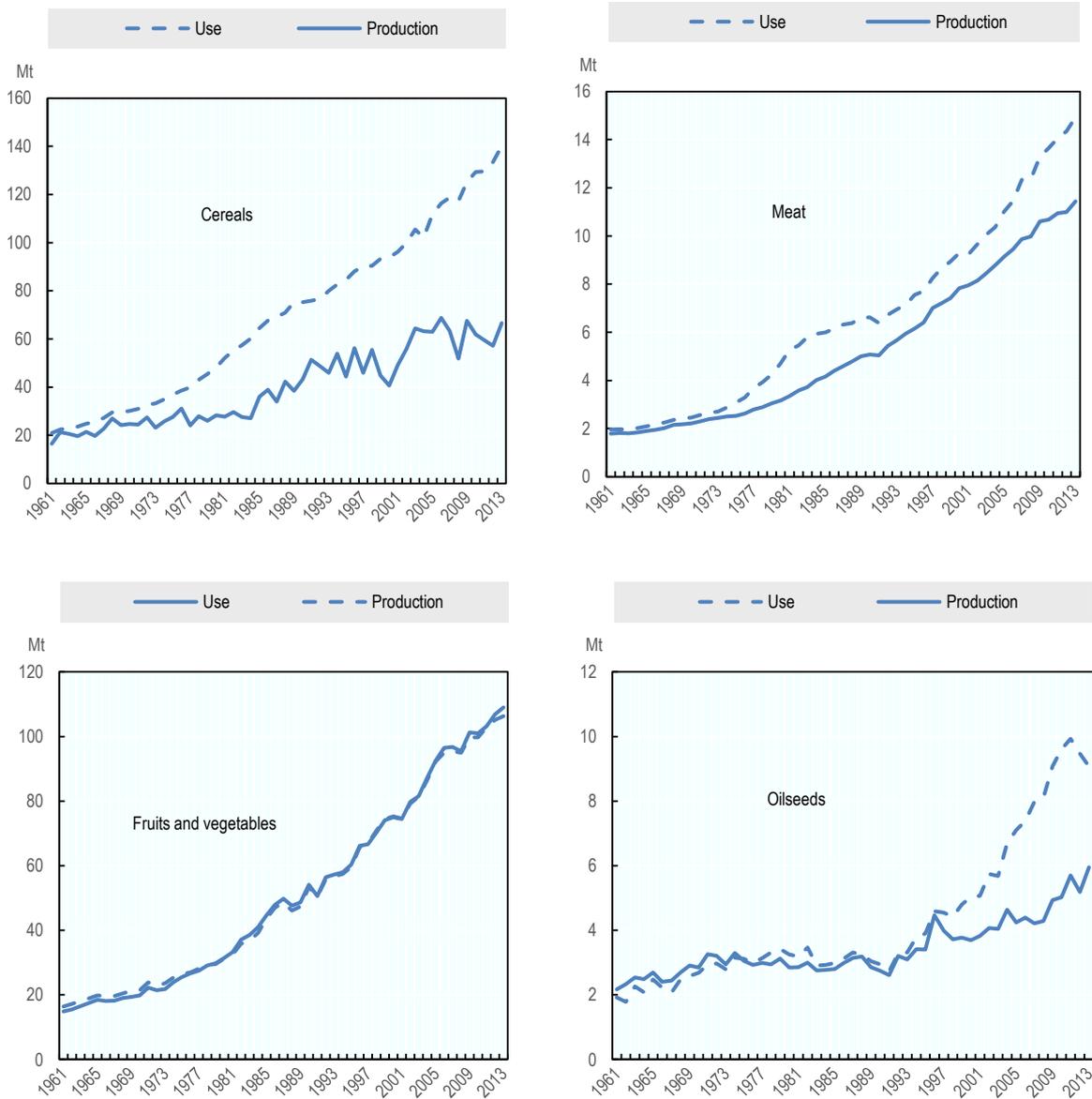
The bulk of aquaculture production still comes from Egypt and Iran, with a share of 73% and 21% respectively in 2016, with the majority of fish farms in the region as small-scale operations. There have been recent actions taken across the region to create an enabling environment for aquaculture to develop through private investments and with industrial-scale marine and freshwater aquaculture gaining attention. A number of countries have finalised strategic aquaculture development plans, conducted spatial analysis for the identification and allocation of suitable sites for the sector, and have enacted clear regulations to assist with the establishment of commercial facilities. The aquaculture sector faces several constraints including limited access to appropriate locations and to sustainable production technologies, inappropriate freshwater fish hatchery installations and management, inadequate seed production in terms of quantity and/or quality and poor handling and transportation. Animal health control systems for aquaculture are also scarce and access to credit, loans and insurance for aquaculture business is almost non-existent in most countries of the region. Furthermore, the expansion of the aquaculture industry in the region has increased environmental concerns and public awareness about food security issues and environmental conservation. In addition, fisheries in the MENA region are particularly vulnerable to the impacts of climate change and variability as well as those induced by human activities. In this respect, the aquaculture sector can be particularly vulnerable as there is a lack of farmer's adaptability to climate change and resilience to natural disasters and socioeconomic risks.

### *Growing import dependence for basic foods*

Low yields and a narrow scope for increases in arable area in the MENA region set limits to crop production for temperate crops, such as wheat and oilseeds. Coupled with income growth and a particularly strong population growth of 2.5% over the period 1971-2016, demand growth has far outstripped production growth for these crops for which the MENA region is ill-suited (Table 2.7). The growing gap between consumption and domestic production (Figure 2.9) has been covered by imports. Growth in horticultural crop production has kept pace with demand, such that the region is self-sufficient in fruits and vegetables (Figure 2.10).

Table 2.7 details that the region is far from self-sufficient in cereals, vegetable oils, oilseeds and sugar and sweeteners, but is self-sufficient or nearly so for fruits and vegetables and meats (including animal fats and offal).

**Figure 2.10. Domestic production and use of selected commodities in the MENA region, 1961-2013**



Source: FAO (2018b).

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**Table 2.7. Food self-sufficiency ratios (SSR) in MENA countries, average, 2011-13 (%)**

SSR	Cereals <sup>1</sup>	Meats <sup>2</sup>	Fruits, vegetables	Milk <sup>3</sup>	Vegetable Oils	Oil crops	Sugar, Sweeteners
Algeria	30	91	93	51	11	88	0
Egypt	58	83	107	89	26	35	73
Iran (Islamic Republic of)	61	95	104	106	15	58	58
Iraq	50	34	86	45	2	80	0
Jordan	4	72	139	51	17	80	0
Kuwait	2	34	36	14	1	0	0
Lebanon	14	77	111	49	20	67	0
Mauritania	27	89	18	65	0	95	0
Morocco	59	100	116	95	29	98	28
Oman	7	32	52	32	4	0	0
Saudi Arabia	8	45	73	76	18	1	0
Sudan (2012-13)	82	100	98	96	89	112	72
Tunisia	42	98	110	90	91	65	1
United Arab Emirates	2	26	21	14	82	0	0
Yemen	17	79	90	35	5	63	1
MENA Total	46	79	99	82	25	64	37

*Note:* The self-sufficiency ratio is defined as food production/(production+imports-exports).

1. Excluding beer.

2. Includes meat and offals.

3. Excluding butter.

*Source:* FAO (2018b).

**Table 2.8. Share of agricultural imports in merchandise exports, 2011-13 (%)**

	Agricultural imports as a percentage of merchandise exports (%)	Stability
Total MENA	8	Stable
Palestinian Authority	74	Volatile, 1990-2002
Syria	58	Volatile since 2007
Lebanon	58	Stable
Egypt	49	Stable
Jordan	44	Stable
Yemen	39	Stable
Sudan	34	Stable
Morocco	25	Stable
Mauritania	17	Stable
Tunisia	15	Stable
Algeria	15	Stable
Iran	11	Stable
Libya	9	Stable
Iraq	9	Volatile, 1990-99
Bahrain	8	Stable
Saudi Arabia	6	Stable
Oman	5	Stable
UAE	4	Stable
Kuwait	3	Stable
Qatar	2	Stable

*Source:* FAO (2018b).

The share of total food imports in total merchandise exports can be used as an indicator to assess the capacity of a country to sustain food imports (Table 2.8). Globally, this share is about 5%. The MENA average has been about 8% in recent years (2011-13), and has shown a downward trend from earlier years. For the countries whose share of total merchandise export earnings spent on food imports is high and volatile, the stability of international food prices is a major concern. Even if export earnings can be maintained, these countries face significant risks associated with spikes in world food prices. The implications of this vulnerability were realised during the 2007-2008 global food crisis, when prices spiked dramatically. The importing countries of the world, including those in the MENA region, were faced with high prices impacting household and government budgets. While world food commodity markets have since returned to more normal conditions, the experience of the crisis brought increased attention to the vulnerabilities of importing countries – and particularly for countries such as the Palestinian Authority and Syria for which food imports constituted a large and volatile share of total export earnings in 2011-13.

The pattern of trade in cereal, oilseed and meat products is consistent with findings based on the Balassa Export Revealed Comparative Advantage Index (XRCA) applied to agricultural products. Table 2.9 shows the comparative strength of exports of six MENA countries in 2011-2013. Though each country is different, most countries have an advantage in the export of fruits, vegetables and nuts, while they have a disadvantage in meats, cereals, and fish (except Morocco). Small farms are suited to producing labour-intensive crops, and the highest value per ha and per drop of water come from producing fruits, milk and vegetables.

**Table 2.9. Coefficients of revealed comparative advantage for selected countries in the MENA region**

	Egypt	Lebanon	Morocco	Jordan	Tunisia	Algeria
Vegetables	10.21	8.80	10.56	16.07		0.09
Fruits and nuts	6.71			4.53	3.36	0.09
Fish	0.15	0.06	3.00	0.08		
Meat	0.01	0.10	0.01		0.02	
Cereals		0.11	0.08		0.00	

*Note:* The table shows the Balassa Export Revealed Comparative Advantage Index (XRCA) applied to agricultural products. The XRCA is defined as the ratio of a product category's share in a country's total exports divided by the product category's share of global exports. An XRCA>1 implies that the country is specialised in the export of that product, while an XRCA<1 implies the opposite.

*Source:* Santos and Ceccacci (2015).

### ***Food security situation***

Households are food secure when they have year-round access to the amount and variety of safe foods their members need to lead active and healthy lives. Changes in food security, then, are driven mainly by events or conditions that affect families' ability to access safe food. Chief among these are incomes, the working of food markets to ensure food availability, and state public services to ensure food safety. The largest disrupter of these three factors in the region is conflict, which divides the region into two distinct sub-regions from the point of view of food security – conflict and non-conflict countries (Box 2.2).<sup>13</sup>

The Prevalence of Undernourishment (PoU) estimates the share of the population of a country facing absolute food deprivation. It is defined as the probability that a randomly selected individual from the reference population is found to consume less than his or her calorie requirement for an active and healthy life. (FAO, 2017c). Table 2.10 shows the prevalence of undernourishment in conflict and non-conflict countries in the MENA region.

As a rule of thumb, countries with a PoU of less than 5% are considered to be relatively food secure. As highlighted in Table 2.10, the non-conflict countries of the region are, in fact, relatively food secure. According to the PoU, in 2014-2016, the conflict countries of the MENA region were less food secure than the average level for least developed countries (LDCs). Whereas 28.2% of the population of the MENA conflict countries faced absolute food deprivation, only 24.4% of the population of the LDCs faced such insecurity (FAO, 2017c).

Though the high level of food insecurity in the conflict countries accords with expectations, care should be taken in interpreting these data for the prevalence of undernourishment. The PoU is a good indicator of hunger during periods when the income or consumption distribution is relatively constant, but it is not a good indicator of hunger when sharp changes in the distribution of food occur. The PoU likely underestimates the actual prevalence of undernourishment during times of conflict, because the inequality in food consumption parameters used to calculate it are derived from national household survey data, which are usually not available or accurate during times of conflict (FAO, 2017c).

Setting aside these caveats for the moment, the level of measured PoU in the conflict countries has been over three times the level in the rest of the MENA countries since 1999-2001, and has been rising gradually *vis-à-vis* the other countries in the region since 2003 (Table 2.10). This pattern in the evolution of the PoU in the conflict countries is consistent with it being partially driven by conflict, but it is also clear that they had relatively high levels of food insecurity even before conflict arose.

**Table 2.10. Prevalence of undernourishment in conflict and non-conflict regions in MENA, 1999-2001 to 2014-16**

	1999-2001	2001-2003	2003-2005	2005-2007	2007-2009	2009-2011	2011-2013	2013-2015	2014-2016
All MENA	9.7	9.8	10.0	10.0	9.6	8.9	8.4	8.4	8.8
Non-conflict countries	6.3	6.4	6.5	6.3	6.0	5.5	5.0	4.7	4.7
Conflict countries	29.0	28.4	28.9	29.1	28.5	26.6	25.3	26.1	28.2
<i>Of which:</i>									
--Yemen	29.9	30.7	30.9	28.9	27.1	25.7	24.6	25.2	28.8
--Iraq	28.3	26.6	27.4	29.3	29.6	27.2	25.9	26.7	27.8
--Sudan							25.9	25.7	25.6

*Note:* Undernourishment data exist for only three of the five conflict countries, and the aggregate is constructed from these data.

*Source:* FAO (2017c).

### Box 2.2. Conflict and food security in the MENA Region

At the end of 2017, over 30 million people in this region were in need of assistance to satisfy their basic food needs. Among those, the food security situation was most critical in countries with lingering or escalating conflicts: Yemen, Syrian Arab Republic, Iraq and Sudan. In Yemen, according to the latest assessment carried out in March 2017, about 17 million people, corresponding to 60% of the total population, required food assistance. In the Syrian Arab Republic, some 6.5 million are estimated to be food insecure, and an additional 4 million at risk of food insecurity as they are using asset depletion strategies to meet their consumption needs. In Iraq and Sudan, about 3 million are food insecure. Smaller figures are reported for Libya and Mauritania, about 0.4 million each.

Residents in conflict zones often have to resort to food coping strategies to cover the severe food shortages they are facing. Households tend to reduce the number of meals and restrict the consumption of adults to prioritise children. If the crisis lingers, households deplete their assets and are no longer able to draw on stocks or other reserves. They resort to child labour, which often includes the withdrawal of children from school to carry out agricultural activities in order to cope.

Economic activity, including agricultural production, suffers in a conflict environment and further impairs livelihoods. While agricultural production is often one of the most resilient activities in an economy, those continuing to farm are often confronted with high production costs, lack of inputs and damaged or destroyed infrastructure. Agricultural activities, particularly those related to irrigated crops, suffer when fuel prices are high, with consequent increases in the share of rain fed crops, which in turn bear lower yields. Fertilisers are often subject to international sanctions. Farmers tend to plant seeds saved from the previous harvests, further constraining yields. Many rural households tend to rely on casual labour opportunities as their main source of income. In many conflict-affected areas, hired agricultural labour tends to be replaced by family labour in order to cope with the increased costs of production. While agricultural production improves household and local food availability, limited infrastructure including cold chain and transportation links often prevents deliveries to urban markets. Consequently, prices of local products tend to be low in producing regions, and high in the urban markets, despite availability.

The impact of lower agricultural production on world agricultural markets may be small, but has been dramatic in the affected countries. Before the conflict, Syria – one of the larger producers – produced on average about 4 Mt of wheat, but reached only 1.8 Mt in 2017. In Yemen, total domestic cereal production covers less than 20% of the total utilisation (food, feed and other uses). The country is largely dependent on imports from the international markets to satisfy its domestic consumption requirement for wheat, the main staple. The share of domestic wheat production in total food utilisation in the last ten years is between 5% to 10%, depending on the domestic harvest. While conflict did not substantially increase the country's dependence on imports, conflict-related decrease in production deteriorated livelihoods of farmers and pushed many to food insecurity.

The unpredictability of conflict threatens food security and local livelihoods but also livelihoods in the host countries. In addition to the millions who have fled countries due to the conflict, many are on the move internally, many multiple times. Internally displaced people and their host communities are often the most vulnerable to food insecurity. In Syria, about two in five people are on the move inside the country. In Iraq, in the first half of 2017, close to 1 million people were internally displaced, mostly due to the military operations in Mosul, in addition to the 3 million people already displaced by November 2016. As of early February 2018, over 5.5 million refugees were registered in the region covering Egypt, Iraq, Jordan, Lebanon and Turkey. In addition, a large share of the population lives abroad without seeking refugee registration.

### *Agricultural support policies*

The vulnerability of countries to perceived risk from dependence on imported food has prompted some governments to support the cultivation of staple crops in the region (Box 2.3). Unfortunately, rigorous recent calculations of government support to (or implicit taxes on) producers have not been widely undertaken for the region, and to date have been made for only three countries with the latest year of available data from 2010. The nominal rate of assistance (NRA) is defined as the percentage by which government policies have raised gross returns to farmers above what they would be without the government's intervention (or lowered them, if  $NRA < 0$ ). The NRA considers only gross returns, and therefore does not consider input subsidies or taxes that may come through government-set prices for inputs. Estimates for wheat show a range of support from -28% (2010) in Sudan indicating effective taxation of their sector, to 44.7% in Egypt (2010) indicating strong support (World Bank, 2013). Support for wheat in Morocco was a more moderate 15% (2009). In addition to assistance to farmers, most countries in the region maintain consumer prices for selected types of bread and other staples at artificially low levels, effectively subsidising consumers. While these programs are often viewed as social support programs, they are extremely costly for government budgets and largely regressive (with the largest benefits accruing to the non-poor), and thus of dubious effectiveness and efficiency as social protection measures to reduce poverty. Between 2008 and 2013, the cost of non-targeted subsidies for fuel and food ranged from less than 1% in Lebanon to over 20% of GDP in the Islamic Republic of Iran. Though there have been efforts in most countries to reduce these subsidies since 2010, for most countries prices on energy products and basic foods are still controlled, albeit at a higher level, which reduces their fiscal impact (FAO, 2017c).

A comparison of farm gate producer prices and border import prices for wheat for the years since 2010 showed that producer prices in Algeria, Jordan, Kuwait, Oman, Saudi Arabia and Yemen were consistently significantly higher than the prices of imported wheat (from 60% to 250% higher). No firm conclusions can be based on these price differences, because the two prices are measured at different stages of the wheat value chain (producer prices at the farm gate and import prices at the border). However, such large price differences do suggest that domestic policies continue to raise prices for wheat above world prices.

#### **Box 2.3. MENA government support for wheat**

MENA governments have subsidised wheat production for many years using three main policy interventions: guaranteed prices, input subsidies, and import tariffs. The purpose of these policies is to raise the price and lower the costs for domestic production of wheat in order to increase self-sufficiency in wheat production.

In Iraq, for example, the Ministry of Trade supports wheat producers through a guaranteed price for no. 1 wheat that exceeds the import price of wheat. In 2015, the Ministry offered 795 000 Dinars (approximately, USD 681), in 2016, 700 000 Dinars (approximately USD 592) and in 2017, 560 000 Dinars (approximately USD 487) (USDA, 2017b). In Iran, the government also sets a minimum purchase price for wheat purchased by the state. State purchases at minimum prices have encouraged farmers to increase their production from 2.2 Mt in 2013 to 8.5 Mt in 2016. In Morocco in 2017, the government subsidised wheat production by establishing a reference price for purchasing domestic wheat (MAD 2 800 per tonne in 2017, equivalent to USD 286 per tonne). In October 2017, the government also introduced subsidies to millers and elevators that purchase domestic wheat. Furthermore, the government raised the import duty on soft wheat from 30% to 135% (Reuters, 2017). Tunisia's Cereal Board controls the marketing of 40% to 60% of total

domestic wheat production and 10% to 40% of total barley production. The government sets guaranteed minimum prices for wheat and barley. For the 2017/18 marketing year, the Ministry of Agriculture set minimum prices of USD 329 per tonne for durum wheat and USD 236 for common wheat. The Ministry also subsidises irrigation water and provides technical advice to farmers targeted at increasing irrigated wheat area. Furthermore, in 2017, the Ministry subsidised agricultural machinery and irrigation equipment by 50% in order to encourage investment in irrigated cereals production (USDA, 2017a).

The Egyptian government heavily regulates wheat production, storage and marketing through many policy instruments. As of 2015, the Egyptian government subsidised the production of wheat through four main channels: (1) input and output subsidies for farmers, i.e. subsidised fertiliser prices and wheat procurement prices at higher than import prices; (2) consumer support in the form of highly subsidised prices for baladi bread; (3) government investment in improvements in grain storage and state grain trading; and (4) government support of wheat yield research, phytosanitary control, and other public goods. The government is also the sole purchaser of domestically produced wheat and imports about one third of total wheat imports. The government owns a large share of storage capacity and over half of the milling capacity of the country.

Saudi Arabia has undertaken the largest policy change. It gradually reduced its wheat production quotas and purchase programs because of strong concerns over the depletion of local water reserves which were used to irrigate wheat production. The country's production fell from around 2.5 Mt in 2005 to less than 30 000 t by 2015. Farmers have been encouraged to engage in alternative sustainable production activities such as greenhouse farming or production of fruits and vegetables using advanced drip irrigation techniques.

Sources: USDA (2017a, b); FAO and EBRD (2015); FAO (2017b); Reuters (2017).

## Medium-term outlook

The previous sections introduced the food and agriculture and fish sectors of the MENA region and discussed the major issues the region has been facing. These include the region's challenges to improve food security and nutrition while sustainably raising productivity and managing the deepening dependence on foreign markets. This section expands on the discussion by exploring the potential future trends in consumption, production and trade of agriculture and fish commodities.<sup>14</sup>

### *Key economic and social factors shaping the outlook*

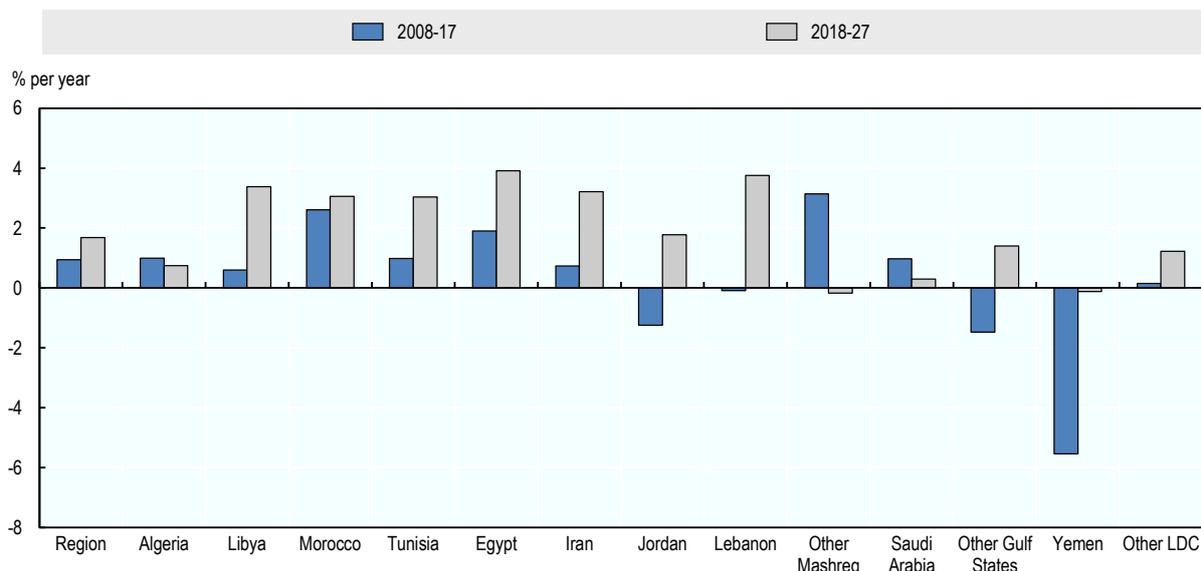
The outlook for agriculture, food and fish in the MENA region is mainly driven by the region's macroeconomic performance, its demographic developments, the presence and extent of conflict and the evolution of policies.

According to World Bank data, on average, households in the region spend about 44% of their income on food and beverages.<sup>15</sup> Because of this high share, economic prospects will remain a critical factor affecting food consumption and food security in the coming decade. Based on the assumptions of improving energy markets, the continuation of structural policy reforms and no major changes in the favourable geopolitical climate, average income growth per capita in the region is projected at 1.6% p.a. for the coming decade, up from 1% p.a. in the previous one (Figure 2.11).<sup>16</sup> However, these income growth prospects are unlikely to lead to significant changes in dietary patterns.

Demographic developments are a second major driver of aggregate food demand. Population growth is expected to slow across the region, falling in aggregate from 2% p.a. in the last decade to 1.6% p.a. in the coming one (Figure 2.12), although this still

represents almost 100 million additional people. The share of rural population is declining, but it will remain above 60% in the LDC countries while falling to around 10% in the Gulf region. The larger proportion of urban consumers will increase the demand for prepared foods, typically containing more fat and sugar.

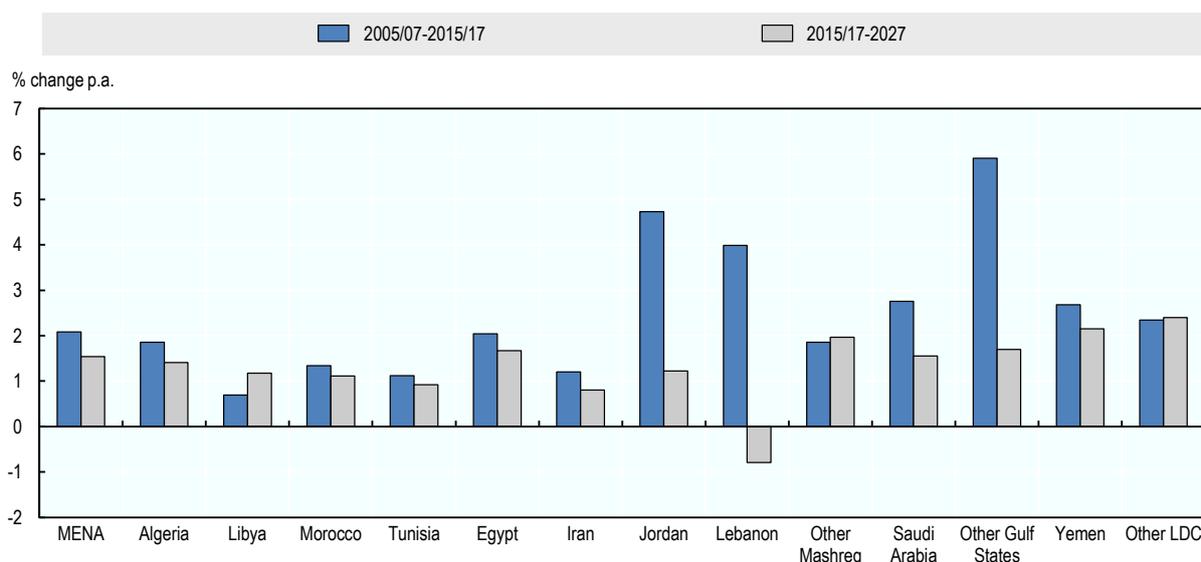
**Figure 2.11. Past and projected GDP per capita growth in the Middle East and North Africa**



Source: OECD/FAO (2018), “OECD-FAO Agricultural Outlook”, OECD Agriculture statistics (database), <http://dx.doi.org/10.1787/agr-outl-data-en>.

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**Figure 2.12. Population growth to slow, but unevenly across the region**



Source: World Population Prospects 2015: Revision from the UN Population Division and OECD/FAO (2018), “OECD-FAO Agricultural Outlook”, OECD Agriculture statistics (database), <http://dx.doi.org/10.1787/agr-outl-data-en>.

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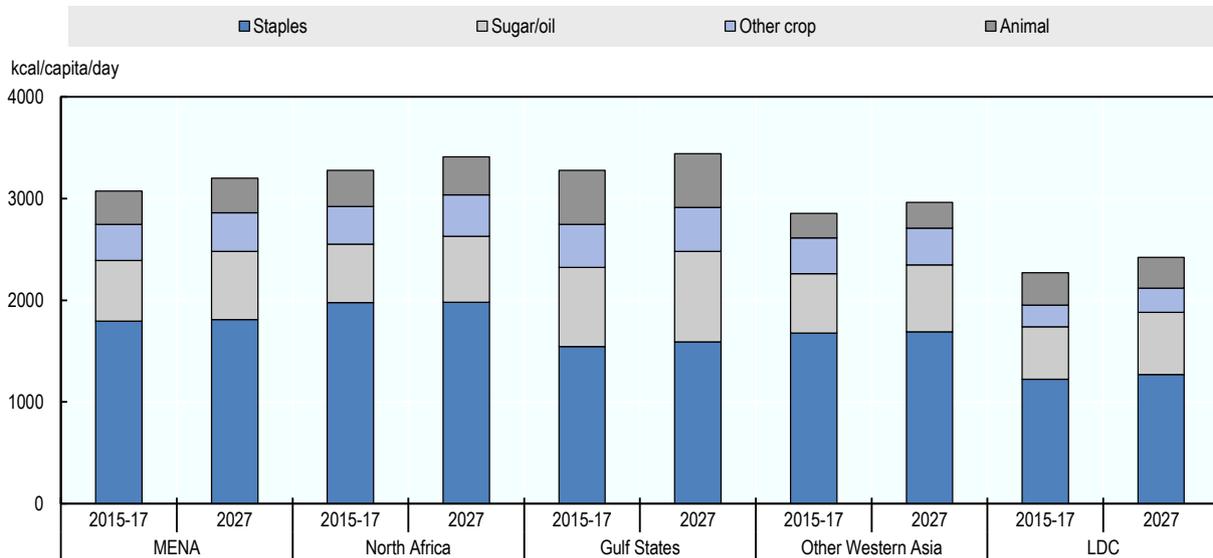
**Food consumption trends**

*Slow growth in per capita consumption*

Food consumption in the region, measured in per capita calorie availability per day, is projected to grow at 0.4 % p.a., due mainly to modest income gains. Saturation effects in many high and medium income countries will slow consumption growth during the coming years, but higher growth (0.6% p.a.) is projected in the LDCs in the region, where it was stagnant or declining in the last decade. These improvements are predicated on higher income growth and no major changes in political stability. Average daily calorie availability (intake and consumer waste) per person in the region is projected to reach 3 200 kcal, varying from 3 440 kcal in the Gulf region, 3 412 kcal in North Africa, and 2 962 kcal in Other Western Asia to 2 420 kcal in the LDCs.

Diets in the MENA region are dominated by vegetal foods. The *Outlook* projects that animal foods will increase in share, due to higher meat, fish and dairy product consumption, but the transition will be slow (Figure 2.13). It is estimated that 89% of calories in the region will still stem from vegetal sources by 2027, only slightly down from the current level. Eating patterns across the region will remain relatively similar, and differences between the sub-regions are mainly due to their income differences. The countries of the Gulf region consume the highest share of animal foods at 15%. Second are the LDCs at 12%, as a result of their large animal husbandry sectors, while the countries of North Africa and Other Western Asia only reach about 10% by 2027. These shares of calories from animal sources compare with the stable 24% share which has been experienced in developed countries for many years.

**Figure 2.13. Calories availability from various sources**



Source: OECD/FAO (2018), “OECD-FAO Agricultural Outlook”, OECD Agriculture statistics (database), <http://dx.doi.org/10.1787/agr-outl-data-en>.

StatLink  <http://dx.doi.org/10.1787/888933742682>

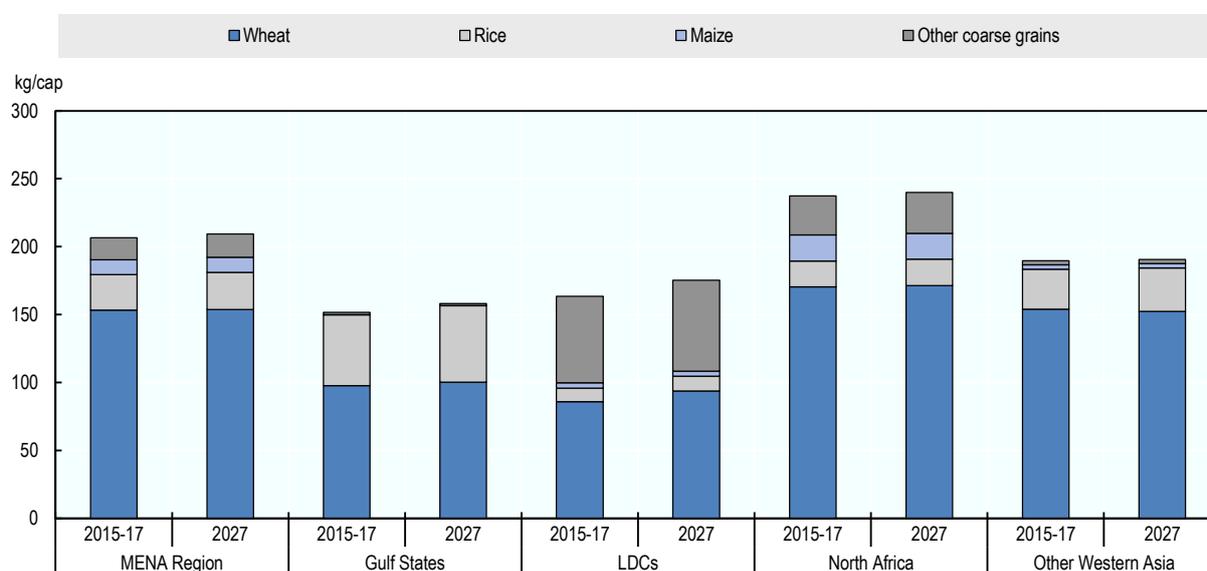
### *Dominance of cereals in diets will continue*

Average annual food consumption of cereals is currently about 200 kg per person in the region, almost 60 kg higher than the world average. It is projected to stay roughly at this level over the projection period. Wheat is the traditional food staple in the region, yet its per capita consumption is projected to be flat. Rice is expected to show continued growth in the Gulf region, due to the consumption by migrants from southern and eastern Asia. In LDC countries, the use of locally grown coarse grains (primarily millet) is also expanding (Figure 2.14).

The share of calories from cereals in the diets continues to fall slowly, as growth in food demand comes from higher value products, especially vegetable oil and sugar.<sup>17</sup> The increased consumption of processed foods and prepared meals is expected to drive per capita vegetable oil use in the region from currently 19 kg to 22 kg per year by 2027. It will remain highest in the Other Western Asia region at 25 kg and lowest in the LDC countries where consumption will attain only 7 kg, as the population will still be largely rural and oilseeds are not grown locally.

Diets in the MENA region are traditionally very high in sugar and they are expected to stay that way, despite mounting health concerns. Consumption levels in countries such as Egypt, Saudi Arabia and Tunisia are around 40 kg/person/year. Average annual consumption of sugar is anticipated to grow, as lifestyles become more affluent, from 32 kg/person to 34 kg by 2027, at which level it will be on par with developed countries.

**Figure 2.14. Wheat remains the most important cereal in the region**



Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), <http://dx.doi.org/10.1787/agr-outl-data-en>.

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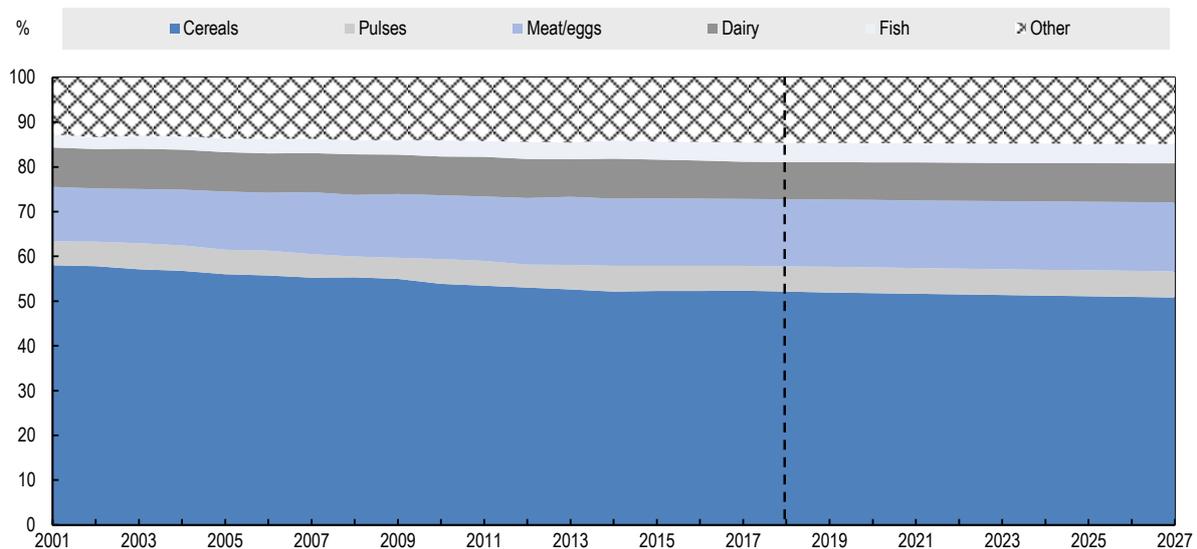
### *Low intake of proteins from animal sources*

Meat is a distant second as a source of protein in the average MENA diet (Figure 2.15). The average meat consumption in the region is currently 25 kg/person p.a. (retail weight). Driven by income growth, it is projected to grow 0.6% per year over the medium term, led by growth in poultry, which is by far the most important meat consumed currently at 18 kg, growing at almost 1%. Meat consumption is highest in the Gulf region where it will increase marginally to 54 kg. Meat consumption in the LDC region will be largely driven by progress in the domestic sheep and cattle sector. It is expected to recover from recent declines to about 17 kg/person/year in 2027 based on projected productivity improvements by pastoralists.

Fish consumption in the MENA region has grown rapidly in recent years, at 4% p.a. in the last decade, and become second to poultry in providing protein in the MENA diet. While consumption is low and stagnant in LDC countries, growth elsewhere continues to outpace meat consumption.

Dairy products have become an important source of nutrition in the region, but per capita consumption fell in the last decade at a rate of 1.1% p.a. due to difficult production conditions especially in Other Western Asia and the Least Developed countries. In contrast, consumption grew strongly in the Gulf region at 4.9% p.a. and 1.8% in North Africa. Dairy product consumption continues to expand in the MENA region as producers enter more markets with a wider range of products. Fresh dairy products will continue to make up the largest share of the dairy market in the region, but there are growing markets for processed products including butter and cheese in more affluent countries. In lower income regions, particularly in North African countries, the demand for milk powders is significant. These are reconstituted into processed dairy products.

**Figure 2.15. Share of animal protein in MENA diets is rising**



Source: FAOSTAT, OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), <http://dx.doi.org/10.1787/agr-outl-data-en>.

StatLink  <http://dx.doi.org/10.1787/888933742720>

### *The outlook for production*

The medium-term evolution of agricultural production in the MENA region will be shaped by a wide range of domestic and international factors. Agricultural production needs to address a series of domestic challenges in order to achieve sustainable development including aridity, limited cultivable land, scarce water resources and serious implications of climate change. Additionally, for almost all agriculture and fish products, price competition from international markets is high and in real terms, prices in these markets are trending down.

Due to these factors, agricultural and fish production in the region, measured in constant international prices, grew slowly at an annual rate of 1.3% p.a. over the last decade.<sup>18</sup> This slow rate of growth is due to falling real prices, but also to weak policies, insufficient investment in science and technology and agricultural development and conflict which have contributed to the impoverished state of agricultural resources and to their inefficient use and low productivity.

A modest improvement in production growth over the medium term is projected based on a generally improved economic setting, no deepening of conflict in some countries, and more stability in others which should improve investment and productivity. Average annual growth for the region as a whole is projected at 1.5% p.a. Critical to the region's growth prospects is the performance of its two main producer countries, Egypt and Iran, which together account for over half of the value of the MENA region's agricultural and fishery production. They are projected to grow 2.0% p.a. and 1.0% p.a. respectively.

#### **Box 2.4. The future of food production in controlled environments**

Many MENA countries are confronted with a dual challenge: they need to conserve their often small and fragile resource base, while also facing high and rising food import dependencies. Climate change will add to these challenges, further limiting production capacities and adding to import needs. These challenges are most pronounced in the countries of the Gulf Cooperation Council (GCC), where import dependencies can exceed 90% of domestic food needs and where both fertile cropland and renewable water resources are practically exhausted. In fact, many of these countries have grown food on irrigated desert land and with fossil water and, unsurprisingly, were forced to cease production completely soon after they had started. While adverse natural production environments have rendered these practices unsustainable, production in so-called "controlled environments" promises new and sustainable options to re-embark on domestic food production.

"Controlled environments" is a term commonly used to denote agricultural production independent of natural production environments. Typically, these are fully climate-controlled greenhouses, closed or semi-closed, where soil is replaced by an inert medium such as gravel or perlite and water supply is based on hydroponics. Nutrient supplies are managed either through fertiliser or "natural" plant nutrient sources such as animal or fish manure. Controlled environments are high-tech production plants that combine a whole range of different technologies, from fully automatic fertilisation, pest and weed control, robotic harvesting systems, LED lighting, solar-based heating, adiabatic cooling and energy-efficient desalination. They also use high ambient CO<sub>2</sub> levels to boost yields, which can reach extra-ordinarily high levels of, for example, up to 100 kg of tomatoes/m<sup>2</sup>. In analogy to smartphones, these production plants are also called "smart farms".

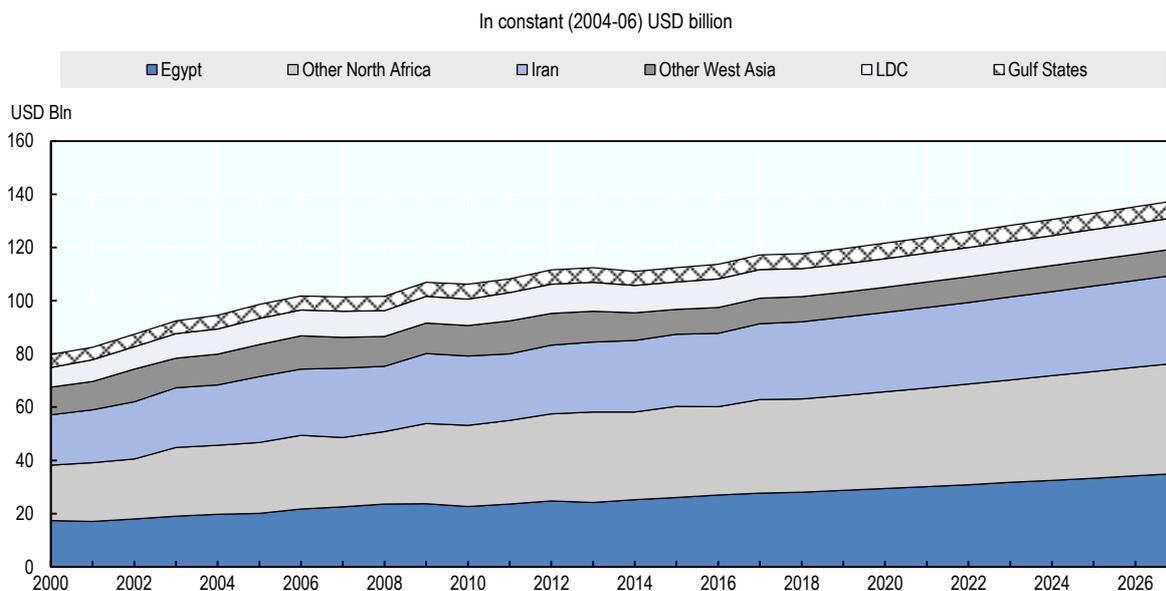
The combination of different technologies allows for location-independent and fully controlled production at high resource efficiency. These properties enabled controlled

environments to make inroads in hot and arid environments, including the deserts of Arizona, Australia, and more recently also the GCCs.

The costs of production for some fruits and many vegetables are surprisingly low. Solar energy provides cheap electricity for cooling and LEDs, for desalination and N-fertiliser. CO<sub>2</sub> is available as a by-product from the hydro-carbon and cement industry, while migrant workers offer access to low cost labour for harvesting, grading and other labour-intensive processes. On the demand side, supermarkets provide cold chains and access to a large consumer base either through retail consumers or the large hospitality sector. Preliminary calculations suggest that products like tomatoes, eggplants, peppers or micro-herbs can be produced at costs of about 30-40% below the prices of airfreighted produce. A number of start-ups but also well-established companies are now seizing these new opportunities, apparent in the swiftly rising investments in controlled environments.

There are, however, risks and GCC-specific limits to producing in controlled environments. They include the need to have a highly-skilled operator (“head-grower”) to run such a plant, the need to manage a complex supply chain from seedlings to spare parts, or the need to establish joint ventures with local partners, as foreign land ownership is heavily circumscribed or completely impossible in many GCCs.

**Figure 2.16. Net value of agricultural production to grow more strongly**



Source: FAOSTAT, OECD/FAO (2018), “OECD-FAO Agricultural Outlook”, OECD Agriculture statistics (database), <http://dx.doi.org/10.1787/agr-outl-data-en>.

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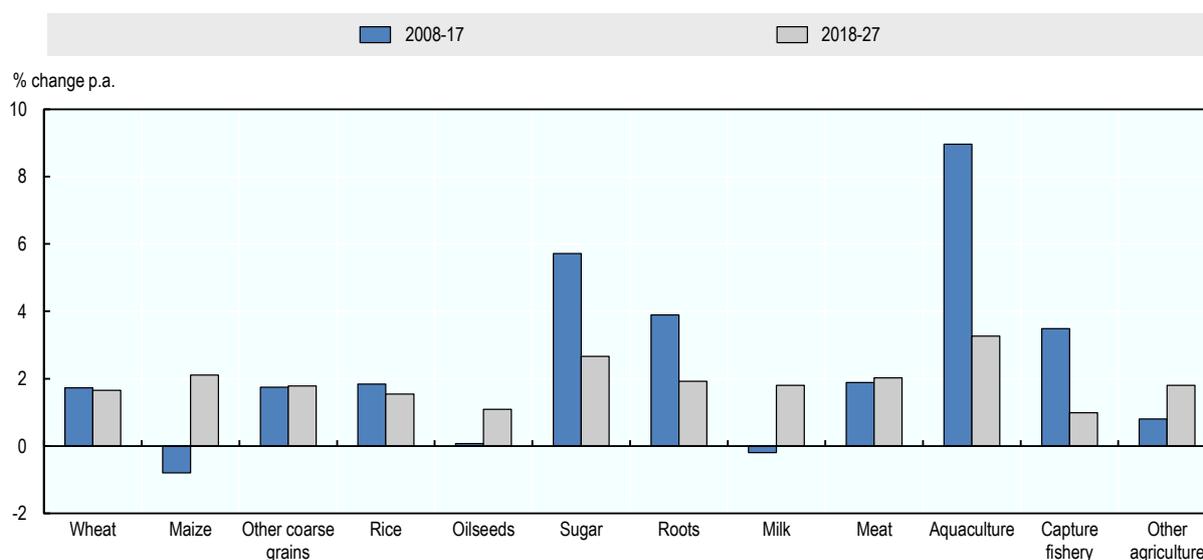
Agricultural production in the region is dominated by cereal production. While in the past production growth was achieved mainly by area expansion, yield improvements are seen as the major source of gains in the future. Cultivated land is projected to remain unchanged to 2027. Yields of the main crops, wheat, coarse grains and rice, are expected to grow at about 1.5% p.a., which is associated with improvements in seed potential, increased input intensity and improved management. Subsequently, the production of wheat, the region’s major crop, is projected to reach 45 Mt by 2027, up from 37 Mt

currently. Iran, the region's largest producer, will increase its share from 32% to 35% as its production will reach 16 Mt in 2027. Maize production, which fell in recent years due to severe declines in Iran, is set to recover in the medium term due to improved yields and will reach 10.5 Mt. Rice production, of which two-thirds takes place in Egypt, will attain 7.6 Mt by 2027, growing at 1.5% p.a., due to slower growth in cultivated area.

Sugar production, from sugar cane and increasingly sugar beets, has been the most rapidly growing commodity in the region. Sugar beet production grew rapidly at 6.4% p.a. in the last decade, underpinned by 10% p.a. area expansion in Egypt. It is projected to grow 3.0% p.a. over the outlook period, as sugar prices remain flat and fewer additional hectares will be cultivated. Growth in sugar cane production is mainly based on yield improvements, and is expected to grow slowly at about 0.8% p.a.

Milk production in the region was stagnant in the last decade, due to production declines in both Other West Asia and LDC countries, which were offset by growth in the other sub-regions. For the coming decade, the *Outlook* projects milk yield improvements of 1.6% p.a. and a cow herd enlargement by 0.2% p.a. As a result, milk production is expected to attain 38.4 Mt by 2027. Iran will continue to hold the largest share of production at about 20% followed by Egypt at 18%. As in the past, about 50% of milk will be consumed fresh, while 18% are going to be processed into cheese and 16% into butter, with the remaining share used in milk powder production.

**Figure 2.17. Changes in major production activities in the MENA region**



Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), <http://dx.doi.org/10.1787/agr-outl-data-en>.

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Current meat production in the region is about 10 Mt (carcass weight), with poultry meat accounting for about 60%, followed by bovine meat and sheep meat with about 20% each. Investments into new livestock production facilities together with higher carcass weights are expected to expand meat production across the region on average at 2.0% p.a., slightly higher than in the previous decade. In order to satisfy the fast growing domestic demand, poultry production is expected to increase at 2.8% p.a., led by strong growth in the North Africa region, where Egypt's poultry sector is dominant. The livestock sector of the LDC sub-region is characterised by a very large cattle inventory, which is currently estimated at about 45 million head, accounting for over 60% of the total MENA cattle inventory. Nevertheless, due to traditional herding practices with low offtake ratios, the sub-region produces just 22% of the bovine meat of the MENA region.

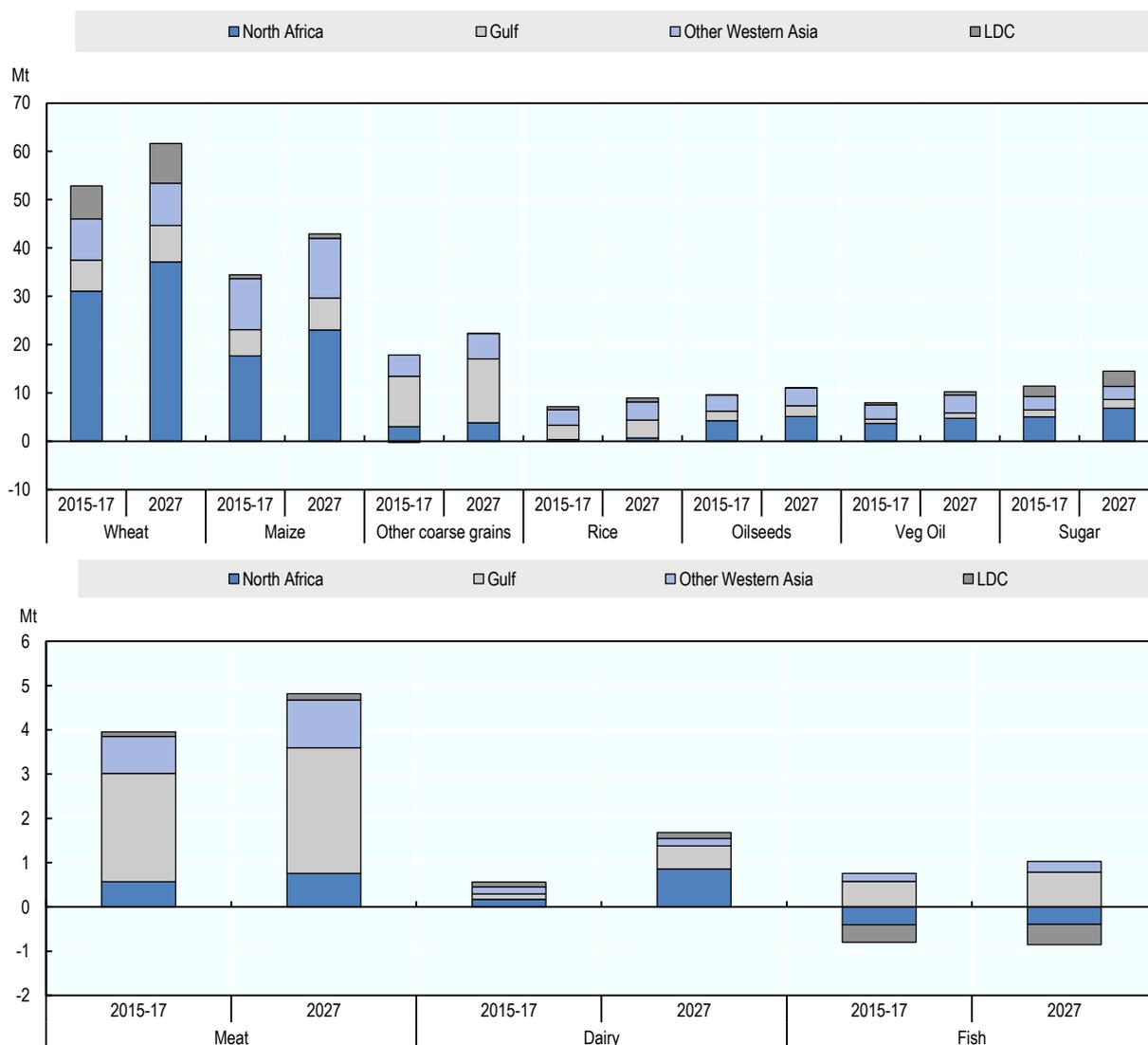
Capture fisheries still dominates fish production in the MENA region. Currently, almost 4 Mt are landed per year, with Morocco accounting for almost 40%. Growth in the next decade is limited to 0.5% p.a. due to dwindling fish stocks. Aquaculture production in the region more than doubled during the last decade, standing currently at almost 2 Mt. It is set to increase by another 50% over the ten years, with growth expected in all sub-regions, particularly North Africa (Egypt) which contributes 75% of the total supply.

### *The outlook for trade*

The MENA region is one of the largest net food importing regions of the world, with significant net imports of virtually all food commodities; trade has been and will remain the most important contributor to additional food supplies in the region. Currently, about 27% of international shipments of cereals, 21% of sugar, 20% of poultry meat, 39% of sheep meat, 20% of skim milk powder and 30% of whole milk powder go to the MENA region. Domestic markets in the region are generally tightly integrated into global agricultural markets and this interdependence is certain to continue and expected to deepen for products such as wheat and maize.

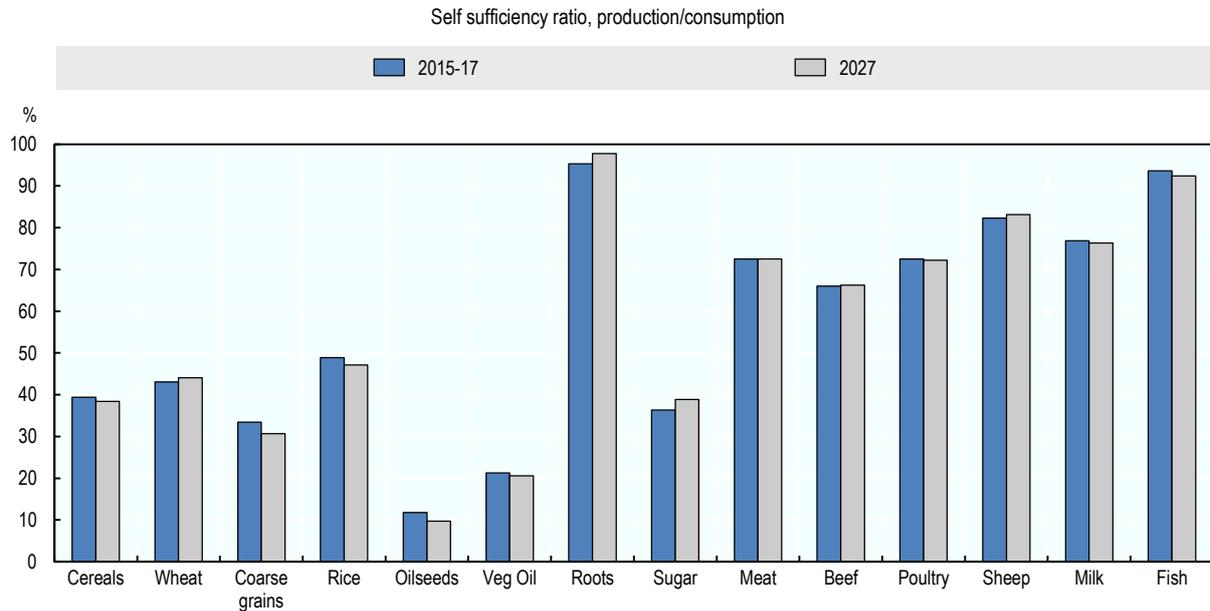
Large increases in net imports are projected, as consumption will continue to outpace production for most basic food commodities. The deficit is projected to reach 58 Mt for wheat and 65 Mt for coarse grains in 2027. The largest share of MENA imports for almost all commodities will continue to go to North Africa, followed by Other Western Asia. Other coarse grains and rice are the exception, as the Gulf region dominates for them (Figure 2.19). The Gulf region dominates meat and fish imports, given its low production and relatively high consumption levels. The LDC countries are the only net exporter of fish in the region, and these exports are projected to increase.

**Figure 2.18. Rising net imports for all commodities and in all regions**



Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), <http://dx.doi.org/10.1787/agr-outl-data-en>.

StatLink  <http://dx.doi.org/10.1787/888933742777>

**Figure 2.19. High dependence on foreign markets for basic foodstuffs**

Source: OECD/FAO (2018), “OECD-FAO Agricultural Outlook”, OECD Agriculture statistics (database), <http://dx.doi.org/10.1787/agr-outl-data-en>.

StatLink  <http://dx.doi.org/10.1787/888933742796>

## Risks and uncertainties

The medium-term outlook projections for the Middle East and North Africa region are subject to risks and uncertainties associated with internal and external issues. Conflicts critically impact food consumption as well as agricultural production. Other uncertainties include, for example, nutritional concerns or volatility in crude oil prices. These issues are analysed below to illustrate their potential impact on the projections.

### *Addressing nutritional concerns*

Parts of the MENA region face what is referred to as the “triple burden” of malnutrition: undernourishment, over-nourishment or obesity, and malnutrition (Box 2.5). Albeit slowly, undernourishment is diminishing, at least where conflicts are not present. But the latter two nutritional outcomes are rising, and governments are considering policy measures to address these.

The United Nations report “Arab Horizon 2030” undertook scenario analysis to examine a radical change in diets of the Arab region (which broadly corresponds to the MENA region as defined here, but excludes Iran).<sup>19</sup> Addressing the diet problem has implications for the dependence on foreign markets for basic foodstuffs. A so-called “Healthy Diet Scenario” was constructed that assessed the impacts of an improved diet on domestic and international markets. Using the OECD-FAO Aglink–Cosimo model, a scenario was simulated in which eating patterns were assumed to conform to FAO and WHO “healthy diet” recommendations of 2 200 kilocalories per day which would be achieved through a 50% decrease in cereal availability for food consumption, a doubling of meat and egg consumption, a tripling of dairy products and reduced sugar and vegetable oil consumption. Assuming a “waste” factor of 30% that is implicit in the baseline calorie

availability estimate, such changes involve a decrease in total caloric availability from 3 100 kcal per day to 2 860 kcal per day.

### Box 2.5. The triple burden of malnutrition in the MENA region

The Middle East and North Africa (MENA) region comprises 22 countries at very different levels of development, income, health and social protection.<sup>1</sup> The range goes from high levels of development in Gulf Cooperation Council (GCC) countries, moderate levels in Mashreq and Maghreb countries to very low levels in the three LDCs of the region. Unsurprisingly, nutritional problems and the ability of the various countries to cope with the burdens of malnutrition also differ across the region. While the LDCs of the region face serious chronic hunger challenges or outright famines, the GCC alongside many of the middle income countries, in contrast, confront a growing problem of over-consumption and, as a consequence, rising levels of overweight and obesity. Almost all MENA countries have rather undiversified diets with high levels of micronutrient deficiencies, notably iron, which can result in anaemia. The table below summarises the prevalence of the various forms of malnutrition. What the table fails to capture is the fact that the various forms of malnutrition are not confined to, nor even concentrated in a given country, but they occur simultaneously in many countries, sometimes within the same household and in a few cases afflicting the same individual

	Middle East		North Africa*	
	2005	2015	2005	2015
	%			
Prevalence of undernourishment in the total population	9.1	9.1	4.6	6.7
Prevalence of food insecurity in the adult population ( $\geq 15$ )	30.9	8.7	27.9	11.2
Prevalence of wasting in children (< 5y)		3.9		7.9
Prevalence of stunting in children (< 5y)	20.6	15.7	21.6	17.6
Prevalence of overweight in children (< 5 y)	7.0	8.0	8.9	10.0
Prevalence of obesity in the adult population ( $\geq 18$ y)	20.3	25.8	17.5	22.6
Prevalence of anaemia among women of reproductive age (15-49)	34.1	37.6	36.7	32.6

\* Including Sudan.

The simultaneous occurrence of the various forms of malnutrition is known as the “triple burden of malnutrition.” It takes a growing toll on the region’s health sector and even on overall economic performance. On the one hand, anaemia and undernourishment reduce a person’s ability to undertake physical work and thus can create poverty traps, particularly but not only in LDCs. On the other hand, overweight and obesity have become increasingly visible through the high prevalence levels of non-communicable diseases (NCDs), observed notably in GCC but also in Mashreq and Maghreb countries.

The simultaneous occurrence of the various forms of malnutrition also makes it difficult to address the three problems efficiently. Past programmes often took a “wholesale” approach, e.g. by lowering food prices for all consumers, particularly for basic foods (bread/flour/sugar). While this resulted in improved access to basic food energy even for the poorest consumers, it also added to a growing problem of overweight and obesity and, not unrelated, food waste. A number of factors make policy choices particularly difficult for the MENA region. They include high inequality of wealth and incomes, hence different responsiveness to price and policy incentives; high shares of migrant populations and different ethnicities particularly in the GCC, hence different genotypic predispositions to develop NCDs; weak institutions as well as deficiencies in food delivery systems and physical infrastructure, hence rendering the administration of food supplementation and fortification programmes difficult. Consequently, addressing the triple burden demands much more targeted and innovative policy instruments than those applied in the past.

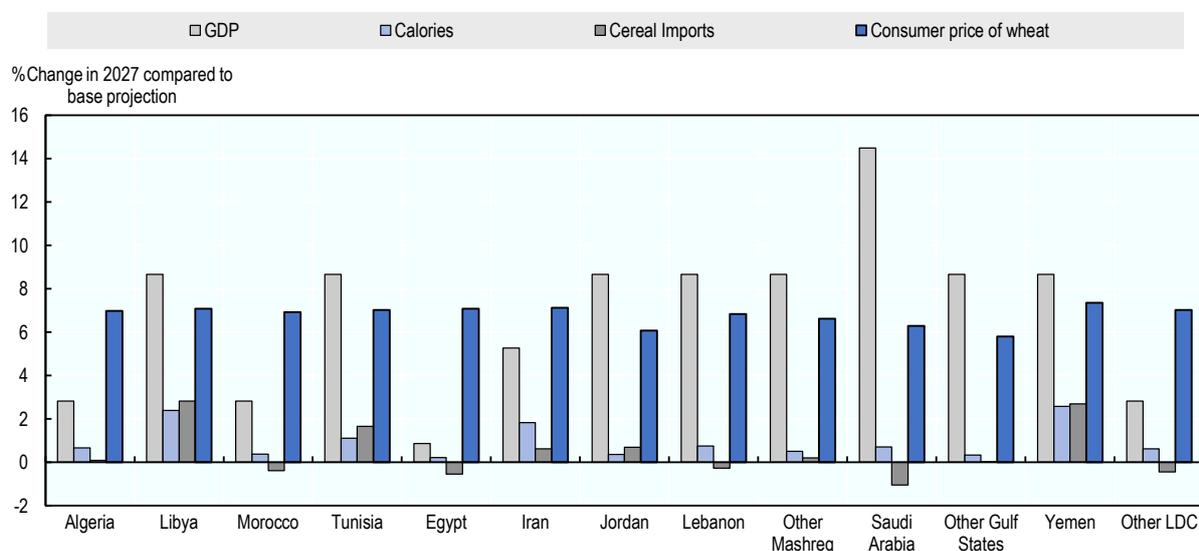
1. Estimates are adjusted to definitions of indicators and regions based on data from the *State of Food Insecurity and Nutrition* (FAO, 2017f).

The effect on domestic production was simulated under the assumption of an unconstrained expansion of the supply in the region. Under this scenario, meat production in the Arab region would, by 2030, increase from 2 Mt to 13 Mt in the healthy diet scenario. Dairy product production (fluid milk equivalent) would increase from 5 Mt to 25 Mt by 2030. Though food consumption of cereals under the healthy diet scenario would decrease substantially, overall demand for cereals under the scenario would increase. The large increase of the livestock sector and subsequent domestic feed use of grains would drive this increase. Feed demand for cereals would grow six times faster under the healthy diet scenario than under the business as usual baseline. Production of feed within the Arab region would not be able to grow this fast, so that the region would require additional feed imports. Consequently, the self-sufficiency rate for cereals would be lower under the healthy diet scenario than under the baseline projection.

While such a substantial change in the average diet would affect the nutrition status of the average consumer in the Arab region in a positive way, it would not lessen the region's dependence on foreign markets, as either feed grains or alternatively livestock products would have to be imported.

#### *Analysis of alternative crude oil price projections*

The foreign exchange balance of many MENA countries is critically influenced by crude oil prices. A simulation as presented in the Overview, using a rise in the crude oil price to USD 122/barrel rather than the baseline value of USD 76/barrel by 2027, illustrates the significance of oil prices for the region. Figure 2.20 illustrates the estimated impacts on consumption and trade. Higher oil prices lead to higher world reference prices for cereals of around 10%, which in turn lead to higher retail prices in MENA of about 6%. The estimated increases in per capita GDP range from 2% for Egypt to 15% for Saudi Arabia. The result is that on average for the region, daily calorie availability increases by 0.6% in 2027, meaning that the income effect of higher oil prices outweighs the hike in food prices, generating overall higher food consumption in the region. Among the least developed countries of the region, Yemen's estimated increase in GDP is 8% by 2027, which leads to a 2.5% increase in calorie intake. The estimated trade impacts for cereals vary by country but for the region as a whole, net wheat imports increase marginally.

**Figure 2.20. Impact of higher oil prices on food prices consumption and trade**

Source: OECD/FAO Secretariats.

StatLink  <http://dx.doi.org/10.1787/888933742815>

### *Implications for food security prospects in the region*

According to recent estimates (FAO, 2017f) for 2014-16, the prevalence of undernourishment is highest in the region for Sudan (25.6%), Iraq (27.8%), and Yemen (28.8%), with no reliable data for Syria. Projections of higher calorie and protein availability, based on the assumption of stable economic development and a stable income distribution, should imply a decline of the prevalence of undernourishment over time, particularly in the least developing countries.

## Conclusions

The outlook for the MENA region assumes little change in agricultural, natural resource and economic growth policies. Its implications for the region are that food demand, supply and trade outcomes will continue along a similar trajectory that has been observed in the past—slow growth in food consumption, gradual changes in diet to include higher consumption of animal products, continued water use at unsustainable rates, and continued and increasing reliance on world markets. The main difference to past trends would be higher meat, milk, maize and oilseeds production associated with higher consumption of animal proteins. While increasing maize and milk production represent a recovery from quite poor performance over the past decade, increasing meat production is based on the assumption that an improved economic environment will lead to more investments and subsequent productivity improvements in the region. These developments are anticipated to limit, but not reverse, increases in the dependence of the region on imports.

Current agricultural policies in the region emphasize wheat price support bolstered by import protection (Box 2.1). These policies are aimed at limiting import dependency for cereals. At the same time, consumer policies emphasise subsidised prices for staple foods

and are viewed as social protection measures. The results of these policies can be seen in the pattern of harvested land, of which 60% remains in water-thirsty cereals.

An alternative approach to food security and agricultural policies would emphasise rural development, support for production of higher-value horticulture products on small farms, supported by a more robust technical extension system. This approach is rooted in the conviction that the level of food security of a country hinges more on the elimination of poverty than on wheat self-sufficiency. Fruits and vegetables both consume less water and provide higher economic returns per drop, and many countries in the region have a comparative advantage in their production. While such higher-value crops and livestock products could potentially increase farmer incomes, improve nutrition, and use water more sparingly, they require a higher level of agronomic and export market knowledge and present higher levels of risk. A revision of food security policies away from self-sufficiency towards poverty elimination would focus the attention of policymakers on rural development and on building the capacity of farmers to minimise risk while raising higher value crops.

From a nutritional perspective, diets in the MENA region will remain very rich in cereals, and wheat in particular. The share of vegetable oil and sugar, as well as meat, fish and dairy products will grow, albeit slowly. Barring increased conflict, undernourishment should decline slowly as average food consumption levels increase. However, the evolution of diets is also expected to contribute to increased rates of obesity with associated health consequences. The current structure of policy support toward consumers of cereals limits needed diet diversification, and should be altered to redress rising health issues.

## Notes

<sup>1</sup> In this chapter, the Middle East and North Africa region includes countries/areas of FAO's North Africa and Near East region: Algeria, Bahrain, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, the Palestinian Authority, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, United Arab Emirates (UAE), and Yemen

<sup>2</sup> Water stress is indicated when annual freshwater withdrawals are high compared to renewable internal freshwater resources. If freshwater withdrawals exceed renewable internal resources then either non-renewable groundwater resources are being withdrawn or desalinated and other supplemental water resources are being used that are not included in the total annual water resources figures (World Bank, 2018).

<sup>3</sup> The Herfindahl-Hirschmann concentration index, is a measure of the degree of product concentration. The index ranges between 0 and 1. An index value closer to 1 indicates a country's exports or imports are highly concentrated on a few products. On the contrary, values closer to 0 reflect exports or imports are more homogeneously distributed among a series of products. For worldwide evidence of systematically high concentration index values for natural resource rich countries, see Bahar (2016).

<sup>4</sup> Sodicy refers to high concentrations of sodium in soils. Sodic soils have a poor structure as sodium causes soils to swell and disperse. A dispersed soil structure loses its integrity, becomes prone to waterlogging, and is usually harder, making it difficult for roots to penetrate.

<sup>5</sup> The value of gross production includes all livestock and crop production, including crops used for feed. The proper land comparator for gross production is agricultural land, which includes both arable land and pastures.

<sup>6</sup> All values are expressed in dollars using average international prices of 2004-2006.

<sup>7</sup> The “water scarcity line” is defined in UNDP (2006).

<sup>8</sup> Generally, water “used” means that it (1) is depleted through evapotranspiration; (2) is absorbed into a product; (3) flows to a location where it cannot be readily reused; or (4) becomes heavily polluted (Molden et al., 2010).

<sup>9</sup> Cline (2007). Calculations are based on the IPCC Third Assessment Report published in 2001.

<sup>10</sup> Verner and Breisinger (2013); FAO (2015); Ward and Ruckstuhl (2017).

<sup>11</sup> Cereal area is mostly planted with wheat. In 2014, of total cereal area, wheat accounted for 43%, sorghum 23%, barley 18% and millet 8%. The current mix of wheat and coarse grains area is only slightly different from that in the 1960s when wheat made up half of all harvested area of cereals.

<sup>12</sup> The Gulf Cooperation Council includes the countries of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.

<sup>13</sup> Conflict countries include Sudan, Syria, Yemen, Libya and Iraq.

<sup>14</sup> In this section, countries are often aggregated into regional groups. The North Africa region is Morocco, Algeria, Tunisia, Libya and Egypt. The Gulf region includes the states of the Gulf Cooperation Council: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and UAE. The Other Western Asia region includes Iran, Lebanon, Jordan and other Mashreq countries of Syria, the Palestinian Authority, and Iraq. The least developed country (LDC) region includes Yemen, Sudan and Mauritania.

<sup>15</sup> See [www.worldbank.org](http://www.worldbank.org), Global Consumption Database. Shares are based on 2016 values.

<sup>16</sup> See IMF *World Economic Outlook*, January, 2018, and World Bank Global Economic Prospects, January, 2018 for more detailed discussion.

<sup>17</sup> Excluding olive oil which is not included in this projection.

<sup>18</sup> See FAOSTAT “Net agricultural production” which weights agricultural production of each commodity by international reference prices during the period 2004-06. The value of production is net of the value of seed and feed inputs. The value of fish production is added, and is net of feed inputs.

<sup>19</sup> Based on Food and Agriculture Organization of the UN (FAO) and United Nations Economic and Social Commission on West Asia (ESCWA). 2018. Arab Horizon 2030 (Beirut, ESCWA).

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