Arab Horizon 2030: Prospects for Enhancing Food Security in the Arab Region

UNITED NATIONS
الاسكوا
ESCWA

Food and Agriculture Organization of the United Nations

E/ESCWA/SDPD/2017/1

Economic and Social Commission for Western Asia

Arab Horizon 2030: Prospects for Enhancing Food Security in the Arab Region

United Nations
Beirut

United Nations publication issued by ESCWA, United Nations House, Riad El Solh Square, P.O. Box: 11-8575, Beirut, Lebanon.

Website: www.unescwa.org.

Photo credits:
Cover: ©kasto – Fotolia
Page 1: ©FAO/Abdelhak Senna
Page 11: ©Susana Perez/Shutterstock
Page 23: ©Nice_Media_PRODUCTION/Shutterstock
Page 35: ©WFP-Fares_Khoailed_0011
Page 53: ©ESCWA/Minerva-Sadek
Page 73: ©robert paul van beets/Shutterstock
Page 91: ©FAO/Jonathan Bloom
Page 103: ©ESCWA/Minerva-Sadek

Acknowledgments

This report is the result of the combined efforts of the Economic and Social Commission for Western Asia (ESCWA) and the Food and Agriculture Organization of the United Nations (FAO). Contributions have come from both organizations as well as from sustainable development and food security experts and practitioners. Special thanks go to the individuals listed below and to ESCWA division directors, publications committee and staff from substantive divisions for their comments and feedback.

The ESCWA project team, Sustainable Development Policies Division, consisted of Roula Majdalani, Director; Reem Nejdawi, Chief; and Fidele Byiringiro, Economic Affairs Officer.

The FAO project team, Regional Office for Near East and North Africa (FAO-RNE), consisted of Abdessalam Ould Ahmed, Assistant Director General, Regional Representative; David Sedik, Senior Policy Officer; and Mohamed Ahmed, Policy Officer.

Project coordinator was Mohamed Al-Hamdi, First Economic Affairs Officer, ESCWA.

Lead authors were Susan Razzaz, Panos Konandreas, Reem Nejdawi, Mohamed Al-Hamdi, David Sedik, and Mohamed Ahmed.

Contributing authors were Holger Matthey (FAO) and Christopher Ward (Fellow of the Institute of Arab and Islamic Studies, University of Exeter).

The Medium-term Outlook and Market Analysis Team, Trade and Markets Division, FAO Headquarters, consisted of Holger Matthey (team leader), Sergio René Araujo Enciso, Eduard Bukin, Emily Carroll, Jiyeon Chang, Merritt Cluff, Hannah Fried and Jorge Soguero.

Authors of background papers were Marie Therese Abi Saab (agricultural production and productivity), Fidele Byiringiro (food loss and waste), Talal Darwish and Ali Fadel (land degradation), Panos Konandreas (status of food security and trade), Musa McKee (technology) and Christopher Ward (agriculture and natural resources). The background papers are available from https://www.unescwa.org/publications/arab-horizon-2030-prospects-enhancing-food-security-arab-region.

Input on food consumption and nutrition security was provided by Rachel Bahn, Nahla Hwalla, Martin Keulertz and Sibelle el Labban, American University of Beirut (AUB).

Input on economic access to food in the Middle East and North Africa was provided by Dipayan Bhattacharyya, Muriel Calo and Mariko Kawabata, World Food Programme Regional Bureau (WFP Cairo).

External peer reviewers were Mahmoud Halablab, Professor, Faculty of Science, Rafik Hariri University, Lebanon; Mahmoud Medany, Chairman, Agricultural Research Centre, Egypt;

Rabi Mohtar, Professor, Biological and Agricultural Engineering, Texas A&M University, United States; Nabeel Saad, Director, Planning and Agricultural Economics Department, Ministry of Agriculture and Forests, the Sudan; and Abdul Karim Sadik, Senior Economic Adviser, Kuwait Fund for Arab Economic Development, Kuwait.

Discussants and participants at the report review meeting were Khalid Nahar Alrwis, Department Head, Agricultural Economics, King Saud University, Saudi Arabia; Elie Choueiri, Programme Associate, FAO Office, Lebanon; Karl-Oscar Anders Ekdahl, Programme Policy Officer, World Food Programme, Egypt; Salah Abdelgadir Hassan, Director, Agricultural Integration and Food Security Department, Arab Organization for Agricultural Development, the Sudan; and Rami Zurayk, Steering Committee member, High-level Panel of Experts on Food Security and Nutrition.

Technical and administrative support was provided by Mona Fattah, Lara Geadah, Kamil Hamati, Moneem Murrah, Minerva Sadek and Rita Wehbe, ESCWA.

Foreword

The adoption of the 2030 Development Agenda, and its associated 17 Sustainable Development Goals (SDGs) in 2015 renewed global commitment to implement a transformative agenda that aims to achieve economic, social and environmental progress in an integrated and sustainable manner by building on regional and local specificities, while promising to leave no one behind. At the centre of the new development agenda is the issue of sustainable agriculture and food security, which is of high concern for the Arab region, particularly in the light of the food crisis of the last decade.

The Arab region is faced with many challenges that include scarce and dwindling natural resources amid growing demand as populations increase and become more affluent, and protracted sociopolitical crises including wars and occupation, the occurrence and impact of which are expected to worsen with the advent of climate change. Embedded in these challenges are issues such as rising inequalities, distress migration, mismanagement of resources and wasteful practices, which hamper the achievement of sustainability in general and food security in particular.

Countries in the region have generally kept food security high on their agenda. As a result, 14 Arab countries achieved the target set by Millennium Development Goal 1 to halve the proportion of individuals suffering from hunger during the period 1990-2015. Food production and per capita dietary energy supply have continuously increased and malnutrition has receded in non-conflict countries. Several countries in the region have succeeded in implementing policies that put agriculture on the path of structural transformation with positive outcomes in terms of food exports and poverty reduction.

Looking ahead, and despite these commendable efforts, there remain major concerns over food security in the region. Physical and economic productivity of natural resources remain relatively low, and the region continues to be highly dependent on the vagaries of global food markets. Alternative projections to the 2030 horizon based on plausible scenarios and assumptions point to a slightly brighter future for local production though the region will continue to depend heavily on food imports to meet its needs, which may prove increasingly challenging for the least developed countries of the region.

The present report provides a deep and comprehensive review of the prevailing food and agriculture situation of the Arab region together with alternative outcomes for the future. It was put together through a partnership between the United Nations Economic and Social Commission for Western Asia (ESCWA) and the Regional Office for the Near East (RNE) of the Food and Agriculture Organization of the United Nations (FAO). Our two organizations are tirelessly working to support our respective members in achieving greater food security by addressing rising challenges, implementing innovative strategies and programmes and

adopting sound policies for the sustainable management of the region's natural resources.

It is hoped that this report will enhance evidence-based policy dialogue on issues of food security and sustainable development in the Arab region not only for decision makers committed to ensuring the continued well-being of the Arab population, but also for the public at large including civil society and the media.

Mohamed Ali Alhakim
Under-Secretary-General, Executive Secretary
Economic and Social Commission
for Western Asia (ESCWA)

José Graziano da Silva
Director-General
Food and Agriculture Organization
of the United Nations (FAO)

Executive Summary

Food security is universally recognized as paramount to human well-being. But what exactly does it mean, and what is required to achieve food security? A comprehensive definition put forward by the World Food Summit in 1996 holds that "food security [is] a situation that exists when all people, at all times, have physical, social[1] and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life". This definition is useful, in that it points to the wide range of factors that need to be in place for a person to be food secure. First, food must be available in the country, through domestic production, import, or both. Second, households must have access to food, which entails both the need for food to physically reach markets and the financial ability of consumers to afford buying food. Third, individuals must consume a sufficient quantity and appropriate quality of food, and be healthy enough to metabolize that food. Furthermore, all of these aspects must be stable over time.

Food security is a complex subject, involving a wide range of areas of study, including agriculture, economics, politics, sociology and human physiology. Moreover, food security is complex in terms of the multiple lines of causality involved. For example, domestic agricultural production plays a role in food availability, but also in terms of access, because agriculture is the primary source of income for many of the poorest households.

This publication hopes to inform the debate regarding the status of food security in Arab countries and policy options for enhancing food security in the future, noting the overarching directions of the 2030 Agenda for Sustainable Development. Given the heterogeneity of the Arab region,[2] both in terms of natural endowment, particularly in water resources, and economic capability, the analysis in the report divides the region into four subregions, each consisting of a number of more homogeneous countries. These are: the Gulf Cooperation Council (GCC) subregion (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates), the Mashreq subregion (Egypt, Iraq, Jordan, Lebanon, State of Palestine and Syrian Arab Republic), the Maghreb subregion (Algeria, Libya, Morocco and Tunisia) and the least developed countries (LDC) subregion (the Comoros, Djibouti, Mauritania, Somalia, the Sudan and Yemen).

Part I of the report provides a broad overview of food security in the Arab region, including availability, access and utilization of food. Issues of stability come into play in all three of these areas. Part II of the study provides an in-depth analysis of selected thematic issues, namely agriculture, international food trade, and food loss and waste. In order to give a sense of the implications of food security issues on the future, chapter 7 in Part II is devoted to descriptions of the likely future if the region were to maintain its present trajectory, as well as the potential impacts of actions to increase yields, shift to healthier consumption patterns, and establish and maintain strategic food stocks.

Part I: The big picture of food security in the Arab region

Expanding populations are increasingly reliant on imports

Food availability is defined as sufficient quantities of food of appropriate quality, supplied through domestic production or imports, including food aid. At the broadest level, food availability is measured by the Average Dietary Energy Supply Adequacy (ADESA), expressed as the ratio of dietary energy supply to dietary energy required. The ADESA for the Arab region is about 134 per cent, indicating that the region, taken as a whole, has considerably more food than is required for its population to have a healthy and active life. At one extreme, some countries in the region have ratios of over 150 per cent – even higher than the average for developed countries. At the other extreme, some of the LDCs in the Arab region barely reach 100 per cent. It is important to bear in mind that the ADESA overstates the consumption of some segments of society because it does not take into consideration the distribution of food among the population.

The quantity of food consumed at a national level depends heavily on demographics. The countries of the Arab region are undergoing a period of demographic transformation characterized by a high population growth rate and increasing urbanization. Between 1950 and 2010, the population of the region increased by nearly five times. In contrast, the other underlying determinant of food consumption – average per capita consumption – has changed much less dramatically. In terms of urbanization, nearly 90 per cent of the increase in the population of the region in the years to come will be in urban areas, such that by 2050 close to 70 per cent of the region's population will be living in cities. Despite variations throughout the region, even the LDCs are expected to become predominantly urban by 2050. Urbanization has a dramatic impact on food security, in terms of changes in livelihoods and lifestyles, as well as land use.

The combination of increasing population and urbanization implies rapidly increasing food consumption, but domestic production is not keeping pace. The region's yields have always been relatively low due to geoclimatic characteristics, and little improvement has been made over time. For most food commodities, production has leveled off since the 1990s while consumption has kept its ever-increasing trend, and the gap between the two is widening.

The widening gap between domestic food production and consumption is met by imports. Where imports are affordable, based on merchandise or service exports, national level availability is secure. Some Arab countries, however, have insufficient export revenue to sustain their imports of food, and these countries are highly vulnerable to global food supply shortages, and consequently to price shocks.

Access to food is primarily an economic challenge

Even in countries with stable food availability at a national level, access at the household level cannot be taken for granted. There is considerable inequality in access to food within the region – more than in either developing or developed countries taken as a whole. Within the Arab region, only for the GCC countries is equality of consumption similar to that of developed countries. For the other three subregions (Mashreq, Maghreb and LDCs),

consumption is more unequally distributed than it is globally or in developing countries as a group. The highest levels of inequality in the Arab region are in the LDCs.

Perhaps the most important factor constraining access to food is poverty: with a sufficient level of income, households can overcome most of the barriers to access. By global standards, poverty in the Arab region is not high. There is wide variation, however, with some Arab countries considered among the richest in the world (for instance, Qatar) and others considered among the poorest (for instance, the Comoros). As is the case in other parts of the world, much of the poverty in the Arab region is a rural phenomenon. In Egypt, the Sudan and Yemen, more than three-quarters of poor citizens live in rural areas. This fact highlights the continuing importance of agriculture as a source of livelihoods, despite its low contribution to the quantities consumed.

Social protection programmes, intended to ensure a minimum level of food consumption, exist throughout the Arab region and are often directly focused on food. In the past, universal food subsidies were common. However, as global food prices have risen, programmes based on food imports have become increasingly more expensive, putting unsustainable pressure on public budgets. In several countries of the region, universal food subsidies are being replaced with targeted cash transfer programmes. Cutting-edge technology is now being used in safety nets for Syrian refugees in Jordan, providing an opportunity to improve the efficiency of safety nets much more broadly.

While poverty is the main factor constraining household access, in several countries of the Arab region, where populations suffer from conflicts and political instability, physical access to food is also a problem. Physical distribution of food is often required in such cases, but can be limited when agencies such as the World Food Programme have insufficient resources or are unable to reach affected populations.

Undernutrition and micronutrient deficiencies exist side by side with obesity

Utilization refers to the types and quantities of food consumed and to the physical metabolism of food. As such, it reflects the biological consequences of food availability and food access. Because utilization can be measured at the level of individuals, it not only provides a glimpse into inequalities across households, but also allows the identification of vulnerabilities among specific demographic groups, such as young children and women of childbearing age.

Yemen has an extremely high rate of malnutrition in the form of stunting among young children, and is considered in the most critical category of countries by the World Health Organization. The other LDCs in the region – particularly the Comoros, Djibouti and Somalia – also have very serious malnutrition problems. The relatively high rate of stunting in the Syrian Arab Republic, recorded before the current conflict, has likely worsened in recent years. Micronutrient deficiencies are also common in the Arab region, and even well beyond common in its LDCs. For example, rates of iodine deficiency among children are higher than the global developing country average in all Arab LDCs, as well as in Algeria, Kuwait, Lebanon, Morocco, Oman, Qatar and the United Arab Emirates.

Access to clean water, sanitation and health care are essential components of food security,

and without them nutritional diseases and infections become increasingly common, even if food consumption levels are otherwise adequate. Although most countries in the region have relatively good overall access, significant portions of their populations have very limited access. In Somalia, for example, over 40 per cent of the population lack access to adequate sources of drinking water, over 70 per cent lack access to adequate sanitation, and there is only one doctor for every 3,000 people – rates which undoubtedly contribute to the high levels of undernutrition and micronutrient deficiency observed.

The urbanization witnessed across the Arab region has had mixed impacts on the nutritional status. In general, the urbanization that the region has experienced in recent years is associated with reduced childhood malnutrition, as a result of improved access to food, as well as clean water, sanitation services and health care, in addition to the higher levels of education among urban mothers. At the same time, however, some of the lifestyle and consumption patterns associated with urbanization have also led to overweight and obesity: obesity in the Arab region is now among the highest in the world, with nearly one-quarter of the population being obese – double the world average – and even higher rates among women. The GCC countries are particularly affected, with obesity rates among Kuwaiti and Qatari women reaching almost 45 per cent.

Conflict and climate change exacerbate food-security challenges

In addition to the causes of food insecurity discussed above, two cross-cutting issues deserve special attention, particularly in the context of the Arab region: conflict and climate change.

Conflicts have a direct effect on food production and often block access to international as well as domestic markets. Moreover, conflicts also impact access: by destroying livelihoods, a conflict exacerbates poverty and strips governments of the revenue needed for social protection programmes. As food and water supplies become compromised and access to health care becomes increasingly difficult, conflicts also impact food utilization factors, thus leading to malnutrition. In parts of Iraq, Somalia, the Sudan, the Syrian Arab Republic and Yemen, the recent increase in food-insecure populations has mainly been attributed to recent or ongoing conflicts.

The ongoing conflicts in the Syrian Arab Republic and Yemen are having devastating effects on food security. The assessment of the impact of the conflict in the Syrian Arab Republic, between 2011 and 2017, suggests a profound increase in the prevalence of undernourishment, wasting and stunting among children under 5 – from 10.1 per cent, 5.5 per cent and 27.5 per cent to 82.1 per cent (underweight), 69 per cent (wasting), and 100 per cent (stunting), respectively. The situation is similar in Yemen, where the 2010 prevalence rates of undernourishment, wasting and stunting among children under 5 stood at 35.5 per cent, 13.3 per cent and 46.6 per cent, respectively. The ongoing conflict has increased those values to 92.7 per cent (underweight), 26.2 per cent (wasting) and 86.7 per cent (stunting), which also suggests that almost every Yemeni child under 5 suffers from at least one anthropometric health concern.

The Arab region is exceptionally vulnerable to the impacts of climate change. More frequent and more intense droughts and warmer temperatures are expected to add stress to

existing challenges related to water scarcity and low soil productivity. It is widely agreed that average temperatures will increase steadily, particularly during the summer months. Changes in precipitation are less predictable, making planning for the future particularly difficult. Even small precipitation changes coupled with a higher frequency of extreme weather events can have considerable impacts on run-off, river flow and groundwater recharge. Additionally, the anticipated sea-level rise is expected to have strong negative impacts on densely-populated low-lying coastal areas in Qatar, Tunisia and the United Arab Emirates, and to exacerbate existing salinity problems in the Nile Delta.

The most obvious impact of climate change is on agriculture, affecting not only availability but also access for many of the region's poorest. Some studies have found that the yields of certain crops could decline by up to 30 per cent in some areas as a result of increased temperatures. The impacts of climate change, however, go well beyond issues of food availability and the income of farmers. Climate change is likely to impact macroeconomics and indirectly trigger conflicts, as evidenced by earlier experiences with droughts in Morocco and the Syrian Arab Republic. Persistent drought in Morocco during the 1980s resulted in food riots. In the Syrian Arab Republic, the droughts between 2006 and 2010 precipitated migration out of rural areas, compounding economic and social tensions. Higher temperatures also make food spoil more rapidly, which can impact utilization aspects of food security through food safety, and could also lead to heat strokes and reduced access to potable water and sanitation services resulting from increased demand.[3]

Part II: Selected thematic issues

Continued important role of domestic agriculture

Although agriculture contributes only 7 per cent to the gross domestic product (GDP) in the Arab region, it plays a key role in food security. Domestic food production is widely seen as essential to ensuring the stability of food availability. Perhaps even more importantly, agriculture is an essential access issue because nearly 40 per cent of the population – especially the poorest – depend on agriculture for their livelihood.

Domestic agricultural production is a function of the extent of land farmed, on the one hand, and yield, on the other. Whereas in most regions of the world, increases in yield are the dominant force behind increases in production, this has not been the case in the Arab region: only one third of increases in production in the region have come from improvements in yield over the past 20 years, compared to 95 per cent of increases in production globally.

There are significant differences in yield trends among the Arab subregions.[4] The Mashreq, which accounts for the bulk of the area devoted to cereal production in the region and harvests the largest share of cereal output, has achieved yields consistently much higher than those of the other subregions. However, this performance is due specifically to Egypt, as the Mashreq without Egypt achieves much lower yields, similar to those of the other subregions. The most worrying case in the Arab region is that of the LDCs, where yields have stagnated and even declined over the past decade. The experience of the GCC countries is also

noteworthy. The pattern for the GCC countries is largely due to the adoption, then rejection, by Saudi Arabia of an expensive and environmentally unsustainable reliance on underground fossil water supplies.

Food production in the Arab region suffers from natural limitations in terms of quality of land and access to water. Of the total land area of Arab countries, less than 1 per cent is categorized as having high or even medium productivity, although there is considerable variation between the different countries. While in the Sudan, 17 per cent of the land area is considered to have high productivity, at the other end of the spectrum, almost 80 per cent of Djibouti is non-arable. Further exacerbating the land quality issue, alongside rapid urban expansion on fertile agricultural land, is the fact that much of the region's soil suffers from severe ongoing degradation, including water and wind erosion, and increased salinity and sodicity.[5]

The Arab region is the most water-scarce in the world, and both economic and demographic pressures are increasing relative scarcity. All Arab countries use most of their water for agriculture, but demand is increasing from other sectors. Some argue that water should be transferred out of agriculture towards higher-value municipal and industrial uses. Others argue that it is important to maintain domestic agricultural production in order to protect against vulnerability to global food markets, and because of the importance of agriculture for the income of the poorest. All agree, however, that improving the efficiency of water use is of the highest possible priority.

To a large extent, existing differences in productivity among Arab countries are driven by differences in how they use water – that is, their reliance on rain-fed versus irrigated farming systems. Rain-fed farming systems are still predominant in the Maghreb, the Mashreq (apart from Egypt) and the LDCs, covering more than two thirds of the region's cultivated land, and providing livelihoods for nearly two thirds of the agricultural population region-wide. Rain-fed farming faces the challenge of unpredictable rainfall, which is increasingly problematic with climate change. Wherever water supply is unpredictable, soil fertility is essential for maintaining an acceptable production level. Despite the importance of rain-fed agricultural systems, agricultural incentive structures have disfavoured research and investment in rain-fed systems, focusing instead on commercial and irrigated production.

Whereas the countries in the region that rely on rain-fed systems have generally low productivity, those that focus on irrigated farming systems have yields that are higher than the global average. Irrigated systems occupy less than one third of the cultivated area but contribute almost half of the total agricultural value, owing to a focus on high value-added commercial crops and generally efficient irrigation systems that result in relatively high yields. The key challenge for irrigated farming systems is sustainability: excessive groundwater use has resulted in the depletion, deterioration and destruction of aquifers.

Increasing domestic production is possible if sufficient resources are invested in water management (including conservation and reuse) and in high value-added crops that are resistant to drought, salinity and sodicity. Such investments may be warranted, particularly where they can address access issues by increasing income and reducing risks for the poorest farmers. Nevertheless, the region's geoclimatic endowments and growing population

are likely to lead to increasing reliance on food imports.

Reliable trade is critical to the region's food security

Despite the fact that some Arab countries export certain food commodities, trade balances are negative for all commodities and all countries. The Arab region's imports of food and animal products have been growing exponentially since the 2000s, reaching over $90 billion in 2013. Cereals are by far the leading item in the food import basket, with an over $30 billion trade deficit in recent years.

In itself, a deficit in food trade is not a problem for food security at a national level: many countries all over the world meet their food requirements through a partial or complete dependence on world markets. Perhaps the indicator most relevant to assessing the ability to sustain food imports is the share of total merchandise export earnings spent on food imports. This measures the extent of affordability of food for a country. When food imports account for a small and stable share of export earnings, a country is able to sustain such food imports. Conversely, when food imports account for a large and unstable share of export earnings, a country should be concerned about its ability to sustain such food imports. For the world as a whole, this share is on average below 5 per cent, while the Arab region average has hovered around 7 per cent in recent years and has shown a downward trend from earlier years.

As expected, the GCC countries have low ratios converging around 5 per cent, and (aside from Kuwait during the war years) have seen a steady decline in this ratio over the years. The ratios of Maghreb countries as a group are about double those of the GCC countries, and they are also more volatile. The situation in some of the Mashreq countries is even more worrisome. As a result of the ongoing conflict, the Syrian Arab Republic is currently importing more food than the total value of all of its merchandise exports. The situation in the Syrian Arab Republic reflects the vast amounts of food aid entering the country since the start of the crisis. The other countries in the region have ratios that currently fall below 100 per cent, but are nevertheless problematic: Lebanon has a long-standing problem, spending over 40 per cent of its export receipts on food imports, and Palestine has been spending the bulk of its export receipts on food imports since 1995. The most problematic of all is the situation faced by Djibouti, whose imports of food are consistently above the total value of all its merchandise exports, and have reached 400 per cent several times in recent history. The Comoros and Somalia also have high and volatile ratios, exceeding 100 per cent, and periodically reaching over 200 per cent. These countries are heavily reliant on international grants and loans as well as remittances. Even the other LDCs, for whom ratios are lower, have highly volatile ratios, meaning that food imports become a very heavy burden to bear in some years.

For the countries whose share of total merchandise export earnings spent on food imports is high and volatile, the stability of food security 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 such vulnerability were painfully felt during the 2007/2008 global food crisis, when prices spiked dramatically. Importing countries of the world, including in the Arab region, were faced with high prices impacting household and government budgets and putting food security

at risk. While world food commodity markets have since returned to normal, the experience of the crisis brought increased attention to the vulnerabilities of importing countries – and particularly countries such as the Comoros, Djibouti and Somalia, for whom food imports constitute large and volatile shares of their total export earnings.

Food loss and waste, an additional concern for the region

In recent years, increased attention has been paid to the role of food loss and waste and its impacts on food availability, access and utilization. Food loss refers to decreases in food mass occurring during the stages of production and harvest, post-harvest handling and storage, processing, and retail, as a result of inadequate practices and technology. Food waste refers to decreases in food mass occurring at the consumption stage at the end of the food supply chain, usually as a result of consumer behaviour.

In the region as a whole, food losses are largely driven by deficient practices in domestic production and imports. Of particular concern are interruptions in the cold chain and infestations during transportation, processing and storage. The increased temperatures associated with climate change will create additional challenges. Food loss at the retail level is a result of deficient market infrastructures, including the reliance on open air stalls where food products are exposed to pollution, heat, humidity and sunlight, which accelerate the rate of food degradation. At the consumption level, food waste is due to overstocking and oversupply. Other drivers of food loss and waste include high transaction costs, inadequate financing and deficiencies in sanitation and energy supply.

At the subregional level, the Mashreq accounts for the largest part of the region's food loss and waste, followed by the Maghreb and then the GCC and Arab LDCs subregions. Food waste in the LDCs remains relatively low compared to other subregions. In the low- and middle-income countries of the region, food loss and waste are, in large part, caused by the inadequacy of the infrastructure and the use of poor food handling practices. In the high-income GCC countries, and increasingly in the upper-middle income countries of the Maghreb and Mashreq subregions, a substantial amount of the food loss and waste occurs in the late stages of retail and consumption, largely as a result of food spoilage and excess quantities of food being bought and prepared.

Simulating future prospects of food security in the region

The final chapter of Part II expands on the issues raised in the preceding chapters by exploring the future of food security in the Arab region. Using the Aglink-Cosimo food supply-consumption model developed and maintained by the Food and Agriculture Organization (FAO) and the Organization for Economic Cooperation and Development (OECD), business-as-usual projections provide a baseline, and alternative scenarios are developed to examine the potential impacts of increasing yields in domestic production, shifting to a healthier diet, and making use of strategic stocks of wheat to mitigate global wheat supply shortages and price hikes.

The business-as-usual projections foresee some improvements in food availability in the region. The average daily calorie availability per person is currently estimated at about 3,000 calories and is projected to reach around 3,100 calories by 2030. However, this aggregate figure is likely to mask wide variations, manifested in high rates of

undernutrition in some countries simultaneously with high rates of obesity in others. The Gulf region will continue to have the highest level of food availability, reaching as high as 3,600 calories per capita per day by 2030. The LDCs subregion, with a current rate of around 2,400 calories, is projected to make some progress and increase its daily calorie availability to 2,600 calories by 2030, a rate which would nonetheless remain significantly lower than those of the other subregions. Calories from vegetal sources will continue to comprise most of the daily intake in the Arab region, well above the levels of both developed and developing country averages. Domestic food production is expected to increase gradually, with wheat production reaching close to 30 million metric tons by 2030. With consumption continuing to rise at a higher pace, self-sufficiency ratios are expected to continue their declining trend and the deficit in food trade is expected to grow.

As elaborated in chapter 4 on agriculture, a range of measures could be used to increase the region's very low yields. If sufficient measures were to be taken, cereal yields could be increased by as much as 25 per cent over the business-as-usual projection. This scenario could result in increased availability and reduced food prices. Results for this scenario show an increase in the region's self-sufficiency ratio for cereals from 34 per cent to 41 per cent by 2030. For the LDCs, self-sufficiency could reach nearly 50 per cent, while it would remain very low in the GCC countries due to their very low base. Changes in cereal consumption would be modest. Such improvements in self-sufficiency could have a significant impact on the sustainability of food imports for the most vulnerable countries. The specific mechanisms to be used for improving yields, as well as their financial costs and environmental sustainability, need to be carefully assessed to determine feasibility, as those factors were not incorporated in the development of this scenario.

The diet of the average Arab citizen consists, in large part, of cereals, sugar and oil, which – combined with low levels of physical activity among the urbanizing population – increases the risk of overweight/obesity and related non-communicable diseases. Shifting to a healthier diet would entail a reduced consumption of cereals and an increased consumption of proteins (from plant and animal sources). In this scenario, the domestic production of animal proteins (red meat, poultry and dairy) would likely increase but still be insufficient to meet the increase in consumption (especially in the LDCs and the Mashreq). Imports are thus projected to increase to make up the difference. Despite the shift away from cereal consumption, the total demand for cereals would increase because of the increased need for animal feed. Although this scenario could potentially result in improvements in terms of indicators of utilization, economic access to the improved diets would be constrained among the poor, unless reductions in poverty keeps pace with the increase in food prices.

As net importers of food, the countries of the Arab region are vulnerable to global price shocks. The Comoros, Djibouti, Lebanon, the State of Palestine, Somalia and the Syrian Arab Republic are especially vulnerable, as their food imports often exceed their total merchandise trade exports. One way to reduce variability of consumer prices is for countries to maintain strategic stocks of key commodities, which can be released into the domestic market when prices are unusually high. The model predicts, in the absence of strategic stocks, a sudden increase of 60 per cent in the global price of wheat. Producer prices in Arab countries are assumed to be linked to the global market and price signals are fully

transmitted to the region. Releasing wheat stocks into domestic markets breaks this link and limits the increase in domestic prices. This price-dampening effect is due to the substitution of government-released domestic stocks for high-priced imports. The extent of the price mitigation impact of the stock release is proportionate to its share of the domestic supply. If all countries of the region release stock equivalent to 3 months' consumption, the increase in producer prices in the subregions is projected to be contained to 50-70 per cent of the unmitigated shock, with an average regional reduction of 1.5 per cent in wheat consumption. If wheat stock equivalent to 6 months' consumption is released, the price increase is expected to be further mitigated in all regions, and almost prevented in countries with higher self-sufficiency ratios, with an average reduction of only 0.5 per cent in wheat consumption compared to 2.5 per cent if no wheat stocks are released. Strategic stocks are a useful mechanism, but they require effective institutional set-ups and entail high costs in terms of the construction of storage facilities, and the management and renewal of stocks.

Policy options to enhance food security

In identifying the way forward, a principal question for each country is to what extent they should focus availability on domestic production versus food imports. Both domestic production and imports of food involve risks. An overreliance on local agriculture exposes populations to risks related to droughts and infestations, not to mention those associated with the unsustainable use of water and land resources. Overreliance on imports exposes populations to risks related to volatility in world markets. Each country will need to find its own strategy to ensure stable food availability, based on its geoclimatic endowments, its comparative advantage in international trade, its political environment and its ability to mitigate various types of risks.

Innovative approaches are available that can contribute to sustainable domestic production: many of these are already being used within the region and many others can be adapted from the experiences of other regions. Appropriate approaches to sustainable domestic production generally differ between rain-fed and irrigated farming systems. For rain-fed farming systems, approaches are needed that would address the low income and weather-related risks faced by poor farmers. In particular, research and development, extension services and investments would be needed for crops that are resistant to drought, salinity and sodicity, in addition to low cost approaches to water harvesting, conservation and reuse.

For irrigated farming systems, reducing demand for water will be essential for sustainability. Cost recovery policies, which would include environmental externalities and opportunity costs, will be needed to create appropriate incentives to maximize crop water productivity. Careful water management could encourage the expansion of the innovative technical approaches already being used in the region.

Despite potential increases in domestic production, none of the Arab countries are likely to achieve food self-sufficiency, and most will probably continue to rely on trade. With the adoption of appropriate policies, trade can be used as a mechanism to support the stability of food security by reducing the risks associated with overreliance on domestic production. For some countries in the region, current trends reflect vulnerabilities. In particular, where food imports absorb a high and volatile share of

foreign exchange earnings, stable food availability can be threatened by spikes in world food prices.

A range of instruments are available at the national, regional and global levels to manage vulnerabilities associated with heavy reliance on food imports. In addition to increasing domestic production, national governments have several other options, including: (a) smoothing prices over time by transferring price risk to trading partners through financial markets, or maintaining physical stocks of key commodities; (b) obtaining the best price by diversifying trade partners; (c) improving the infrastructure and management of import supply chains; and (d) investing in production in other countries. Working together, Arab countries can respond to common challenges by: (a) expanding intraregional trade; (b) coordinating market information; and (c) coordinating physical stocks and food-related funds. Finally, Arab countries can usefully contribute to global actions, notably by: (a) expanding global trade agreements, including export policies, in order to avoid the magnification of shocks to local production; and (b) broadening the donor base to allow for the expansion of international food assistance programmes.

In addition to domestic production and trade, a third aspect of food availability, that of loss and waste, has been gaining increasing attention. Food loss and waste create a gap between the quantity of food potentially available from domestic production and imports, and the quantity actually consumed by individuals. As with any emerging issue, major efforts are needed to raise awareness and improve the data. Equipped with better information, policymakers, the private sector and consumers could then mobilize efforts. The development of new and more efficient approaches to reducing food loss and waste are also needed. A wide range of innovative approaches already exists in the Arab region and beyond: the adoption and scaling up of these technologies can go a long way towards supporting food security. Government and relevant private sector entities involved in food logistics can usefully support the reduction of food waste and loss by addressing structural deficiencies, including bureaucratic red tape, taxes and regulations. At the retail level, food loss can be addressed through improved business techniques, such as inventory and production management. And at the consumption level, the reform of policies that lead to food loss, such as non-targeted subsidies, can also support food security.

Because stable food security is central to human well-being, achieving it will require a wide range of actions. In addition to the opportunities to enhance food security through agriculture, trade and reducing food loss and waste, more attention is needed to address other aspects of food access and utilization. Efficient, targeted social protection programmes will continue to be essential for both the rural and urban poor. Education and incentives will be needed in order to shift to healthier lifestyles and diets, with the goal of reducing the region's malnutrition and obesity problems. Increased access to health care, water and sanitation are essential elements for improving the nutritional status.

While remaining on a path of business as usual could lead to a dire future, there are opportunities to enhance food security throughout the Arab region. This publication has highlighted success stories in each dimension of food security. Each country will need to determine what strategy best fits its circumstances. But in all cases, lessons from other countries can serve as inspiration and provide a variety of options to be adapted and adopted.

Contents

Contents (continued)

List of Tables

Contents (continued)

Page

List of Figures

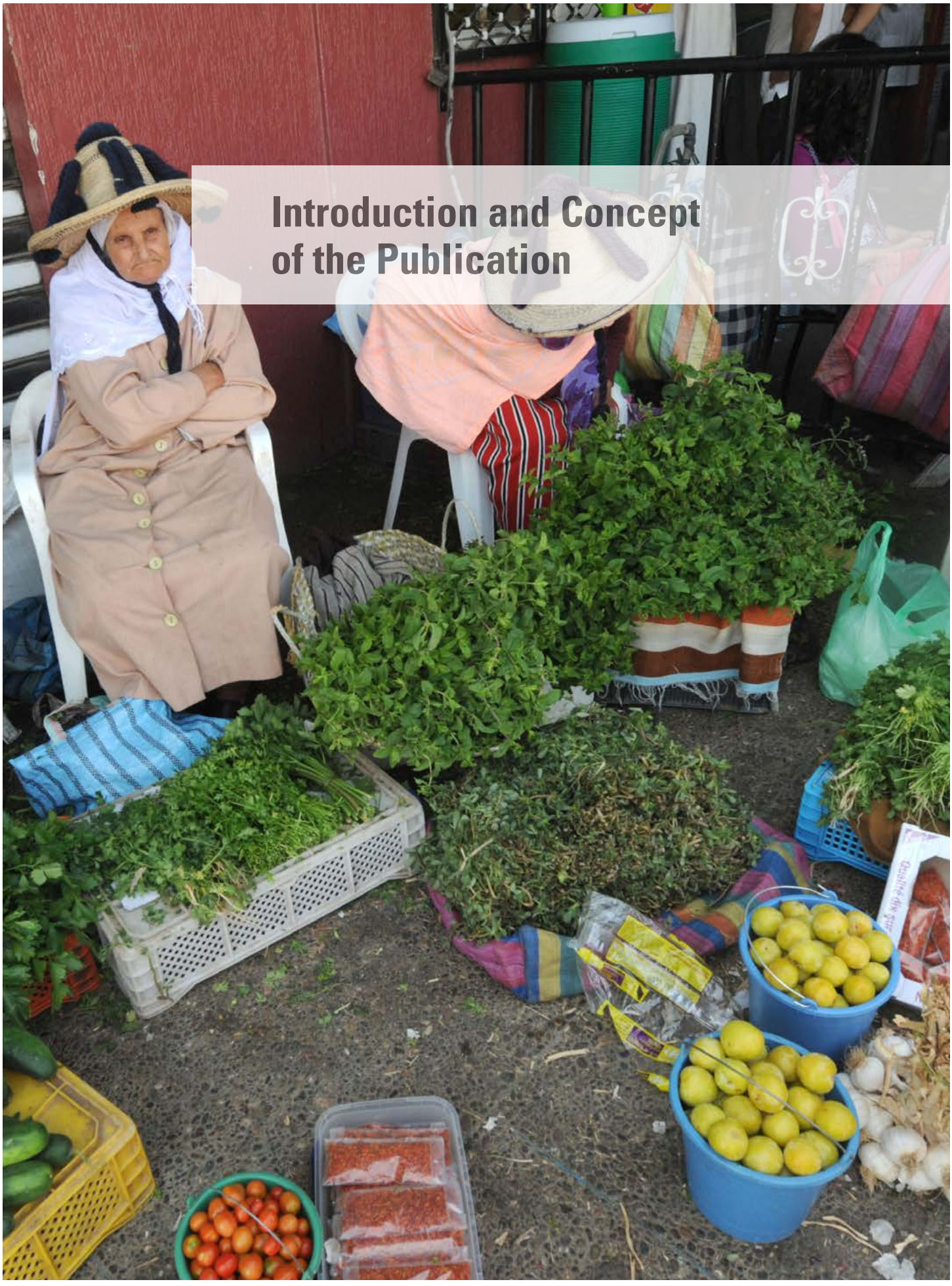
Contents (continued)

List of Maps

List of Boxes

Abbreviations and Acronyms

ADESA	average dietary energy supply adequacy
AMIS	Agricultural Market Information System
AOAD	Arab Organization for Agricultural Development
ESCWA	Economic and Social Commission for Western Asia
FAO	Food and Agriculture Organization
FIES	food insecurity experience scale
GAFTA	Greater Arab Free Trade Area
GAP	good agricultural practice
GCC	Gulf Cooperation Council
GDP	gross domestic product
HHS	United States Department of Health and Human Services
ICARDA	International Centre for Agricultural Research in the Dry Areas
IDP	internally displaced persons
IFAD	International Fund for Agricultural Development
JMP	Joint Monitoring Programme
kWh	kilowatt hour
LDC	least developed country
LE	Egyptian pound
MT	metric ton
NGO	non-governmental organization
OECD	Organization for Economic Cooperation and Development
PoU	prevalence of undernourishment
RNE	Regional Office for the Near East (and North Africa)
SDG	Sustainable Development Goal
SSR	self-sufficiency ratio
TFA	Trade Facilitation Agreement
UNCTAD	United Nations Conference on Trade and Development
USDA	United States Department of Agriculture
WFP	World Food Programme
WHO	World Health Organization
WTO	World Trade Organization



Introduction and Concept of the Publication

Introduction and Concept of the Publication

What is food security?

Discussions around food security have converged upon the importance of its stability dimension, in terms of ensuring availability of, access to, and utilization of sufficient and nutritional food. A comprehensive definition put forward during the World Food Summit in 1996, and reaffirmed at the 2009 World Summit on Food Security, holds that "food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life".[6] Developing a comprehensive approach to realize such a definition of food security involves a wide range of actors, resources and relations, operating across varying scales. Global food availability and price fluctuations, for instance, can influence food imports and production at the national level. National prices and availability, among many other factors like subsidies and social safety net programmes, influence the ability of households with varying incomes to access adequate supplies of food, within the context of other essential household needs, such as those connected to health and education. Nutritionally, several factors are involved in the ability of individuals to effectively obtain and utilize the nutrients conducive to leading a healthy and active life.

While the four dimensions of availability, access, utilization and stability interlock to ensure food security, their sphere of impact is felt at different levels. Whereas availability is essential at the global and national levels, and access is more directly connected to the household level, utilization, related to the quality and nutritional aspects of available food, is entirely associated with the individual level. Stability is viewed as a set of overarching measures that ensure the sustainability of the other three dimensions. Trade has gained importance as a vital food availability component that has helped many countries overcome difficult environmental conditions to produce their food domestically. When food is made available, through local production and/or trade, food security becomes mostly connected to the economic capability of individuals to obtain nutritious food.

What challenges does the Arab region face?

An array of natural, social, economic and geo-political challenges, some historical, others nascent, combine to influence the ability of nations, households and individuals to access sufficient and nutritious food. Among the most fundamental of these challenges are natural limitations in renewable water resources and land available for cultivation. Most Arab countries are among those receiving the lowest average rainfall each year, with the per capita share of renewable water resources for all but four of the twenty-two member States falling below the water poverty line of 1,000 cubic meters per year. Similarly, the per capita availability of arable land

for the majority of the region's countries falls considerably below the world average, and is likely to shrink further as current progressions in urbanization and land degradation continue. Increased demands on already scarce land and water resources to produce greater amounts of food for expanding populations also increase the likelihood of resource depletion and deterioration.

As elsewhere in the world, the agricultural sector is the predominant consumer of water. In many countries in the region, low levels of water availability have resulted in the overextraction of fossil groundwater reserves. Because of the serious scarcity of water resources and growing shortages of arable land, in addition to other factors, the quantity and value of the agricultural production of almost all Arab countries falls far below their food requirements. This has contributed to a persistent regional food trade imbalance, exposing local populations to global price fluctuations. Growing reliance on world markets for grain imports also accentuates the low productivity of water withdrawals for agricultural production, when compared with water withdrawals for other sectors such as industry. This raises the need to maximize economic water productivity, as well as the need for integrated and sustainable management of the scarce natural (water and land) resources. Despite the low contribution of agriculture to the gross domestic product (GDP), it can be viewed as a factor supporting social stability through employment, by providing poor rural farming communities with income to obtain food, in addition to the direct supply of food from subsistence farming. In this context, agriculture strengthens food security by, on the one hand, enhancing the economic access to food of farming communities, and on the other, contributing to the supply of food to domestic markets. Despite the importance of agriculture in many countries of the region, achieving food self-sufficiency is not environmentally feasible, as has been demonstrated in some countries. There is thus a need for new integrated, sustainable and holistic approaches at the social, economic, environmental and political levels.

Considering the length and safety concerns of domestic value chains, increased reliance on food imports also presents new geopolitical challenges. Historically, and in light of current conflicts and fluid security conditions, supply routes and bilateral relations with key grain exporters have been central to maintaining access to food imports, and even maintaining intraregional and domestic political stability. The continued strategic importance of the Suez Canal, the Strait of Bab el-Mandeb and the Strait of Hormuz in global food trade, and the continued political instability surrounding these three areas, creates potential disruptions to the movement of millions of tons of food each year. Some countries in the region remain particularly vulnerable to political instability, violence and acts of terrorism, not least those neighbouring the aforementioned strategic supply routes. Such conflicts and shifting political climates can combine with crop failures resulting from climate change impacts (varying rainfall patterns and extreme weather events) in key grain producing countries to foment export bans. While the geopolitical aspect of food imports is a general concern in the region, for some of the least developed countries (LDCs), importing food poses an additional economic challenge, given their large trade deficits and limited export potential.

Where does food security fit in the Sustainable Development Goals?

Goal 2 of the Sustainable Development Goals (SDGs) is generally denoted as the "zero hunger" goal, encompassing all dimensions of food security, namely: access (targets 2.1 and 2.3), utilization (target 2.2), availability (targets 2.3, 2.4, 2.a, 2.b and 2.c) and stability (targets 2.4, 2.5, and 2.c).[7] Nevertheless, the cross-cutting nature of food security makes it difficult to isolate in a single goal. Water scarcity in the Arab region is often viewed as an impairment factor for agricultural production and, in view of this, target 4 of SDG 6, dealing with water-use efficiency, becomes a determinant factor for food availability through domestic agricultural production. The notions of resource efficiency and sustainability also have direct and indirect impacts on food availability, as reflected in target 4 of SDG 8 (Decent Work and Economic Growth), target 2 of SDG 12 (Responsible Consumption and Production) and target 3 of SDG 15 (Life on Land).

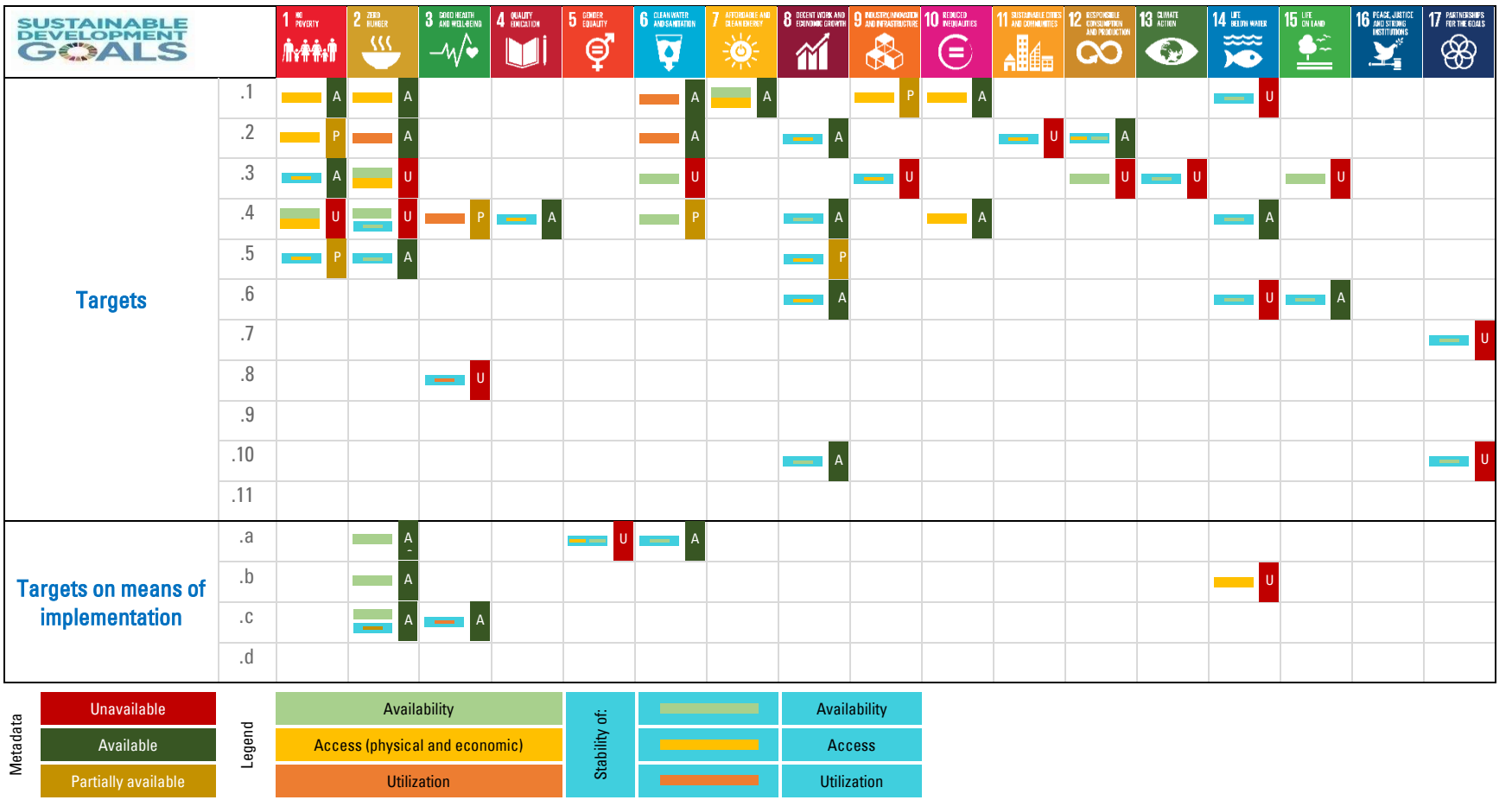
The access dimension of food security is usually seen as an imperative concern, over the other dimensions, when assessed at the household or individual level. When considered to include both physical and, more importantly, economic access to food, besides SDG 2, targets 1, 2 and 4 of SDG 1 (No Poverty), target 1 of SDG 7 (Affordable and Clean Energy), target 1 of SDG 9 (Industry, Innovation and Infrastructure), targets 1 and 4 of SDG 10 (Reduced Inequalities) and target (b) of SDG 14 (Life Below Water), all have direct and indirect impacts on people's access to food.

Food insecurity and bad dietary habits are invariably reflected in the health status of people, particularly children, in the form of stunting, underweight or obesity. It is therefore important for access to food and food availability to be complemented by measures that ensure the adequate utilization of food. Some of these measures are highlighted in target 4 of SDG 3 (Good Health and Well-being) and targets 1 and 2 of SDG 6 (Clean Water and Sanitation).

The stability dimension of food security is embedded in the other three dimensions, in the sense that availability of, access to and utilization of food must exist at all times, at individual, household, national, regional and global levels. In this regard, targets 1.3, 1.5, 4.4, 5.a, 8.2, 8.5, 8.6, 9.3, 11.2 and 12.2 contribute to enhancing the stability of improved access to food. Moreover, targets 5.a, 8.4, 8.10, 12.2, 13.3, 14.1, 14.4, 14.6, 15.6, 17.7 and 17.10 have impacts on the stability of food availability at the national level. Similarly, targets 3.8 and 3.c have links to stability in the utilization dimension of food security. A mapping of the four food security dimensions within the SDGs framework is illustrated in table I.1.

The integrated nature of the 2030 Agenda for Sustainable Development, reflected in the interlinkage and complementarity of the SDGs, is clearly demonstrated in the above mapping exercise of food security dimensions across all SDGs. It is therefore imperative to recognize that achieving food security in a holistic manner that takes into considerations the various elements of all its dimensions entails much more than just a focus on SDG 2.

Table I.1 Mapping of food security dimensions across Sustainable Development Goals



Source: Compiled by ESCWA. Metadata availability as of August 2017.

Why this publication?

The general aim of this report is to inform debate and policy development on food security in the Arab region and guide further research by the Economic and Social Commission for Western Asia (ESCWA) and others. The specific objectives of the publication are to better understand the current status of food security in Arab countries, and to identify important trends across and within specific countries, subregions and climatic zones. More accurate mapping of the current stability of food systems in the region, together with available resources, constraints and liabilities, will allow for more realistic projections of the prospects of member States for achieving the relevant SDGs by 2030. In turn, more nuanced policy directions can be identified, and service plans tailored in accordance with the available resources and constraints, to support the region in its timely achievement of regional food security.

In support of these aims, this publication tackles a number of the most prescient themes involved in the timely achievement of SDG 2 and relevant targets. These shall be organized around issues of water availability and use efficiency, soil and land degradation, agricultural production and productivity, and food loss and waste, as well as key issues in trade, finance and technological improvement.

While it is important to be comprehensive in looking at all dimensions of food security, it becomes a challenging task to try to deal with all issues in an integrated manner in a single analytical study. In view of this, Part I of this study aims to map the status of food security in the Arab region, including coverage of the various relevant issues of access, availability and utilization of food. Part II of the study offers a more in-depth assessment of some thematic issues that directly relate to food security, including integrated land and water management, agricultural production and productivity, trade, and food loss and waste. An important contribution of this publication is the mobilization of the Aglink-Cosimo model developed by the Food and Agriculture Organization (FAO) of the United Nations together with the Organization for Economic Cooperation and Development (OECD). The food supply-consumption model generates future projections arising from probable food supply scenarios. The model allows for the examination of various supply – or consumption – modifying events and their subsequent impact on key indicators of food security. Ultimately, those scenarios and their subsequent implications are used to support the broader analysis of key policy trajectories for subregions and member States in their timely achievement of the relevant SDGs, and the mitigation of potential challenges to the stability of regional food supplies.

ESCWA and the FAO Regional Office for the Near East and North Africa (RNE), with their direct mandates to follow the implementation of the SDGs in Arab countries, are well positioned to identify the challenges and complexities that arise when dealing with the important and cross-cutting issue of food security. Clarity and a unified understanding of the factors affecting food security in the Arab region can enhance integrated policy development at the national level, and potentially promote intraregional cooperation on such relevant issues as trade, joint investments, and joint research and development, among others.

This being a regional report, policy questions and proposed directions are articulated in such a way as to provide examples of options that could be considered, given the socioeconomic

and political situation prevailing at both national and regional levels. It needs to be clear that the report does not provide the necessary depth to make detailed recommendations at the country level.

Throughout this publication, efforts are made to reflect the enormous economic and environmental diversity of the Arab region. Where data allows, the analysis is presented at the level of the subregion or country. Four subregions are used in the publication: Gulf Cooperation Council (GCC) countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates); the LDCs (the Comoros, Djibouti, Mauritania, Somalia, the Sudan and Yemen); the Maghreb countries (Algeria, Libya, Morocco and Tunisia); and the Mashreq countries (Egypt, Iraq, Jordan, Lebanon, State of Palestine and Syrian Arab Republic). Because of the uniqueness of Egypt as a major food producer and the weight it has on the overall Mashreq average, data for the Mashreq without Egypt is also shown separately where relevant.

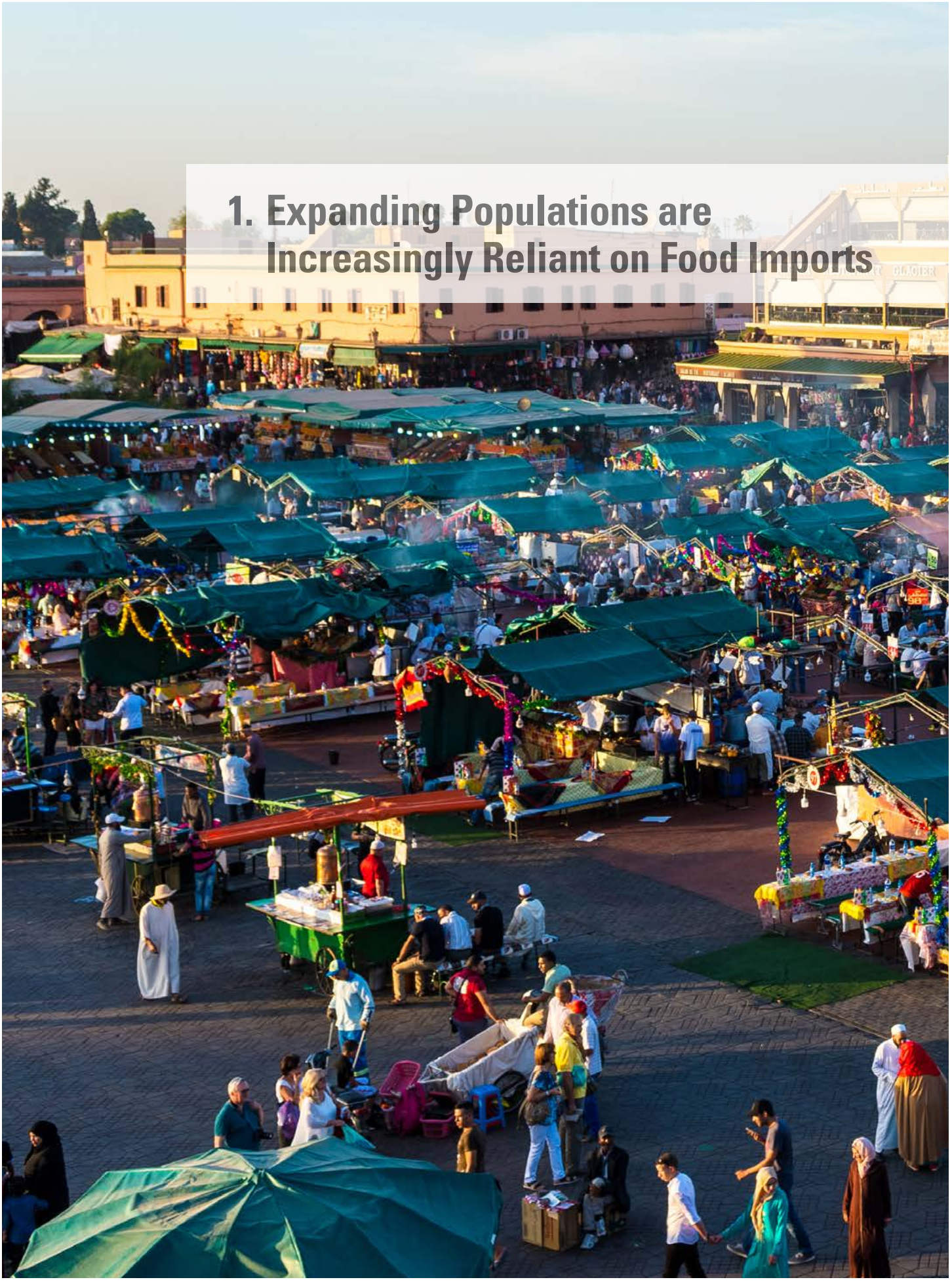
It must be emphasized that the analysis contained in this report is both long term in scope and regional in coverage, and thus the focus has been on data sources that allow comparability across countries of the region.[8] While there is some more recent data available for some countries that was not used in the report, it does not have an impact on long-term trends. Moreover, some recent measures taken by some countries, like the lifting of subsidies and devaluation of the local currency in Egypt, were not taken into consideration in the analysis, since the report was being finalized when these measures were adopted. It is clear that such measures have profound impacts on food security, which may enhance food availability at the national level, but could also lead to adverse access and utilization consequences at the individual and household levels.

Part One

The Big Picture of Food Security in the Arab Region

This section provides an overview of food security. Three dimensions of food security are discussed in turn: availability, access and utilization. Food availability is defined as sufficient quantities of food of appropriate quality, supplied through domestic production or imports, including food aid. More detailed analyses of agriculture and trade are included in Part II of this publication. Food access refers to the affordability and physical supply of food, as well as the preferences of individuals and households. Because food insecurity is often associated with the inability to afford food, the subsection on access focuses on issues of poverty and safety nets. Utilization refers to the types and quantity of food consumed and to the physical metabolism of that food. The subsection on utilization focuses on undernutrition and micronutrient deficiencies, as well as on the region's high rates of obesity.

1. Expanding Populations are Increasingly Reliant on Food Imports



1. Expanding Populations are Increasingly Reliant on Food Imports

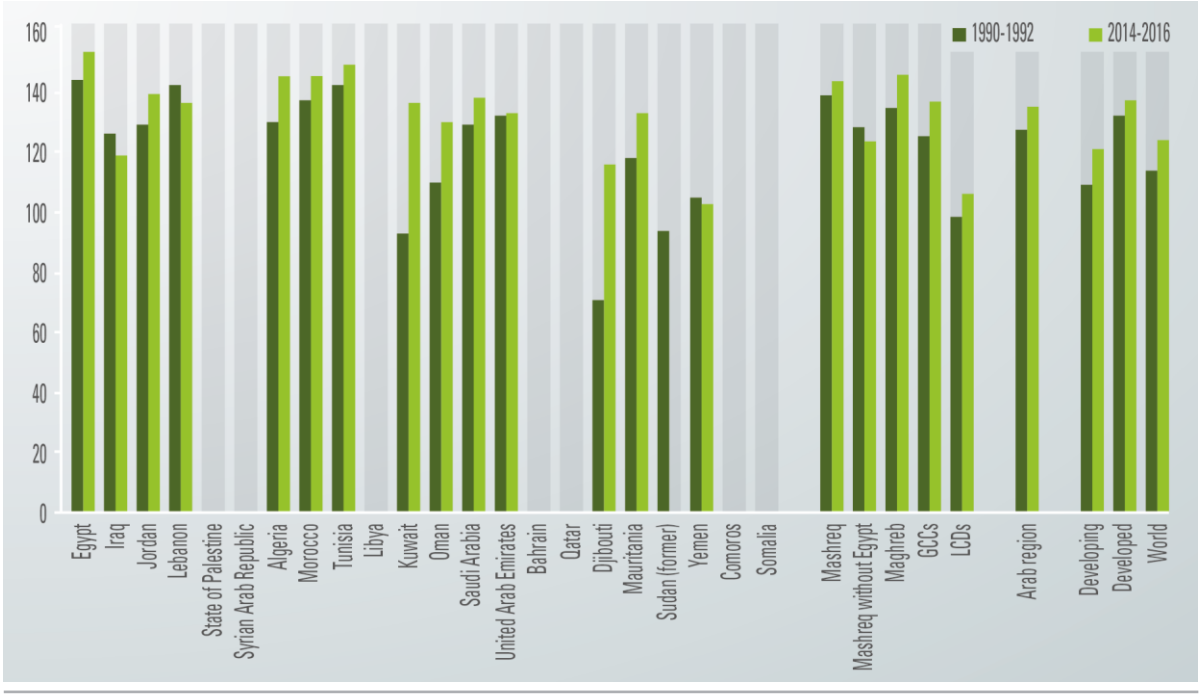
As noted above, food availability is defined as sufficient quantities of food of appropriate quality, supplied through domestic production or imports, including food aid. Challenges related to availability are highlighted in several of the SDGs and their targets, including increasing the productivity and sustainability of agriculture, developing markets to limit extreme price volatility, and reducing food loss and waste.

This chapter starts by discussing overall measures of food availability. It then analyses the factors determining the quantity of food consumption before turning to food supply based on domestic production and, finally, to how the gap between national-level demand and supply is filled through imports. While this chapter is intended to provide a brief overview, detailed analyses of agriculture, food imports, and food loss and waste are included as stand-alone chapters in Part II.

A. Measuring food availability

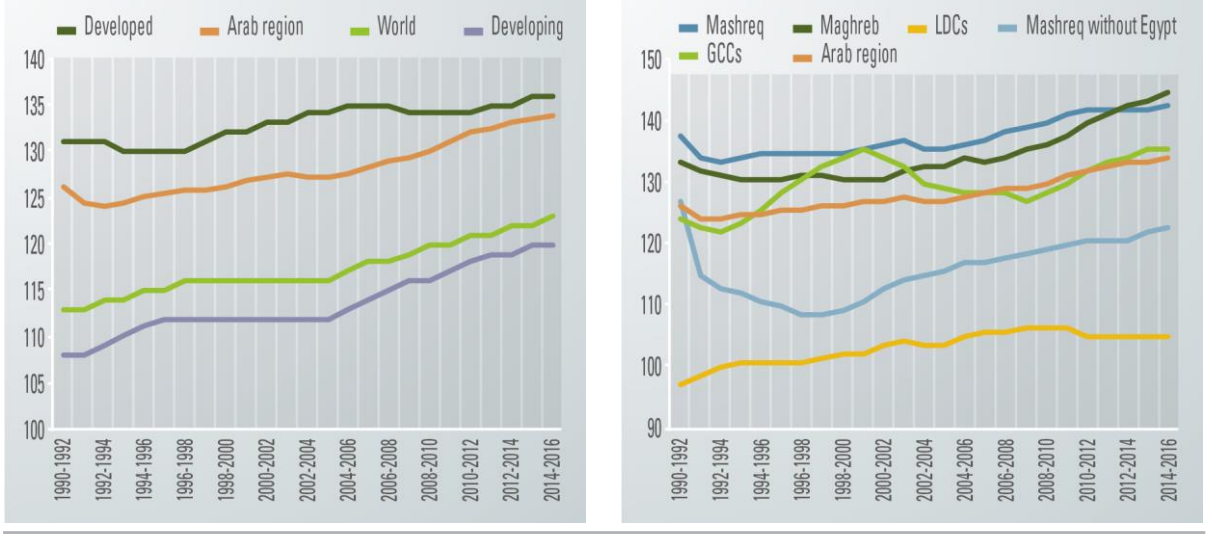
Food availability is measured by the average dietary energy supply adequacy (ADESA).[9] An ADESA value greater than 100 indicates that, on average, the total dietary energy supplies available in a country are more than sufficient to meet the needs of the population for a healthy and active life. It is important to bear in mind that ADESA overstates the food consumption of the poorer segments of society because it does not take into account the distribution of available food among the population. The average ADESA for the Arab region was about 134 per cent in 2014-2016, well above that of developing countries (120 per cent) and the world (126 per cent), and fairly close to that of developed countries (136 per cent). An ADESA of 134 per cent means that, on average, dietary energy supplies in the Arab region stand at 34 per cent more than would be required for a healthy and active life for its population. However, there is wide variation in supply adequacy within the region (figure 1.1). The LDCs barely make it with a ratio of just above 100 per cent in 2014-2016, a modest improvement from 97 per cent 25 years earlier, although some countries in that subregion, notably Mauritania, have reached high levels of supply adequacy. At the other extreme, the ratios for the Maghreb and the Mashreq are well above 140 per cent, even higher than the average for developed countries. Egypt has the highest ADESA ratio with over 150 per cent in 2014-2016, followed by Tunisia, Morocco and Algeria, and the GCC subregion. It might be noted that the Mashreq without Egypt has an ADESA level well below that obtained when including Egypt, by some 14 per cent in 2014-2016.

Figure 1.1 Average dietary energy supply adequacy 1990-1992 and 2014-2016 (percentage)



Source: FAOSTAT Data, FAO, 2017a.

Figure 1.2 Evolution of average dietary energy supply adequacy over time (percentage)



Source: FAOSTAT Data, FAO, 2017a.

Over the past 25 years, ADESA of the Arab region has shown a steady trend that is gradually catching up to the average level of developed countries (figure 1.2). Year-to-year fluctuations have been small at the regional level. However, this overall picture changes when the region is viewed at a more disaggregated level. The historical record reveals important differences within the Arab region, notably: the sharp drop in ADESA for the Mashreq without Egypt during the 1990s, largely on account of conflicts in Iraq; the large gains achieved by the GCC countries during the second part of the 1990s, linked to increased petroleum revenues; and the relative stagnation of ADESA in the LDCs of the region. In fact, the LDCs have experienced a worrisome downward trend in ADESA during the past decade.

B. Population growth and urbanization drive aggregate food consumption

The quantity of food consumed at a national level depends heavily on demographics. The countries of the Arab region are undergoing a period of demographic transformation characterized by a relatively high population growth rate and increasing urbanization. Between 1950 and 2010, the population of the region increased by nearly five times. In comparison, world population during the same period increased by less than three times and that of Western Europe by 1.3 times. Only the least developed countries in the world have experienced a population growth rate comparable to that of the Arab region.

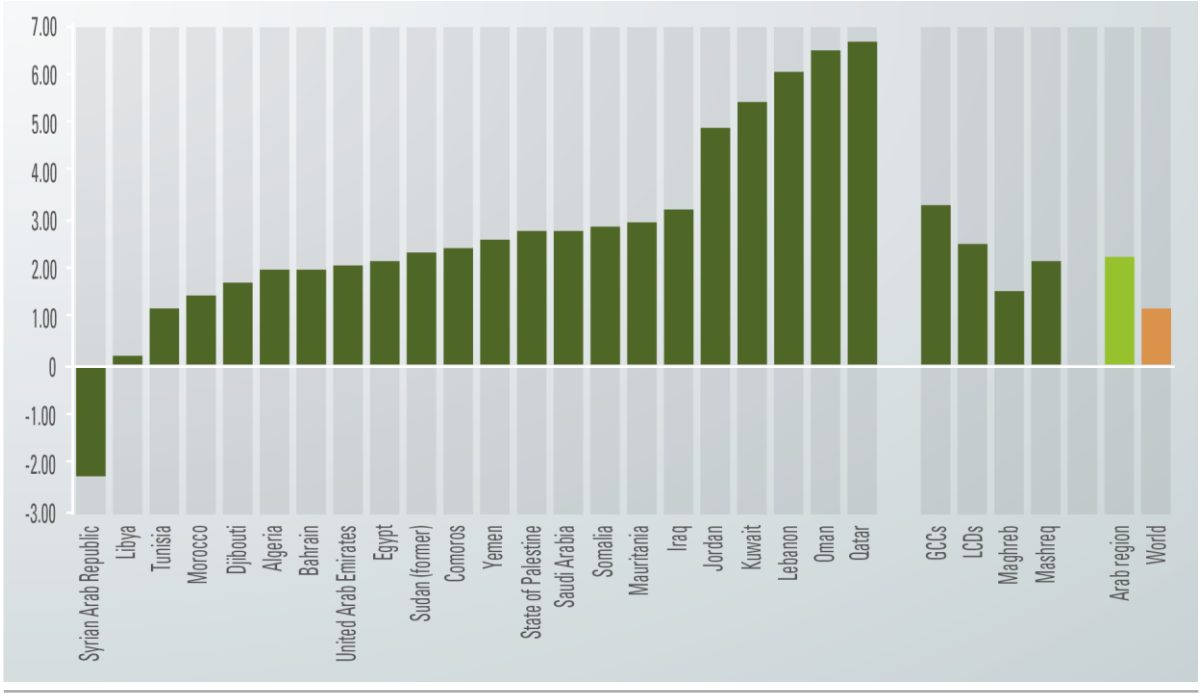
The current overall average annual population growth rate for the Arab region (2010-2015) is estimated at 2.2 per cent, compared to a world average of 1.2 per cent. However, there are substantial differences within the region, with GCC countries having an annual growth rate of 3.3 per cent, followed by the LDCs at 2.5 per cent, the Mashreq at nearly 2.1 per cent, and finally the Maghreb at 1.5 per cent (figure 1.3). Even within the same subregion, differences in demographic trends are noticeable.

The high population growth rate has had a direct impact on food requirements. The other underlying determinant of aggregate food requirements – average per capita consumption – has changed much less dramatically. At the aggregate regional level, during the 10-year period from 2004-2006 to 2014-2016, increases in per capita consumption in the Arab region have been similar or inferior to those realized by developing countries overall.

For the region as a whole, the urban population surpassed the rural population towards the early 1990s (figure 1.4). By 2015, an estimated 58 per cent of the population of the region was urban, compared to 52 per cent for the world as a whole. Going forward, it is expected that the urban population will continue to grow nearly exponentially, while the rural population will continue to increase in absolute numbers until the 2040s and start declining thereafter. Nearly 90 per cent of the increase in the population of the region in the years to come will be in urban areas,[10] so that by 2050, close to 70 per cent of the region's population will be living in cities.

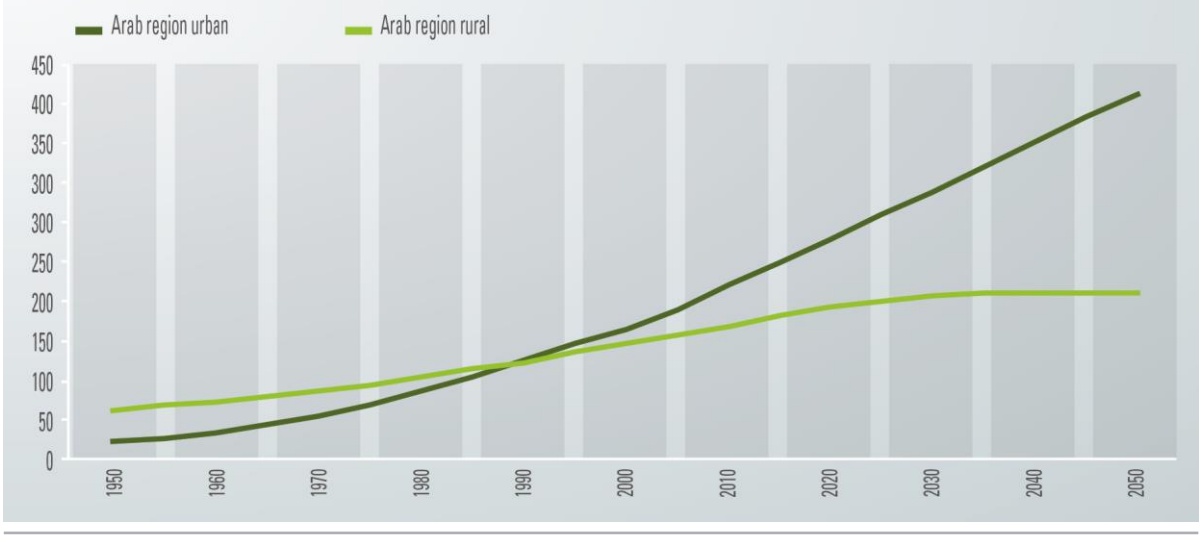
The subregions vary widely in their urbanization process, with the GCC countries already 84 per cent urban (Kuwait and Qatar close to 100 per cent urban), followed by the Maghreb at 67 per cent, the Mashreq at 54 per cent, and finally the LDCs at 34 per cent. Even the LDCs are expected to become predominantly urban by 2050.

Figure 1.3 Annual population growth rates, 2010-2015 (percentage)



Source: Data from the United Nations Department of Economic and Social Affairs, Population Division.
Note: Population growth rates for some countries during the period of 2010-2015 have been influenced by ongoing conflicts, as in the case of Jordan, Lebanon, Libya and the Syrian Arab Republic.

Figure 1.4 Urban and rural population trends in the Arab region (thousands)



Source: Data from the United Nations Department of Economic and Social Affairs, Population Division.

Urbanization has a dramatic impact on food security, not only in terms of differences in lifestyle between rural and urban areas, but also in terms of land use. A recent assessment of urban spatial distribution in the Arab region using Landsat images in 1990 and 2015 revealed a general increase of the area of human settlement.[11] Changes in urban area coverage shows an increase in 0.4 per cent of the total land area of Arab countries, with urban sprawl occurring mainly in coastal areas and along river banks. The main increase in terms of urban expansion for the last 25 years was observed on highly and moderately productive soils. Urban expansion on highly and moderately productive soils was particularly pronounced in Jordan (91.5 per cent), the Sudan (76.8 per cent), Iraq (54 per cent), Algeria (41 per cent), Egypt (36 per cent), the Syrian Arab Republic (25.2 per cent), Libya (17 per cent) and Morocco (13 per cent). There was relatively little urban expansion on highly productive soils in the other countries, where values were 9 per cent (Algeria), 8 per cent (Somalia), 4 per cent (Lebanon, Iraq and Syrian Arab Republic), 1.3 per cent (Yemen) and 0 (State of Palestine).[12]

C. Domestic food production is not keeping up with consumption

The combination of increasing population and urbanization means that the quantity of food required has increased, while reduced quantities of inputs (land and labour) are available for domestic production.

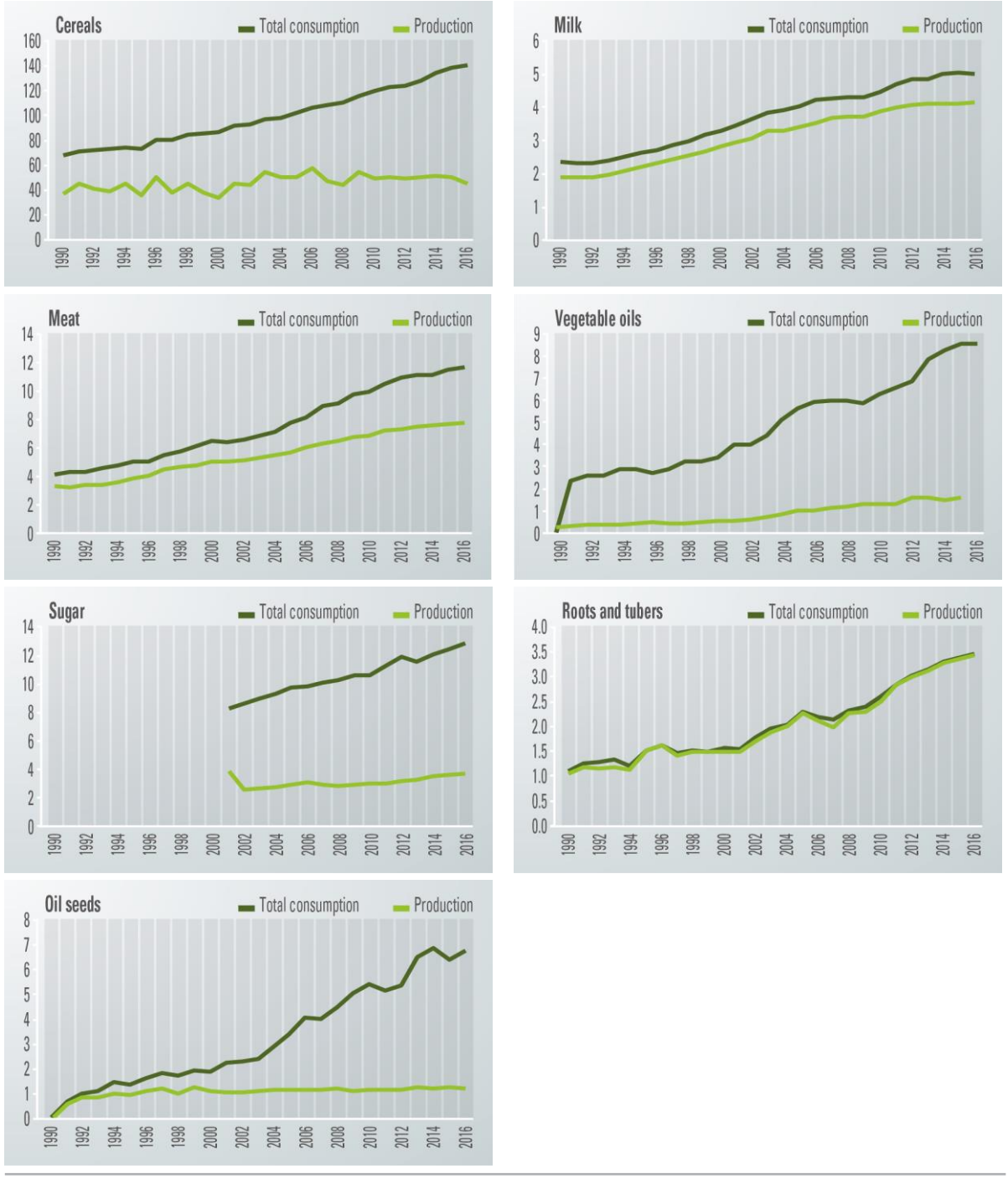
Production of cereals has leveled off since the 1990s while consumption has kept its ever-increasing trend, and the gap between the two is widening (figure 1.5). With the exception of roots and tubers, the same pattern is also evident in other basic food commodity groups, such as pulses, sugar, oil-crops and vegetable oils – and is the case, to a lesser degree, for meat and milk.[13]

Increasing domestic production is possible if sufficient resources are invested in water management and high value-added crops that are resistant to drought, salinity and sodicity. The agriculture chapter in Part II highlights several success stories from Arab countries that could be usefully expanded to other parts of the region. Nevertheless, the region's geoclimatic endowments are likely to imply increasing reliance on food imports.

D. Food imports bridge the gap between domestic production and consumption

Finding an appropriate balance between domestic production and imports will be one of the most important strategic decisions for Arab countries to make going forward. The idea of self-sufficiency in food evokes strong emotional reactions, based on natural instinct and patriotic attachment to the land, as well as fears of being exploited by exporting countries. Nevertheless, many countries have been successfully managing their food security through partial or complete dependence on world markets for many years.

Figure 1.5 Trends in food consumption and production in the Arab region (1,000 MT)



Source: FAOSTAT Data, FAO, 2017a.

Both domestic production and imports of food involve risks. An overreliance on local agriculture exposes populations to risks related to droughts and infestations. An overreliance on imports exposes populations to risks related to price volatility in world markets. Each country will need to find its own strategy to ensure stable food availability, based on its geoclimatic endowments, its comparative advantage in international trade, its political environment and its ability to mitigate various types of risks.

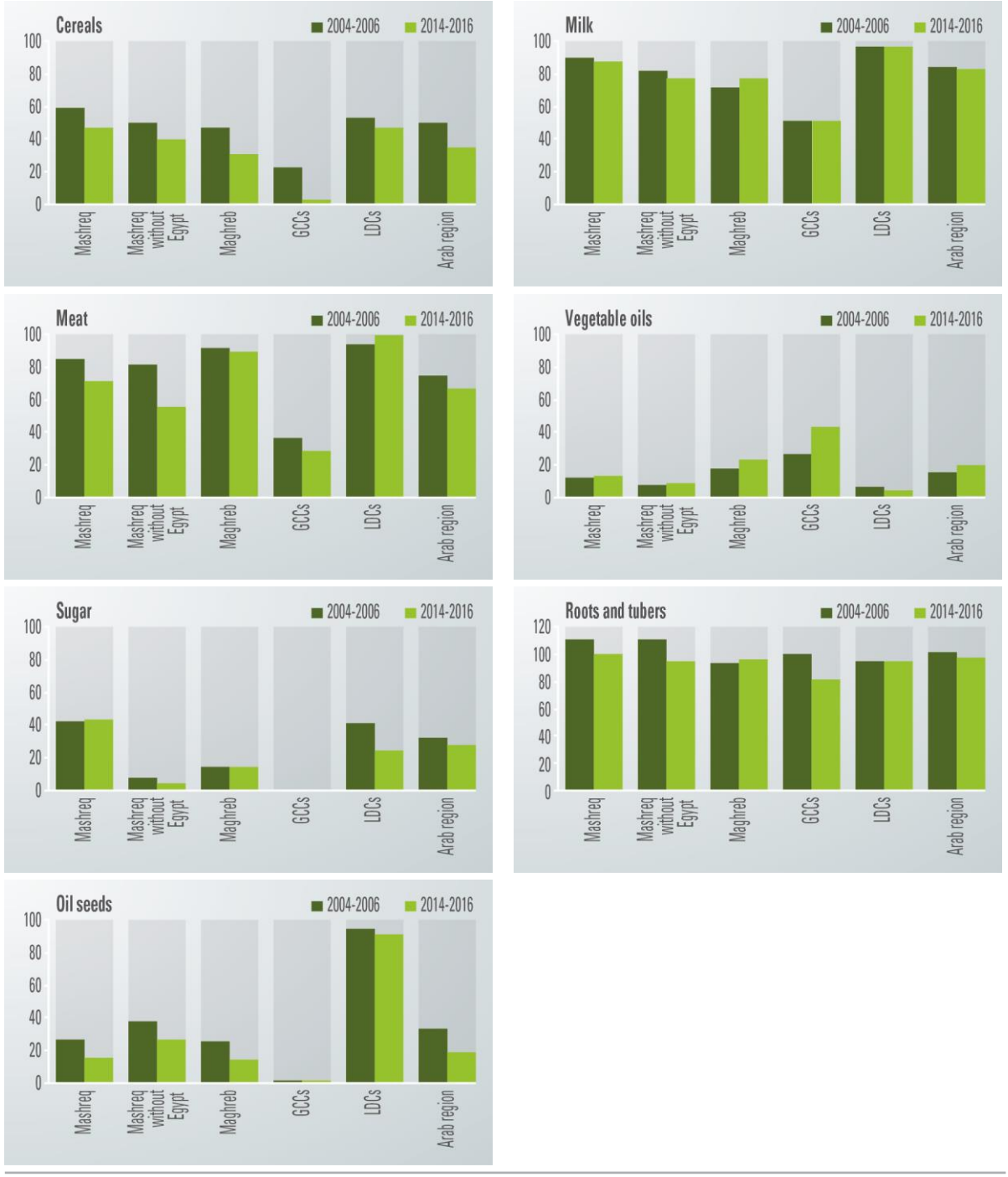
At the present time, the Arab region imports more than half of the food it consumes. From a food security perspective, the most important food commodity group for which the region continues to be heavily dependent on imports is cereals. Figure 1.6 shows the self-sufficiency ratios (SSRs) for key food commodities.[14] In the aggregate, the region imported 65 per cent of its consumption in cereals in 2014-2016, up from just 50 per cent ten years earlier. This increased dependence is due to several factors, coming both from the demand and the supply sides. On the supply side, there has been underperformance in productivity gains, inter alia due to resource limitations. On the demand side, in addition to the strong demographic growth, increased consumption has been due to a combination of food subsidies and increasing use of coarse grains as feedstuff for meat and milk production.

Among individual commodities, the highest dependence for the region on world markets is in oilseeds and vegetable oils, where over 80 per cent of all consumption was imported during 2014-2016. The marginal improvement in the SSR of vegetable oils in this last period compared to 2004-2006 may be due to an increasing share of imported oilseeds for domestic processing. Indeed, the SSR of the latter has declined from 34 per cent in 2004-2006 to just 18.7 per cent in 2014-2016, indicating a pattern in which the growth in production of one commodity may affect the importation of another commodity, used as the input.

As regards meat and milk, a handful of countries that have traditionally been livestock producers maintain high levels of SSR close to 100 per cent. Among them are the largely pastoral populations of the LDCs that include Mauritania, Somalia and the Sudan. Some other countries have increased or maintained their SSRs. Among them, the Maghreb subregion has managed to more or less maintain its SSRs in both milk and meat, despite a large increase in per capita consumption in both of these commodities, of some 2.5 per cent per annum from 2004-2006 to 2014-2016. The lowest SSRs for meat and milk are in the GCC countries. For meat, these countries cover only 28 per cent of their consumption from domestic production, while their SSR for milk actually increased marginally, to 51 per cent, largely on account of the expansion of highly intensive milk production in Saudi Arabia.

Sugar is also an important food commodity in which the majority of countries in the region are heavily in deficit. Overall, some 72 per cent of sugar consumed in the region was imported in 2014-2016, up from 67 per cent ten years earlier. Aside from a few countries in the region, notably Egypt in the Mashreq and the Sudan in the LDCs, which produce a sizeable part of their consumption, all the other countries meet their sugar needs from imports, several of them totally.

Figure 1.6 Self-sufficiency ratios of key food commodities



Source: FAOSTAT Data, FAO, 2017a.

It should be stressed that high/low or increasing/decreasing levels of SSRs do not, on their own, signify an improvement or deterioration of the food security situation in a given country. Clearly, the SSR level is an outcome and not a choice, and it can remain high or increase in a country which does not have the foreign exchange to import enough food to meet growing needs. Hence, SSRs are of limited usefulness in measuring food security. Attaining high SSRs is generally not positively correlated with a high level of food security (the LDCs subregion is a case in point, with generally high SSR levels in most commodities but high food insecurity). Conversely, SSRs can remain low or decrease in a country which has no foreign exchange limitations (as has been the case for the GCC subregion) and/or prioritizes food imports vis-à-vis other consumables.

E. Reducing food loss and waste can enhance food security

An increasingly recognized problem in food systems, globally, and even more so in countries with large food production deficits due to resource constraints, is food loss and waste. Food loss refers to decreases in food mass occurring at the beginning of the supply chain, whereas food waste refers to decreases in food mass occurring at the consumption stage. Food loss and waste impacts food availability and is often due to inefficient practices in production or harvest, post-harvest handling, transportation (internationally or domestically) and processing. It also exacerbates the depletion of natural resources, as production increases to compensate for loss, and acts as a wedge between required imports and quantities actually consumed. Access is affected through reduced income and revenue for food producers. Utilization is also impacted, as food loses its nutritional content when inappropriately handled and through delays in transportation.

2. Access to Food is Primarily an Economic Challenge

2. Access to Food is Primarily an Economic Challenge

The previous chapter explains that the principal measure of food availability at a national level is ADESA, which is relatively good in most countries of the Arab region. That same chapter points out, however, that ADESA overstates the consumption of certain segments of society because it does not take into account the distribution of available food among the population. The present chapter focuses on access, which can vary widely among households even within a single country. As shown below, access is largely a function of the ability to pay for food, although issues of physical access to food are also essential.

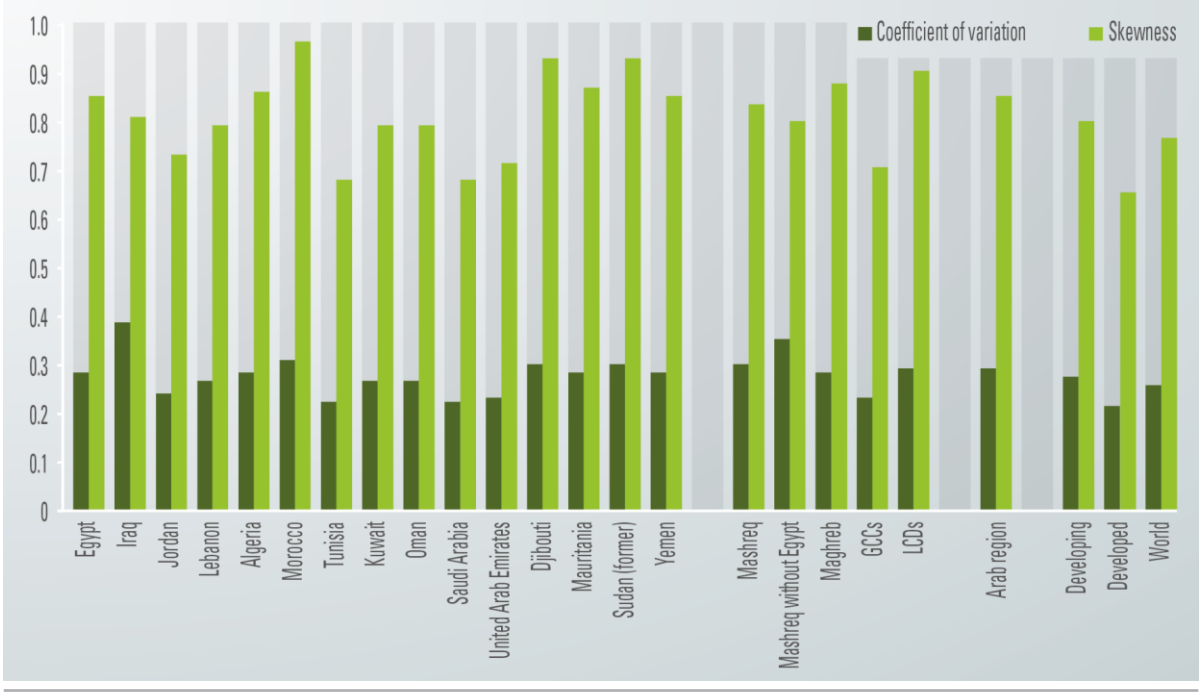
Access issues are reflected in several SDGs and their targets, including: ending poverty, increasing the income of small-scale food producers, providing social protections and enhancing infrastructure.

A. Access to food is highly unequal

An important metric on the extent of widespread access to food in a country is the degree of distribution of aggregate available food supplies. Two measures indicative of access to food by individual households have been calculated by FAO. The first is the coefficient of variation of habitual calorie consumption within the general population, derived from available household surveys that collect data on food consumption and/or expenditure. The greater the coefficient of variation, the less uniform is food consumption in a country, implying that there are individuals with very low consumption levels, as well as others with much higher consumption levels than the average consumption for that country. The second measure is the skewness of habitual caloric consumption distribution, which is an indicator of the asymmetry of consumption distribution. The higher the value of the skewness indicator, the higher the proportion of the population with very low levels of consumption, compared to the share of the population with very high levels of consumption. In graphical terms and compared to the familiar "normal" distribution, a distribution with a high coefficient of variation and high skewness is one resembling a very tall bell with its long neck deformed towards the left side, where the horizontal axis measures per capita food consumption.[15] Referring back to the previous chapter, countries with a high coefficient of variation and high skewness of habitual caloric consumption distribution would require an ADESA level considerably higher than 100 per cent in order for food to reach the entire population.

Figure 2.1 shows that the distribution of habitual caloric consumption for most countries in the region is more uneven and more skewed than it is in both developing and developed countries, as well as in the world as a whole. Within the Arab region, only for the GCC countries is the distribution more even and approaching that of developed countries. For the other three subregions, habitual consumption is relatively more unequally distributed than for the world and developing countries, with the highest inequality being in the LDCs of the region.

Figure 2.1 Coefficient of variation and skewness of habitual caloric consumption, 2012 (percentage)



Source: FAOSTAT Data, FAO, 2017a.

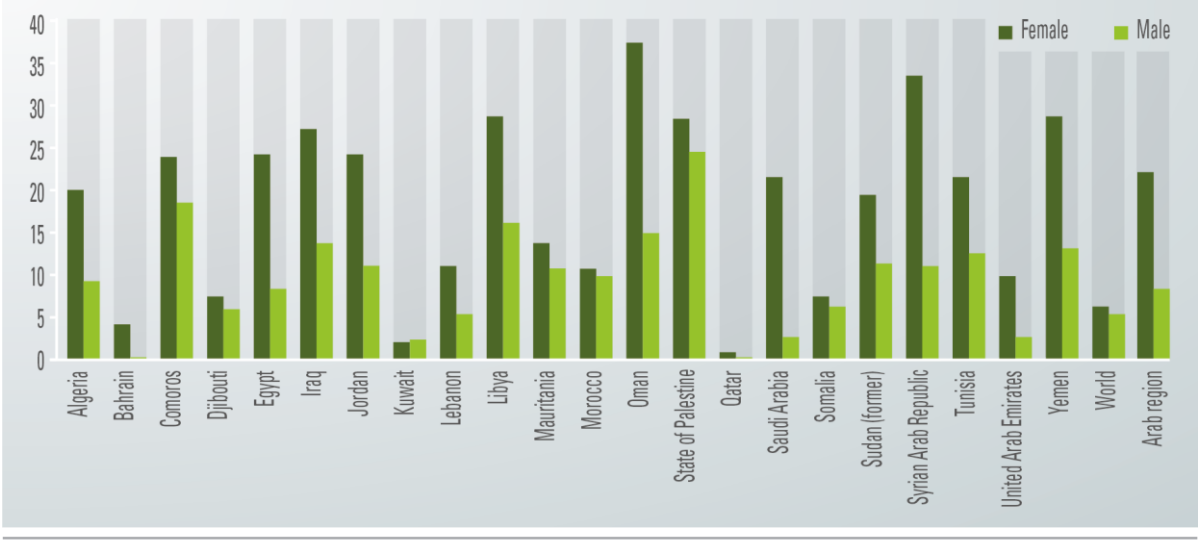
B. Poverty constrains access for many households

Perhaps the most important factor constraining access to food is poverty: with a sufficient level of income, households can overcome most of the barriers to access. By global standards, poverty in the Arab region overall is not high.[16] Yet, there is wide variation between the better-off and the very poor. On the one hand, for example, in the oil-rich countries of the region, including Algeria, poverty levels are very low and comparable to those in developed countries. On the other hand, some of the Arab LDCs are among the poorest countries in the world. In many countries, female-headed households are more likely to be poor than male-headed households, for several interconnected reasons. One main reason for the economic disadvantages of women is insecure land tenure rights, an issue that often extends to other productive assets, in addition to the fact that women are far more likely to be unemployed than men in most countries of the region (figure 2.2).

Expenditure on food claims a high proportion of household budgets, even under normal circumstances, in several countries of the Arab region. For example, in 2008 a study found that households in Tunisia spend some 35.8 per cent of their budget on food, in Egypt 38.3 per cent, in Morocco 40.3 per cent, in Jordan 40.8 per cent, and in Algeria 43.8 per cent. At the other end of the scale are the better-off oil-rich GCC countries, where percentual household expenditures on food are much lower (United Arab Emirates, Qatar and Kuwait at 9.0 per cent,

12.8 per cent and 14.6 per cent, respectively).[17] These are comparable to the averages of most Western European countries (ranging from 10 to15 per cent), and that of the United States (6.8 per cent), the lowest in the scale.

Figure 2.2 Unemployment rates by gender, 2016 (percentage)



Sources: ILOSTAT; ILO, 2017.

Figure 2.3 Urban poverty rates (percentage of urban population) and rural poverty rates (percentage of rural population)

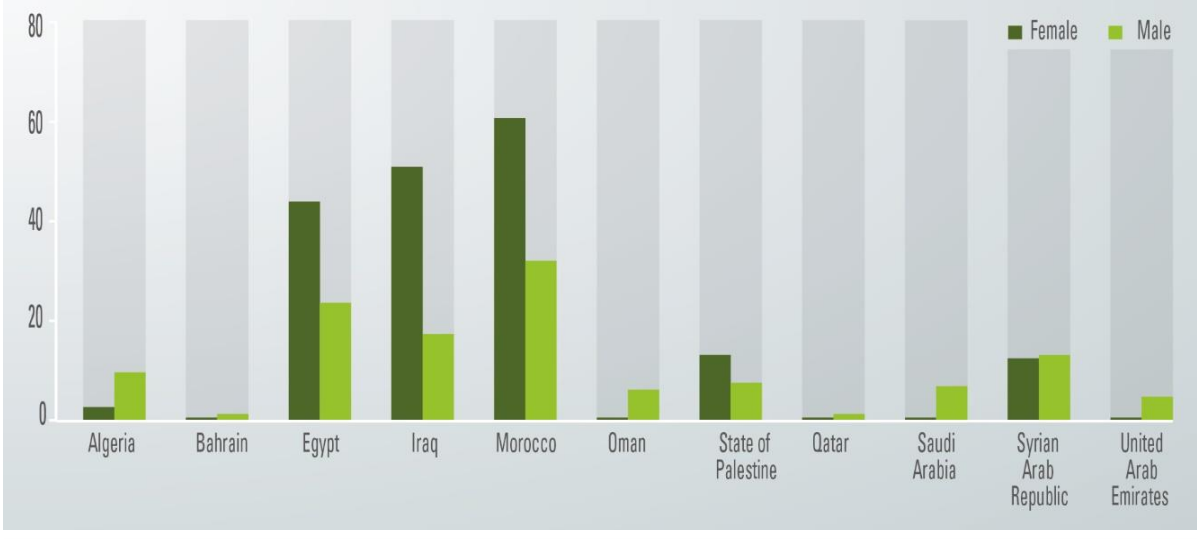
Sources: World Development Indicators; World Bank, 2014.
Note: Poverty rates are based on national poverty lines. Algeria and Palestine 2011, the Comoros 2004, Egypt and Jordan 2010, Iraq 2012, Mauritania 2008, Morocco and the Syrian Arab Republic 2007, the Sudan 2009, and Yemen 2005.

As is the case in other parts of the developing world, much of the poverty in the Arab region is a rural phenomenon. Rural areas account for the bulk of the poor, especially in the most populous countries of the region (figure 2.3). In addition to being home to a large share of the poor population, rural areas generally have significantly higher rates of poverty than do urban areas. In Egypt, Iraq, Mauritania, the Sudan and Yemen, rural poverty rates are double the rates of urban areas.

The concentration of poverty and food insecurity in rural areas highlights the continuing importance of agriculture and food production in addressing food insecurity in the region. Despite the low contribution of agriculture to the GDP of most countries in the region, and even though most rural households rely on the market for a large share of their food needs, farming is an important source of employment and income in most countries of the region (figure 2.4). Agriculture employs around 40 per cent of the workforce in Morocco and between 20 and 30 per cent in Yemen and Egypt.[18] In addition, in several countries such as Egypt, Morocco and Tunisia, agriculture produces a large share of the export earnings which these countries use, in turn, to import basic foodstuffs. Unless and until other economic sectors are able to absorb some of the on-farm labour force, agriculture will remain an essential sector that supports the rural economy and contributes to food security, directly through the provision of agricultural produce, and indirectly through the provision of the income needed to purchase food. While women make essential contributions to agriculture, in many countries of the region their land tenure rights are often not secure. They suffer from inadequate access to land and other productive resources and inputs, and this remains a serious obstacle for agricultural productivity improvement and food security in the region. The percentage of female agricultural holders in Egypt, Jordan, Lebanon, Saudi Arabia and Tunisia, for example, is generally very low, not exceeding 7 per cent.[19]

Turning to the urban poor, who purchase most of the food they consume in the market, their income earning capability is paramount to attaining food security. While the urban poor generally have access to more stable food markets than their rural counterparts, they also face serious challenges in terms of finding steady and remunerative employment. Unemployment rates in several countries in the Arab region are high, especially among urban populations, and particularly for young people and women. Even when they are employed, their income can be eroded by higher prices for food and other necessities. Urban employment from sectors such as tourism or construction is often seasonal, which presents difficulties in accessing food on a regular basis. Also, while the urban poor have better access to social protection programmes than their rural counterparts, the benefits from such programmes tend to get eroded during difficult times.[20] The large numbers of refugees, IDPs and economic migrants in several host countries in the Arab region are also largely concentrated in urban centres, where they are usually subject to irregular employment and are poorly paid. These doubly-destitute people hardly have any entitlements to social protection from either their home or host countries. Given the vital role of employment in maintaining integrity and improving livelihoods, especially for the youth and women, it is directly reflected in a number of the SDGs and can be found in such targets as 4.4, 8.5 and 8.8.

Figure 2.4 Employment in agriculture by gender (percentage of total male and total female employment)



Source: World Development Indicators. World Bank, 2014.
Note: Data for Algeria and Egypt is from 2014, Bahrain and Oman from 2010, Iraq and the United Arab Emirates from 2008, Morocco from 2012, Palestine and Saudi Arabia from 2015, and the Syrian Arab Republic from 2011. Data for Qatar is from 2012 (female) and 2015 (male).

C. Conflicts and occupation limit economic and physical access

This chapter has so far focused on the impact of poverty on food access. Although economic access is necessary, it is not sufficient for ensuring food access. In several countries of the Arab region, where populations have suffered from prolonged periods of conflict and political and economic instability, physical access to food can hardly be taken for granted. Trade flows and the functioning of markets have been seriously disrupted in many instances, and people's mobility to access markets has been restricted, even when such markets exist. Moreover, the escalation of armed conflict in several countries in the region since 2010 has created a surge in refugees and IDPs, who typically lose both their economic and physical access to food. In the first instance, such conflicts and related political instability seriously undermine physical access to food, by depriving displaced people of their most important sources of food supplies, which in many cases used to come from their own fields and household gardens. Where agencies such as the World Food Programme (WFP) have sufficient resources and access to the affected populations, physical distribution of food is often an appropriate response. The supplemental feeding programmes in Yemen fit into this category. Yet, there have been many situations in the Arab region in which a combination of conflict, poor infrastructure and extreme weather events meant that air drops were the only feasible option.

Box 2.1 Conflicts and food security – the cases of the Syrian Arab Republic and Yemen

The ongoing conflicts in the Syrian Arab Republic and Yemen have devastating effects on food security. Since in conflict situations many random factors affect food security and malnutrition, assessing food insecurity in real time is difficult, if not impossible. The only reliable assessments could be obtained from representative on-the-ground surveys. Such surveys, while providing the best possible snapshot at a given time, however, may soon be outdated in the course of new conflict dynamics.

An alternative to real-time measurements is the identification of long-run equilibrium vulnerabilities from existing data. Thus, as opposed to asking how many people are currently affected by certain food security and malnutrition indicators in an ongoing conflict, which surveys struggle to provide accurate answers for, answering the question of how many people will ultimately be affected by certain food security and malnutrition indicators if the conflict situation prevails might be more feasible.

In this context, we found that for every 1 per cent decrease in income, the following food insecurity indicators for children under 5 increase: mortality rate by 0.51 per cent, prevalence of underweight (weight for age) by 0.42 per cent, prevalence of wasting (weight for height) by 0.24 per cent, and prevalence of stunting by 0.42 per cent. When measuring the effect of conflict on food insecurity using the armed conflict total score from the Major Episodes of Political Violence dataset, a one-unit increase in the armed conflict score increases the same food insecurity indicators: mortality rate by 3.6 per cent, prevalence of underweight by 2.8 per cent, prevalence of wasting by 2.1 per cent and prevalence of stunting by 1.2 per cent. Moreover, these anthropometric indicators correlate with various micronutrient deficiency indicators, such as prevalence rates of anemia, iodine deficiency, and vitamin A deficiency.

Applying those elasticities to the real income reduction and conflict intensity that has taken place between 2011 and 2017 suggests that the under-5 mortality in the Syrian Arab Republic has increased from 1.5 per cent to 7.9 per cent. Applied to the actual cohort of children under 5, an estimated extra 26,505 children will not live passed their fifth birthday as a result of the conflict. In the case of Yemen, child mortality was 5.4 per cent in 2010 and is predicted to increase to 17.8 per cent in 2017. This implies that an additional 99,586 children will die prematurely as a result of the conflict.

The prevalence of undernourishment, wasting and stunting among children under 5 in 2010 stood at 10.1 per cent, 5.5 per cent and 27.5 per cent, respectively, in the Syrian Arab Republic. In six years of war, these numbers are estimated to have increased to 82.1 per cent (underweight), 69 per cent (wasting), and 100 per cent (stunting). Since many children suffer from various anthropometric deficiencies simultaneously, the number of children affected by at least one anthropometric shortfall increased from roughly one quarter of the population to the entire cohort.

The situation is similar in Yemen, where the 2010 prevalence rates of undernourishment, wasting and stunting among children under 5 stood at 35.5 per cent, 13.3 per cent and 46.6 per cent, respectively. The conflict has increased those values to 92.7 per cent (underweight), 26.2 per cent (wasting) and 86.7 per cent (stunting), also suggesting that almost every Yemeni child under 5 suffers from at least one anthropometric health concern.

Such estimates, of course, must not be interpreted as instant food security responses to conflict and conflict-induced reductions of income, but long-run equilibrium effects that will prevail if the conflict situation continues. Of course, the longer a conflict lasts, the more accurately the model estimates will reflect the actual humanitarian situation on the ground.

Source: Marktanner, 2017.

Conflicts have a direct effect on food availability, through razing farm land, spreading cluster bombs and mines, killing livestock, destroying machinery and blocking access to international as well as domestic markets. In addition to its direct impacts on availability, conflict results in refugee migration and the deterioration of the regional investment climate. It also impacts access: by destroying livelihoods, conflict exacerbates poverty and strips governments of the tax revenue needed for social protection programmes. As food and water supplies become compromised and access to health care becomes increasingly difficult, conflict also impacts utilization and leads to malnutrition. In parts of Iraq, Somalia, the Sudan, the Syrian Arab Republic and Yemen, the recent increase in food insecurity has mainly been due to ongoing conflicts.[21]

Despite the significant contribution of agriculture to the Palestinian economy and food security, the sector has been operating well below its potential, with a declining contribution to GDP and exports. Despite them sharing the same agroecological zone, much of the difference in productivity observed between Palestine, on the one hand, and Jordan and Israel, on the other, has been attributed to the ongoing Israeli occupation.[22] The ongoing occupation and the expansion of Israeli settlements is estimated to deprive the Palestinian economy of 63 per cent of the agricultural resources of the West Bank, including the most fertile and best grazing land. Palestinian farmers are denied the right to build wells to meet the growing demand for water, even when that water originates almost entirely in the West Bank. Moreover, Israel's restrictions on the importation of fertilizers have had a damaging impact on Palestinian agriculture, where a decline of 20-33 per cent in agricultural productivity is estimated to have taken place since the enforcement of these restrictions.[23]

D. Well-designed social safety nets can enhance access

This chapter has highlighted some of the impacts of inequality, poverty and conflict on food access. Ensuring sufficient access to food at the individual and household levels can be bolstered by further developing and targeting social protection systems. Effective social protection systems preclude the need for emergency relief, both by ensuring timely access to a minimum level of food for more vulnerable individuals, and by supporting local livelihoods. Due to the centrality of food to well-being, social protection approaches often focus on ensuring household-level access to food, especially in response to crises or price shocks. Given the predominance of wheat and other staple grains in the diets of the region's poor, price volatility globally can disproportionately affect the most vulnerable segments of the population, particularly children and women. With less purchasing power, and a higher proportion of income needed to purchase food, impoverished households are invariably forced to cut back on other essential spending, such as health care and education.

Social protection measures set up to mitigate food insecurity tend to target different aspects of food supply chains. This can involve supporting food producers and livelihoods; providing market-based social protection through retail improvement strategies, direct price controls and subsidies; or directly supporting the end consumer through cash or credit transfers and feeding programmes. Increasingly, technological advances are being used to increase the efficiency of social safety

nets. Box 2.2 describes several innovative uses of technology to ensure food security for Syrian refugees in Jordan.

1. Supporting livelihoods

In acknowledging poverty as a root cause of food insecurity, approaches which focus on supporting the livelihoods of food-insecure communities take on various forms, directly or indirectly promoting food production, through training and asset transfers. Livelihood support can take the form of key food production input subsidies, such as diesel, fertilizers and pesticides. Crop and livestock insurance also helps mitigate the economic risks of crop failure or livestock deaths, thus ensuring the ability of producers or farmers to support their families and communities. This is particularly important for pastoralists or farmers relying on rain-fed crops in the more arid countries of the region. Training around food production can also greatly help increase the efficiency of food systems, reduce waste and increase the economic viability of rural livelihoods. Off-farm employment opportunities are often generated through public works programmes which exchange labour for food or for cash. When effectively designed, public works programmes allow for the rehabilitation of community assets vital for food production, such as irrigation canals or farm access roads. Such programmes also increase the income and purchasing power of those employed in the project, while possibly improving production yields and efficiencies, through asset construction and repair.

2. Market-based social protection mechanisms

The ability of markets to effectively respond to emergent food security concerns can be greatly enhanced through the use of various instruments. One of the most commonly used instruments for ensuring food access are strategic grain reserves that work to provide buffer stocks to respond to food price and or supply risks. In addition, policy interventions such as reducing import tariffs, restricting exports and reprioritizing agricultural investment are some of the measures that were adopted by countries in the region in response to the 2007 food price crisis.[24] However, such sweeping food price stabilization policies are often costly. These types of interventions are described in detail in the chapter on trade in Part II of the report.

Box 2.2 Innovative uses of technology to ensure food security for Syrian refugees in Jordan

Delivering aid to refugees is an enormous task in Jordan, where the vast majority of the approximately 650,000 Syrians registered with the United Nations High Commissioner for Refugees (UNHCR) live outside of refugee camps. The use of technology starts with the registration process. A global digital record is created for every refugee using barcode scanners to record the data from Syrian identity cards. Rather than using photos and fingerprints to verify the identity of refugees, UNHCR uses iris scanning, and 1.6 million Syrian refugees across the region have been registered this way.

The data collected during registration is used to identify the most vulnerable households, who are then included in the cash-based social safety scheme. At branches of the participating commercial bank, refugees are able to withdraw UNHCR cash transfers by looking into an iris-recognition scanner – no card is required and fraud is dramatically reduced. The success of this programme has encouraged other aid organizations to pilot the use of this technology to allow refugees to purchase food in participating supermarkets.

Source: Favell, 2015.

Retail improvement programmes: An innovative programme, which combines livelihood support with retail markets, has been developed and rolled out across the region by WFP. The retail engagement strategy works by providing training, management and support to contracted retailers. By optimizing retailer supply chains, the strategy works to reduce the cost to the consumer on average by 10 per cent, and increase the capability of retailers, such that efficiency gains are sustained after project completion. The vertical approach to supply chain management sees retailers trained in purchasing, inventory management, logistics and storage, supported by the deployment of affordable itemized sales and inventory technology, and barcode reader mobile apps. The strategy is already active in Iraq, Jordan and Lebanon, and helps increase the capability of local retailers, while reducing the impact of subsidized food stuffs or emergency assistance on retailer livelihoods. The coordination of retailer purchases has also enabled them to access lower prices for key commodities, further lowering the price to the consumer by 7 per cent.[25]

Food subsidies: Market-based measures have most prominently featured across the region as universal food subsidies. In part due to the increasing reliance on food imports, governments in the region have favoured food price subsidies for consumers as the primary mechanism for responding to domestic food insecurity. However, non-targeted subsidies and interventions can be inefficient and fiscally burdensome. General food subsidies often come to be disproportionately enjoyed by non-poor residents of the country.[26] For instance, of those benefiting from non-targeted food subsidies in the region, only one quarter are in the poorest quintile, while some 15 per cent of beneficiaries are in the richest quintile.[27] Universal food subsidies also generate particular challenges during food price spikes, as maintaining the cost to the consumer at a fixed price increases the strain on government budgets.

Like many countries in the Arab region, Egypt has long struggled with the budgetary strain associated with universal food subsidies. In Egypt, universal food subsidies represented an average of 9 per cent of GDP over the last decade, compared to a lower, but still high 2.2 per cent of GDP for the region as a whole.[28] In 2014, the Egyptian Government committed to reforming its system of food subsidies, primarily by shifting from input subsidies (for instance, wheat flour) to output subsidies (for instance, bread), which can more easily be targeted to poor households. With a smart card issued to qualifying households, recipients are entitled to purchase five loaves of bread at a subsidized rate, which reduces potential abuse and inefficiency in the subsidy system. By better targeting subsidy recipients and the allocation of key commodity discounts, this system would result in cost savings that can reduce the budgetary burden and be redistributed to those most in need.

3. Transfers and feeding programmes

Cash transfer programmes: These initiatives are becoming increasingly common in the region, as they allow households the freedom to allocate support to whatever expenditure they need most. Cash transfer programmes can be targeted based on means-testing alone or in combination with conditions that encourage long-term investments, such as school attendance. The takaful programme in Egypt combines means-testing and conditionality. Takaful awards means-tested recipient families a monthly pension of some 325 Egyption pounds (LE) per month, in addition to LE60 monthly for each child who attends primary school, LE80 for each student in preparatory

school and LE100 once they reach secondary school. The conditional cash transfer not only provides immediate benefits such as economic access to food, but also reduces the need for impoverished families to rely on child labour for income, and supports the long-term poverty reduction benefits associated with education.[29]

Targeted feeding programmes: These schemes are also used to address access to food, and provide a mechanism that directly ensures consumption at the individual level. Feeding programmes are particularly important in contexts where physical access to food is problematic, or where intra-household distribution of food is a concern. In Yemen, unprecedented levels of food insecurity are affecting millions of children and pregnant and lactating women. Currently, 67 per cent of children under 5 are estimated to be chronically malnourished. The physical and mental developmental effects of this can be permanent if not addressed appropriately. At the same time, more than 80 per cent of women of reproductive age are anemic and one quarter are underweight, significantly increasing the risk of maternal death. In response, emergency relief efforts entailing targeted supplementary feeding programmes have been launched, providing 90-day rations of 535 kcal/day of food supplement for children between 6 months and 5 years old, while a blanket feeding programme provides all children under the age of 2 with just under 300 kcal/day, together with key micronutrients. Pregnant and breastfeeding mothers are supplied with a fortified cereal blend.[30]

School meal programmes: These programmes bring together a raft of government institutions, regional organizations, donor agencies, businesses and non-governmental organizations (NGOs) in providing cash transfers, in-school meals, snacks, take-home food rations or vouchers to families, conditional upon regular classroom attendance. With the elevated prevalence of malnutrition, stunting and wasting among children in some countries of the region, and the vulnerability of often rural communities in absorbing shocks and food price volatility, the programmes build on the core interdependencies between social protection, education, health, and food and nutritional security. They represent an important element of nutritional stability and educational continuity, not least for refugee communities, displaced families and poor communities. Opportunities are also taken to develop local livelihoods by incorporating rural communities into the programmes through local sourcing from smallholder farmers, thus helping to maintain the viability of rural livelihoods.

3. Undernutrition and Micronutrient Deficiencies Exist Side by Side with Obesity

3. Undernutrition and Micronutrient Deficiencies Exist Side by Side with Obesity

Utilization of food refers to good eating habits, the choices people make in terms of food, behavioural issues including excessive intake, and intra-household distribution due to traditions and cultural practices, as well as factors affecting the metabolism of food eaten. As such, utilization also reflects the biological consequences of food availability and food access, and can be measured at the level of individuals. Because utilization can be measured at the level of individuals, it gives a glimpse not only of inequality among countries and households, but also of inequalities within households. In particular, it is at the level of utilization that we can identify vulnerabilities among key demographic groups, such as young children and women of childbearing age.

Utilization aspects of food security are highlighted in several SDGs and targets including: ending hunger, improving nutrition, and improving access to drinking water, sanitation and health care. This chapter begins by assessing inequalities in undernourishment in order to highlight links with food availability and food access. The chapter then turns to what is sometimes referred to as the double burden of nutrition in the Arab region: the simultaneous presence of undernutrition and overnutrition.

A. Overall undernourishment low, but very high in the region's least developed countries

Chapter 1 referred to ADESA as a key indicator of food availability, where ADESA measures the availability of food on average at the national level. Chapter 2 explained how poverty can prevent households from accessing food, even if ADESA indicates that large quantities are available at the national level. The disconnection between food availability and food access is evident in rates of undernourishment.

The term undernourishment refers to the inability of individuals to obtain enough food, namely the quantity of food sufficient to lead a healthy and active life.[31] Operationally, FAO defines the prevalence of undernourishment as the proportion of the population whose dietary energy consumption falls below a predetermined country-specific and age-specific threshold, and is thus inadequate to cover even the minimum needs of a sedentary lifestyle.[32]

The prevalence of undernourishment in the region spans the whole range from very low to very high levels (table 3.1). For most of the countries in the Mashreq, Maghreb and GCC subregions, undernourishment hovers around 5 per cent, the order of magnitude encountered in developed

countries. However, some outliers have been identified within these subregions with high levels of undernourishment in recent years, notably Iraq, estimated by FAO at 22.8 per cent in 2014-2016, and State of Palestine, at 31 per cent in 2010-2012.

The most problematic countries in terms of undernourishment are the LDCs of the region, where undernourishment persists at high levels. Aside from Mauritania, where the latest FAO estimate is reported as 5.6 per cent, all of the LDCs are reported to experience high undernourishment rates. The levels of undernourishment are staggering for some, as high as 70 per cent for the Comoros, 39 per cent for the Sudan and 26 per cent for Yemen. As several countries in the region remain in situations of protracted conflict, reliable and updated data remains unavailable for them, and hence actual rates may be even higher than those reported.

Table 3.1 Prevalence of undernourishment and depth of food deficit in 2014-2016

Country	Prevalence of undernourishment (percentage)	Depth of food deficit (kcal/capita/day)	Depth of food deficit (percentage of calorie availability)	Depth of food deficit in cereal equivalent (metric ton)
Algeria	<5.0	20	0.6	69,511
Bahrain	<5.0	..	..	..
Comoros	70.0	..	..	..
Djibouti	15.9	118	4.4	10,261
Egypt	<5.0	12	0.3	100,497
Iraq	22.8	185	7.2	605,767
Jordan	<5.0	13	0.4	8,253
Kuwait	<5.0	21	0.6	6,473
Lebanon	<5.0	29	0.9	11,712
Libya	<5.0	..	..	..
Mauritania	5.6	36	1.2	12,260
Morocco	<5.0	31	0.9	97,112
Oman	<5.0	33	1.0	15,328
Palestine	31.0	..	..	..
Saudi Arabia	<5.0	9	0.3	23,761
Somalia	..	..	..	..
Sudan	39.0	176	7.7	766,544
Tunisia	<5.0	3	0.1	2,979
United Arab Emirates	<5.0	18	0.5	8,530
Yemen	26.1	182	8.2	461,996
Developing	12.9	96	3.4	..
Developed	<5.0	8	0.2	..
World	10.8	81	2.8	..

Sources: FAOSTAT Data, FAO, 2017a; FAO, IFAD and WFP, 2013.
Note: Data for undernourishment for Bahrain, the Comoros, State of Palestine and the Sudan are from 2010-2012.

Another useful indicator of food deprivation computed by FAO is the depth of the food deficit, which calculates the calories that would be needed to lift the undernourished out of their condition (expressed on a per capita basis for the whole population of a country). As expected, the depth of the food deficit is the highest for the LDCs of the region. In the case of Yemen, an additional 182 kcal/capita/day would be required so that the whole population of the country could lead a normal and active life, while in the case of the Sudan, the depth of the food deficit is estimated at 176 kcal/capita/day – amounting to 8.2 per cent and 7.7 per cent, respectively, of their average calorie availability. These numbers suggest that, in the case of Yemen, total available calories would have to increase by 8.2 per cent to lift the undernourished out of their condition, while in the case of the Sudan, the necessary increase would be of 7.7 per cent. Apart from the LDCs, the only other country with a high depth of food deficit is Iraq, at 185 kcal/capita/day, implying a necessary increase in average caloric availability by 7.2 per cent to lift the undernourished out of their condition.

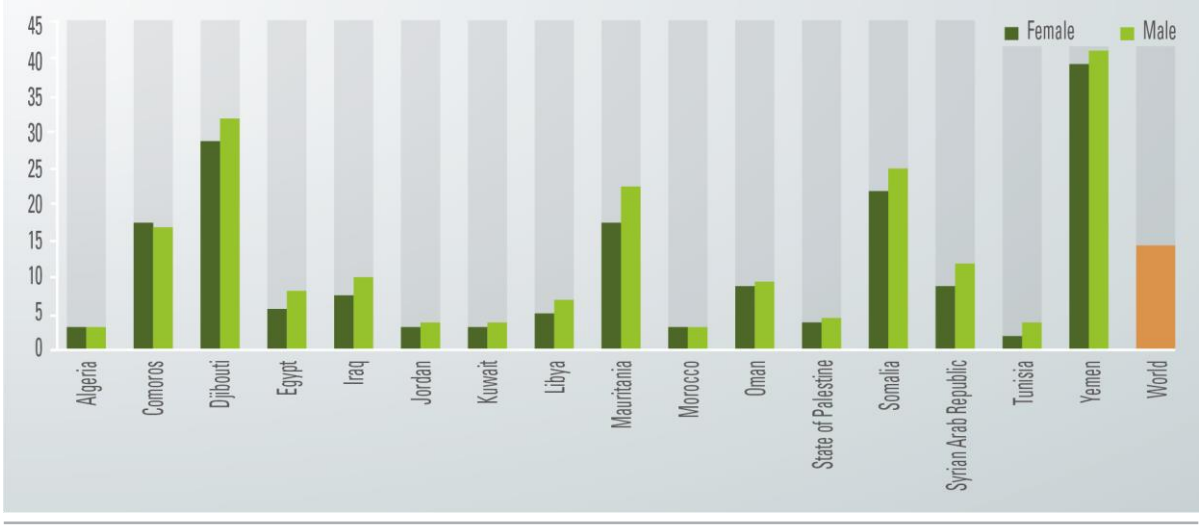
It is also possible to arrive at a rough estimate of the absolute annual amount of cereal that would correspond to the estimated depth of food deficits.[33] In the case of Yemen, the equivalent of some 462 thousand metric tons of cereals would be required; in the case of the Sudan, 767 thousand metric tons; and in the case of Iraq, about 606 thousand metric tons. These are not large quantities, compared with the amounts produced or imported by these countries. However, even if the aggregate supply were to increase by these amounts, there is no guarantee that undernourishment would be eradicated, unless these supplies are targeted specifically at undernourished individuals. In other words, an increase in food availability (at a national level) would not translate into reduced undernourishment unless food access issues are also addressed.

B. Several Arab countries face extreme undernutrition and micronutrient deficiencies

Undernutrition refers to the health conditions that result from inadequate quantities or quality of food. Three indicators of undernutrition are commonly used: underweight, stunting and wasting. In addition, micronutrient deficiencies are often cited as indicative of the absence of key food components other than calories.

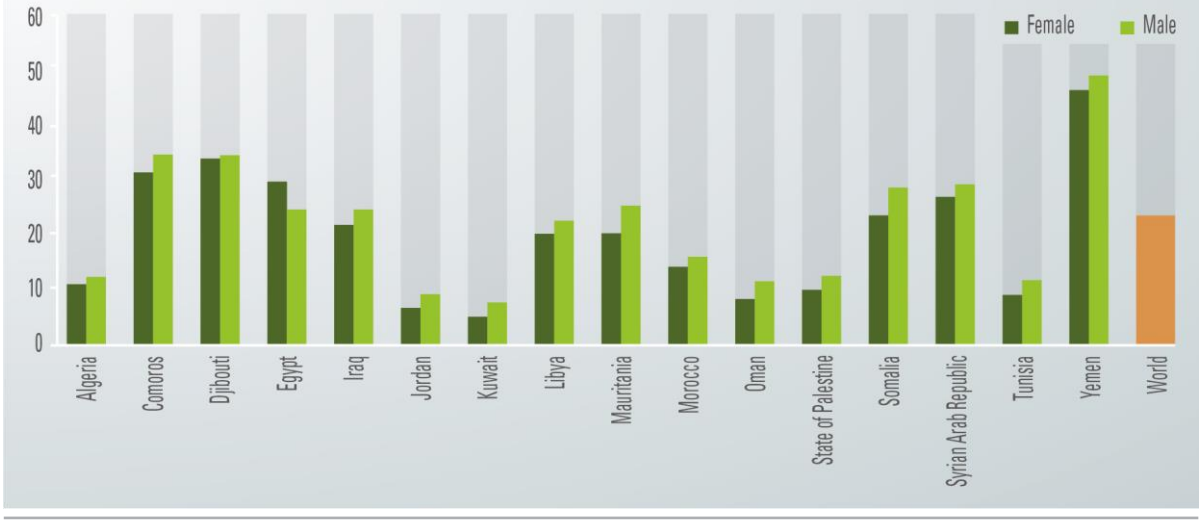
An underweight child is one who has low weight for his or her age. As weight can change rapidly, the prevalence of underweight is a useful measure of the instability of food security. Evidence shows that the mortality risk increases for children who are even mildly underweight, and that severely underweight children are even more at risk. As figure 3.1 shows, most Arab countries have a low prevalence of underweight. However, Yemen has very high rates, with around 40 per cent of Yemeni children under 5 years of age being underweight. Djibouti and Somalia also have rates above 20 per cent. These rates place Yemen in the category of “very high”, and Djibouti and Somalia in the category of “high”, by the standards of the World Health Organization (WHO).[34] In most countries, rates of underweight are slightly higher among boys than among girls.

Figure 3.1 Prevalence of underweight by gender (based on weight for age, percentage of children under 5)



Sources: World Development Indicators; World Bank, 2014.
Note: Data for Algeria, the Comoros, Djibouti, Jordan, Mauritania and Tunisia is from 2012; for Iraq and Morocco, data is from 2011; for Kuwait, data is from 2014; for Libya, data is from 2007; for Oman, Somalia and the Syrian Arab Republic, data is from 2009; for the State of Palestine, data is from 2010; for Yemen, data is from 2013; for Egypt, data for females is from 2008 and data for males is from 2014. The world average for both sexes in 2016 was 14 per cent.

Figure 3.2 Prevalence of stunting by gender (based on height for age, percentage of children under 5)

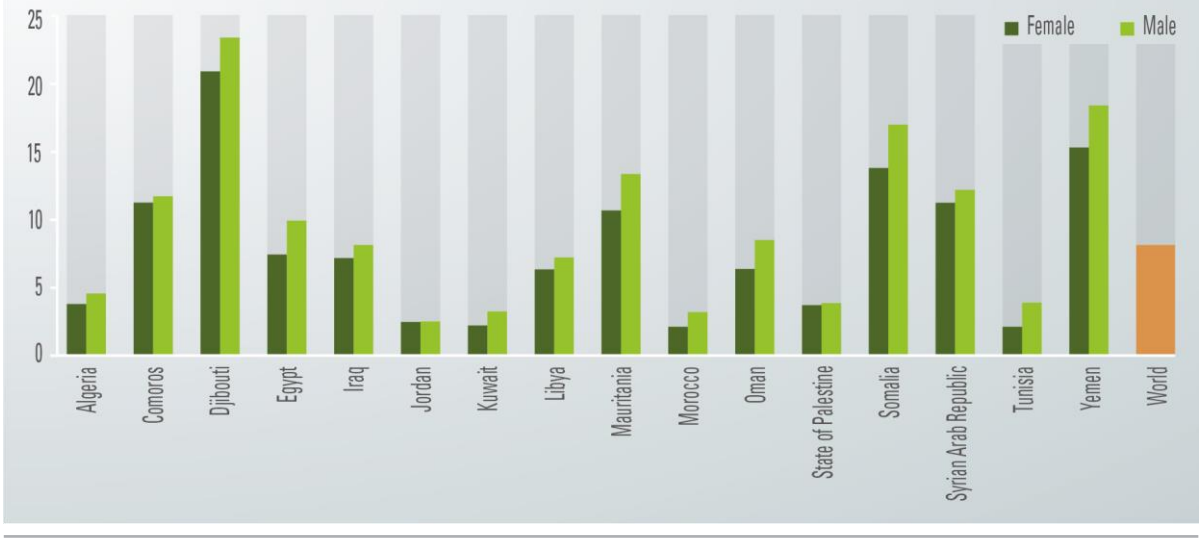


Sources: World Development Indicators; World Bank, 2014.
Note: Data for Algeria, the Comoros, Djibouti, Jordan, Mauritania and Tunisia is from 2012; for Iraq and Morocco, data is from 2011; for Kuwait, data is from 2014; for Libya, data is from 2007; for Oman, Somalia and the Syrian Arab Republic, data is from 2009; for the State of Palestine, data is from 2010; for Yemen, data is from 2013; and for Egypt, data for females is from 2008, and for males from 2014. The world average for both sexes in 2016 was 22.9 per cent.

Whereas underweight is an indicator of acute malnutrition, stunting is the result of long-term nutritional deprivation. Stunting often leads to delayed mental development and reduced intellectual capabilities. This, in turn, affects economic productivity when the children become adults. As with underweight, Yemen has the highest rates of stunting, followed by Djibouti, the Comoros, the Syrian Arab Republic and Somalia (figure 3.2). WHO includes Yemen among the countries with "very high" rates of stunting, and Djibouti and the Comoros among the countries with "high" rates. Unlike other countries, stunting in Egypt is more common among girls than among boys.

The third common measure of undernutrition is wasting, which is usually a consequence of insufficient food intake or a high incidence of infectious diseases, especially diarrhea. Wasting impairs the functioning of the immune system and can lead to increased severity and duration of, and susceptibility to, infectious diseases, and an increased risk of death. Rates of wasting are highest in Djibouti, with the other LDCs also strongly impacted (figure 3.3). WHO considers the rates in Djibouti and Yemen to be "critical", while rates in the Comoros, Mauritania, Somalia and the Syrian Arab Republic are considered to be "serious". It is worth noting here that the rates in the Syrian Arab Republic reflect the situation before the current conflict: the rates today are likely to be higher. Rates among boys are higher than among girls throughout the region.

Figure 3.3 Prevalence of wasting by gender (based on weight for height, percentage of children under 5)



Sources: World Development Indicators; World Bank, 2014.
Note: Data for Algeria, the Comoros, Djibouti, Jordan, Mauritania and Tunisia is from 2012; for Iraq and Morocco, data is from 2011; for Kuwait, data is from 2014; for Libya, data is from 2007; for Oman, Somalia and the Syrian Arab Republic, data is from 2009; for the State of Palestine, data is from 2010; for Yemen, data is from 2013; for Egypt, data for females is from 2008, and for males from 2014. The world average for both sexes in 2016 was 7.7 per cent.

Table 3.2 Micronutrient deficiencies in children under 5

Country	Prevalence of deficiencies among children (percentage)		
	Anemia	Vitamin A	Iodine
Algeria	42.5	15.7	77.7
Bahrain	24.7	..	16.2
Comoros	65.4	21.5	..
Djibouti	65.8	35.2	..
Egypt	29.9	11.9	31.2
Iraq	55.9	29.8	..
Jordan	28.3	15.1	24.4
Kuwait	32.4	..	31.4
Lebanon	28.3	11.0	55.5
Libya	33.9	8.0	..
Mauritania	68.2	47.7	69.8
Morocco	31.5	40.4	63.0
Palestine	30.0	..	..
Oman	50.5	5.5	49.8
Qatar	26.2	..	30.0
Saudi Arabia	33.1	3.6	23.0
Somalia	..	61.7	..
Sudan	84.6	27.8	62.0
Syrian Arab Republic	41.0	12.1	..
Tunisia	21.7	14.6	26.4
United Arab Emirates	27.7	..	56.6
Yemen	68.3	27.0	30.2
Mashreq	37.0	15.7	31.8
Mashreq without Egypt	45.7	20.3	36.5
Maghreb	35.1	24.3	64.9
GCC	34.0	2.9	30.6
LDCs	68.7	32.4	51.2
Arab region	43.6	20.1	35.9
Developing	52.4	34.0	29.6
Developed	11.8	3.9	37.7
World	47.9	30.7	30.3

Sources: FAO, 2017a; FAO, IFAD and WFP, 2013.
Note: Data is for most recently available year as of time of publication of sources.

Calorie deficits do not tell the full story of malnutrition. In diets consisting mainly of staple cereals or root crops, it is possible to consume enough calories without consuming enough micronutrients (from foods rich in micronutrients, such as fruits, vegetables and animal source proteins). While averages for micronutrient deficiencies in the Arab region are generally below the averages for the world as a whole (aside from iodine deficiency), individual statistics provide a much more worrisome picture (table 3.2).[35] Many household diets across

the Arab region lack the essential micronutrients (iron, iodine, zinc, calcium, folic acid and vitamins A and D) for a healthy life. The prevalence of anemia and micronutrient deficiencies (vitamin A and iodine) is very high in the LDCs of the region, whether compared with Arab averages or those of the world as a whole.

Micronutrient deficiencies have direct and specific negative impacts on health: anemia results in fatigue and shortness of breath; iodine deficiency also causes fatigue, in addition to slowing mental processes; and vitamin A deficiency causes problems with vision and can lead to blindness. Micronutrient deficiencies can also exacerbate a general inadequacy in calories to increase risks of underweight, stunting and wasting. The case of Egypt – which has a problem with stunting despite a generally high consumption of calories – is indicative of this (box 3.1).

Box 3.1 The impacts of micronutrient deficiencies on stunting

In general, the high prevalence of stunting among children is associated with a high prevalence of food (caloric) inadequacy, as evidenced by the high correlation between these two indicators.[a] However, caloric inadequacy is not the only determinant of stunting among children, as is evident in the case of Egypt. In Egypt, stunting rates are 22.3 per cent despite very low rates of caloric inadequacy (less than 5 per cent). Even though Egypt has witnessed a remarkable increase in dietary caloric intake in recent years (encouraged by high subsidies), the bulk of the diet is dominated by cereals and other basic products (sugar and oil) that are energy-rich but micronutrient-poor. Indeed, the prevalence of anemia and vitamin A deficiency remains high in Egypt. Legumes and cereal grains, which are the main staples of poor households, often contain antinutrients (such as phytates), which inhibit the absorption of essential micronutrients, especially iron and zinc.[b] In urban slums and isolated rural areas where poverty is prevalent, access to basic services, such as antenatal care and clean water, is lacking, so that human development indicators are considerably below the national average. For instance, a child in rural Upper Egypt is 3.4 times less likely to attend primary school than a child in urban Lower Egypt.[c]

Correlation between stunting and food inadequacy/deficiencies in the Arab region

	Prevalence of stunting among children	Prevalence of food inadequacy	Prevalence of deficiencies among children		
			Anemia	Vitamin A	Iodine
Prevalence of stunting among children	1.00	0.83	0.77	0.56	0.14
Prevalence of food inadequacy		1.00	0.79	0.56	0.02
Prevalence of anemia			1.00	0.63	0.35
Prevalence of vitamin A deficiency				1.00	0.48
Prevalence of iodine deficiency					1.00

Source: Calculated based on data from FAO, 2017a; FAO, IFAD and WFP, 2013.

[a] Stunting is also a result of lack of access to clean drinking water, education of mothers, breastfeeding practices, and health and nutrition programmes (or the lack thereof).

[b] Welch and Graham, 2002.

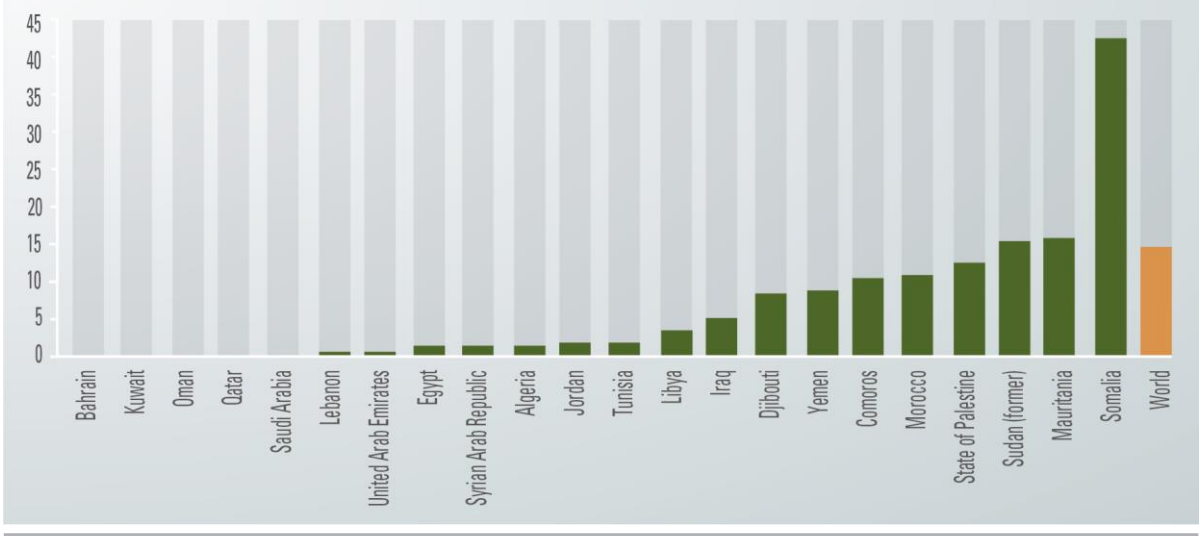
[c] Silva, Levin and Morgandi, 2013.

C. Adequacy of food is not enough: access to clean water, sanitation and medical care is essential for good nutrition

In general, the increasing urbanization the region has experienced in recent years is associated with improvements in the nutritional status of children.[36] To a large extent, this association is understood to be due to improved access to food. Except for breastfeeding practices, which are generally more prevalent among rural mothers, children's diets in urban areas are generally more diverse and more likely to include nutrient-rich foods such as meat, dairy products and fresh fruits and vegetables.[37] An analysis of 11 demographic and health surveys shows a consistently higher intake of milk and meat products by toddlers in urban areas, compared with rural areas.[38] In addition to improved access to food, nutritional improvements in urban areas are tied to better access to clean water, sanitation and health care, as well as to the higher levels of education of urban mothers.[39]

Access to clean water and improved sanitation: When pathogens enter the body through unclean food or drinking water, or through dirty hands or improper hygiene, individuals can easily develop intestinal problems such as diarrhea. In such cases, the body is unable to absorb nutrients and even a healthy diet cannot prevent malnutrition.

Figure 3.4 Share of population lacking access to improved sources of drinking water, 2015 (percentage)

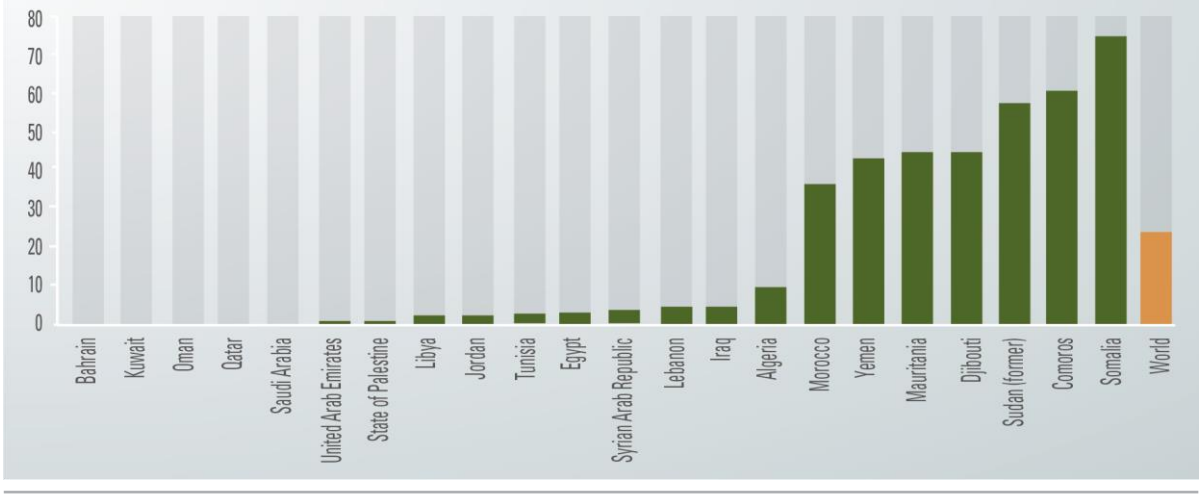


Sources: WHO-UNICEF Joint Monitoring Programme (JMP); WHO and UNICEF, 2017.
Note: Improved includes: SAFELY MANAGED (drinking water from an improved water source which is located on premises, available when needed and free from faecal and priority chemical contamination), BASIC (drinking water from an improved source, provided collection time is not more than 30 minutes for a roundtrip including queuing) and LIMITED (drinking water from an improved source for which collection time exceeds 30 minutes for a roundtrip including queuing). Unimproved includes: UNIMPROVED (drinking water from an unprotected dug well or unprotected spring) and SURFACE WATER (drinking water directly from a river, dam, lake, pond, stream, canal or irrigation canal). Improved sources include: piped water, boreholes or tube wells, protected dug wells, protected springs and packaged or delivered water.

The proportion of the population with access to clean drinking water has improved over time, but remains below the global average of 91 per cent as of 2015 (figure 3.4). Although progress was made in most of the region, improvement in access did not keep pace with population growth in the LDC subregion. Moreover, this indicator fails to tell the complete story, as many of those with access to improved water sources receive the service only intermittently, posing the threat of water contamination in storage facilities at homes or through the use of supplementary drinking water of questionable quality. Access to water is complicated by conflict and occupation, including through restricted access to wells.[40] Access to improved sources of sanitation is similarly crucial for preventing the spread of diseases that compromise good health (figure 3.5).

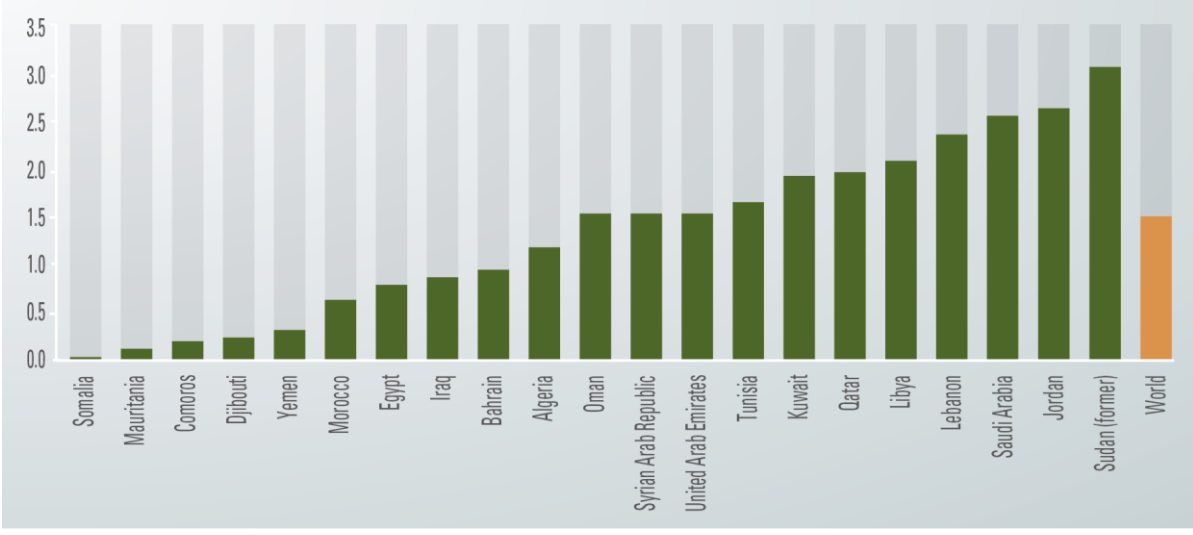
Access to health care: Food insecurity is associated with inadequate access to health care in a vicious cycle of causality. On the one hand, inadequate access to health care can lead to food insecurity, as many aspects of malnutrition are easily addressed through basic health care, with diarrhea being an obvious example of a medical problem which, when left untreated, can lead to malnutrition. On the other hand, food insecurity causes a myriad of both acute and chronic health problems. Among pregnant women, food insecurity is associated with iron deficiency anemia, depression, anxiety and excess weight gain. Infants born to food insecure mothers are smaller and sicker and have an increased risk of certain birth defects. Among children, food insecurity harms long-term physical and mental development, and can lead to cognitive impairment. Food insecure adults are more likely to be diagnosed with diabetes, hypertension and high blood pressure.

Figure 3.5 Share of population lacking access to improved sanitation, 2015 (percentage)



Sources: WHO-UNICEF JMP; WHO and UNICEF, 2017.
Note: Improved includes: SAFELY MANAGED (use of improved facilities which are not shared with other households and where excreta are safely disposed of in situ or transported and treated off-site), BASIC (use of improved facilities which are not shared with other households) and LIMITED (use of improved facilities shared between two or more households). Unimproved includes: UNIMPROVED (use of pit latrines without a slab or platform, hanging latrines or bucket latrines) and OPEN DEFECATION (disposal of human faeces in fields, forests, bushes, open bodies of water, beaches and other open spaces or with solid waste). Improved facilities include: flush/pour flush to piped sewer system, septic tanks or pit latrines; ventilated improved pit latrines, composting toilets or pit latrines with slabs.

Figure 3.6 Access to health care – number of doctors (per 1,000 population), 2014



Source: WHO, 2017a.
Note: Data for Algeria is from 2007, for the Comoros from 2004, for Mauritania from 2009 and for the World data from 2012.

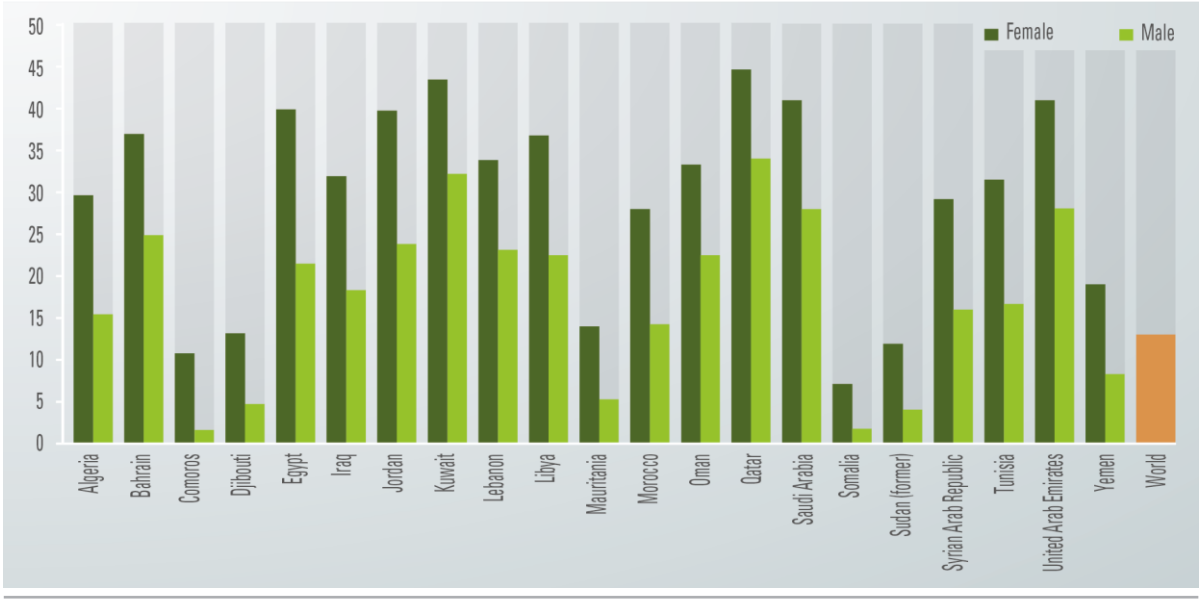
In general, access to health care is considered good in the Arab region. Figure 3.6 shows one measure of access to health care: the number of doctors per 1,000 population. Most of countries in the region are above the world average of 1.5 per 1,000 population. There exist, however, wide variations among countries. Several of those with the poorest access to health care are also those with the greatest challenges in other aspects of food security.

D. Obesity rates in the Arab region are among the highest in the world

Although urbanization has allowed for an improved nutritional status, some of the lifestyle and consumption patterns associated with urbanization have also led to overweight and obesity. Obesity in the Arab region is among the highest in the world, with nearly one quarter of the population being obese (figure 3.7). This is double the world average, slightly above the prevalence in developed countries and nearly three times that in developing countries as a whole.[41] Within the Arab region, the GCC countries have the highest prevalence of obesity, averaging 33 per cent (ranging from 27 per cent for Oman to a staggering 37 per cent for Kuwait and Qatar), followed closely behind by the Mashreq at about 28 per cent (largely on account of Egypt at 30 per cent), the Maghreb with 23 per cent (ranging from 21 per cent for Morocco to 29 per cent for Libya), and finally the LDCs of the region with an obesity rate of about 9 per cent (ranging from 4.5 per cent for Somalia to 14 per cent for Yemen).

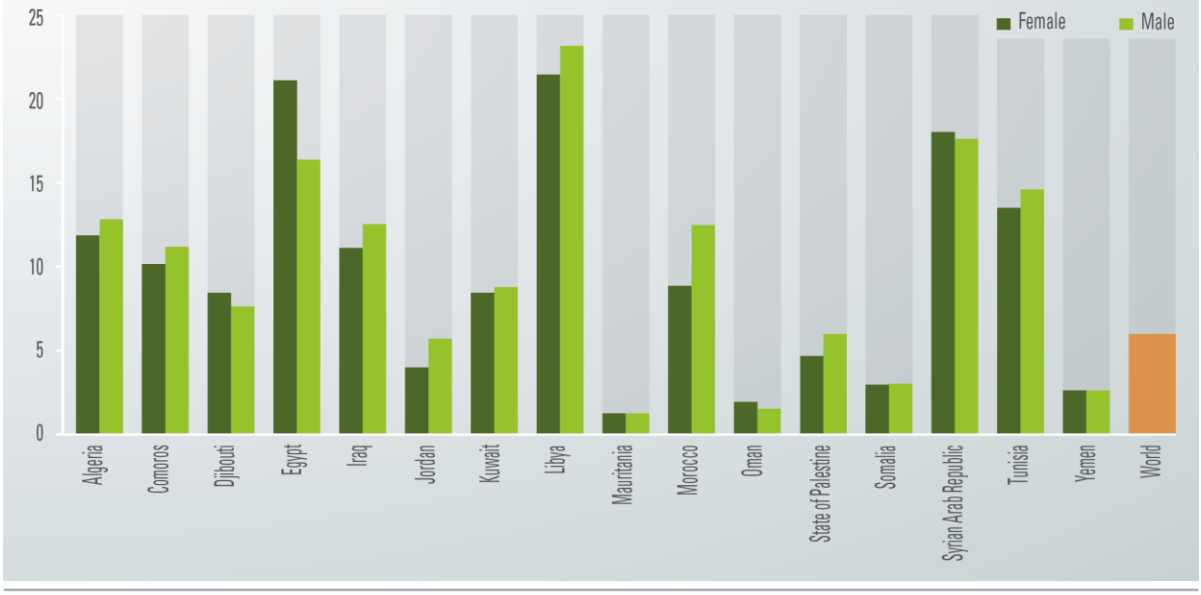
The specific causes of obesity include increased intake of energy-dense and convenience foods as well as decreased physical activity.[42] Obesity can lead to a variety of disabilities and diseases, such as diabetes and cardiovascular diseases (high blood pressure, high blood cholesterol and other lipid disorders), osteoarthritis and an increased risk of cancer of the breast, colon, prostate, endometrium, kidney and gall bladder.[43]

Figure 3.7 Adult obesity by gender, 2014 (percentage)



Sources: Compiled by ESCWA, based on data from WHO; WHO, 2017b; WHO, 2017c.

Figure 3.8 Prevalence of overweight among children under 5 (based on weight for height, percentage of children under 5)



Sources: World Development Indicators; World Bank, 2014.
Note: Data for Algeria, the Comoros, Djibouti, Jordan, Mauritania and Tunisia is from 2012; for Iraq and Morocco, data is from 2011; for Kuwait, data is from 2014; for Libya, data is from 2007; for Oman, Somalia and the Syrian Arab Republic, data is from 2009; for Palestine, data is from 2010; for Yemen, data is from 2013; for Egypt, data for females is from 2008, and for males from 2014. World data is from 2016 and is not disaggregated by sex.

As is the case globally, also in the Arab region, the obesity rates of women are generally higher than those of men, with an average prevalence of 30 per cent for women compared to about 17 per cent for men relative to the region's female and male populations. It may be noted that in the poorest countries of the region, the gender obesity gap is greater. In the Comoros, for example, women are five times more likely to be obese than men. Noteworthy is the fact that these gender differences emerge with age, as young girls are not generally more likely to be overweight than young boys (figure 3.8). The emergence of a gender gap with age is likely due to several factors, including insufficient time for women to return to normal body weight between pregnancies.

Identifying the causes of obesity is important in the search for preventive measures. Fundamentally, obesity is the result of an energy imbalance between calories consumed and calories expended. Changing lifestyles everywhere in the world have resulted in increased intakes of energy-dense and convenience foods that are high in fat, and a reduction in physical activity due to increasingly sedentary behaviours both at work and at home. In identifying the underlying factors for these trends, studies from developed countries have pointed, inter alia, to (a) supply-side factors, including the changing roles of industries that supply lifestyle commodities, increasingly sophisticated use of promotion and persuasion methods to entice consumption, and changes in productivity dynamics that have changed relative prices in favour of processed food products; (b) government policies, including subsidies and taxation affecting the prices of food commodities, public transportation policies which have in some cases encouraged the use of private cars, urban planning policies without the provision of facilities for physical activity and other infrastructure that promotes healthy lifestyles; and (c) changes in working conditions, including decreased physical activity at work due to changes in the nature of human activity, greater work-related stress, job insecurity and longer working hours.[44]

While the above identified factors responsible for increased obesity are based on evidence from OECD countries, they are increasingly applicable to many countries in the Arab region. Of particular relevance is the role of government policies, especially untargeted subsidies of food commodities. In fact, for some countries in the Arab region, food subsidies are seen as primarily responsible for increasing obesity.

E. Nutrition education and incentives are essential for food security

Beyond increasing access to food for the poor, many malnutrition problems in the region (even for people who have enough to eat) are due to a lack of nutrition education. Consumers ultimately determine what they eat, but nutritional information-related government interventions, aimed at increasing consumers' knowledge of what constitutes a good diet, can help consumers make healthier dietary choices. The ultimate goal of such campaigns is a change in behaviour, with individuals choosing more nutritious diets and healthier lifestyles. Such programmes may include, inter alia, elements of nutrition training, public information campaigns and the regulation of advertising and labelling.

Public information campaigns can communicate in simple terms what constitutes an adequate and nutritious diet, thereby simplifying the

technical information provided by nutritionists in a way that is intelligible to the general public. FAO and WHO have been promoting the use of such guidelines since the International Conference on Nutrition in 1992. These have evolved to include not only nutrition concerns, but also food safety and recommendations concerning physical activity.

A pertinent aspect of nutrition education is that of programmes directed specifically at women (mothers), with an emphasis on micronutrient deficiencies and dietary diversity. Nutrition education in schools is effective in addressing problems of overweight and obesity, especially when combined with school-feeding programmes aimed at improving the diversity and nutritional quality of diets. Nutrition education in schools could also be instrumental in laying the foundations for good lifelong eating and exercise habits among the students.

There is also scope for considering incentive and disincentive measures to reduce malnutrition. Incentive measures to encourage the consumption of certain foods have taken the form of generalized subsidies, as discussed above, which are generally focussed on energy-rich staple foods. Much less common have been subsidies or other incentive measures to encourage the consumption of a more diverse basket of foods, including desirable food items such as fruits and vegetables, or taxes to discourage the consumption of bad foods, such as sugar-sweetened beverages. The lack of balance between incentive and disincentive measures has been partly responsible for increasing the prevalence of overweight and obesity in some countries of the region. Thus, in their efforts to address malnutrition, especially that leading to overweight and obesity, the countries of the region could also consider the option of introducing appropriate disincentive measures.

Part Two

Selected Thematic Issues

Part I of this publication provided an overview of food security in the Arab region, including the complex linkages between geoclimatic, economic, social, political and biological factors.

Part II analyses selected thematic issues, namely, agriculture, international food trade, and food loss and waste. The chapter on agriculture analyses the importance of agriculture for livelihoods and prospects for improving yields, as well as the geoclimatic factors that limit sustainable self-sufficiency in food. The chapter on trade describes the region's increasing reliance on food imports, identifies the conditions under which such reliance creates challenges for the stability of food security, and provides policy options for mitigating trade-related risks. The chapter on food loss and waste introduces an emerging area of focus in food security, describing the concepts, estimating the magnitude of the problem, and presenting a range of innovative approaches already being used. Part II then expands on these themes by modelling alternative future scenarios, including the likely consequences of business as usual and of several approaches to improving food security.

4. Continued Important Role of Domestic Agriculture

4. Continued Important Role of Domestic Agriculture

A. Agriculture plays a dual role in food security

Agriculture plays an important role in food security in many Arab countries, in terms of its contribution both to national level availability and to household-level access.

Rural areas and agriculture remain very important in most Arab countries, and 38 per cent of the region's households are still engaged in farming, ranging from under 5 per cent in GCC countries to over 50 per cent in the Sudan. In the poorest nations of the region, namely Mauritania, the Sudan and Yemen, rural poverty is chronic and widespread. Elsewhere, rural poverty mainly affects three high-risk categories, which are households headed by women, the landless and farm labourers.[45]

Agriculture's share of the region's economies has been declining, but the sector is still growing in absolute terms. Overall, agriculture contributes 7 per cent to the regional GDP, ranging from less than 2 per cent in most GCC countries to around 40 per cent in the Sudan.[46] Growth has been largely in higher-value crops. Food production, measured in metric tons, has been stagnant in many food commodities. Even in the commodities for which there have been significant increases in production, those increases did not keep pace with increases in domestic consumption.

The region's farming systems are diverse, varying by geography, climate and natural resource endowments, and include rain-fed and irrigated crops, livestock and fisheries. Rain-fed farming systems are still predominant in many countries, covering more than two thirds of the region's cultivated land. As precipitation falls over most of the Maghreb and Mashreq in winter, rain-fed crops are grown in the winter months, maturing for harvest generally in spring and early summer. The main rain-fed crops are wheat, barley, legumes, olives, grapes, as well as some fruits and vegetables.

Irrigated agriculture is market-oriented and commercialized. Although irrigated systems occupy less than one third of the cultivated area, they contribute almost half of the agricultural value. Irrigated areas are cultivated all year round, with peak demand for irrigation water during the dry summer months. Although cereals are widely cultivated across both rain-fed and irrigated systems, a wide range of higher-value crops is also grown. Fresh fruit and vegetable production accounts for about 10 per cent of the cropped area region-wide, with a significantly higher share in countries practicing intensive irrigated agriculture.

Livestock are integrated in farming systems, and extensive pastoral systems are practiced across the region's more arid zones, where cropping is not possible. Pastoral production is the most important farming activity throughout the

semi-arid and arid rangelands of the region, making use of the scarce feed in the predominantly arid lands to convert them into nutritionally and economically valuable products. There is also a substantial modern livestock sector, with intensive and semi-intensive production of meat, poultry and milk. As production of fodder and feed are heavily constrained by limited water resources, this sector is strongly reliant on feed imports, estimated at $10.4 billion in 2012.[47]

Fisheries and aquaculture make a significant contribution to food security and the livelihoods of millions of people along the seashores and waterways of Arab countries. Collectively, Arab countries have more than 23,000 km of shoreline and access to two oceans, three major seas and adjacent gulfs. The region also has 16,600 km of rivers, fresh and brackish water lakes and reservoirs. In 2013, its total fish production was estimated at 4.1 million tons, 2.9 million tons from capture and 1.2 million tons from aquaculture. Particularly important both for the incomes of the poor and for production are the small and rural or artisanal fishermen and fish farmers who contribute consistently to the seafood supply chain, but do not have the capability to optimize their farming or fish catch.[48]

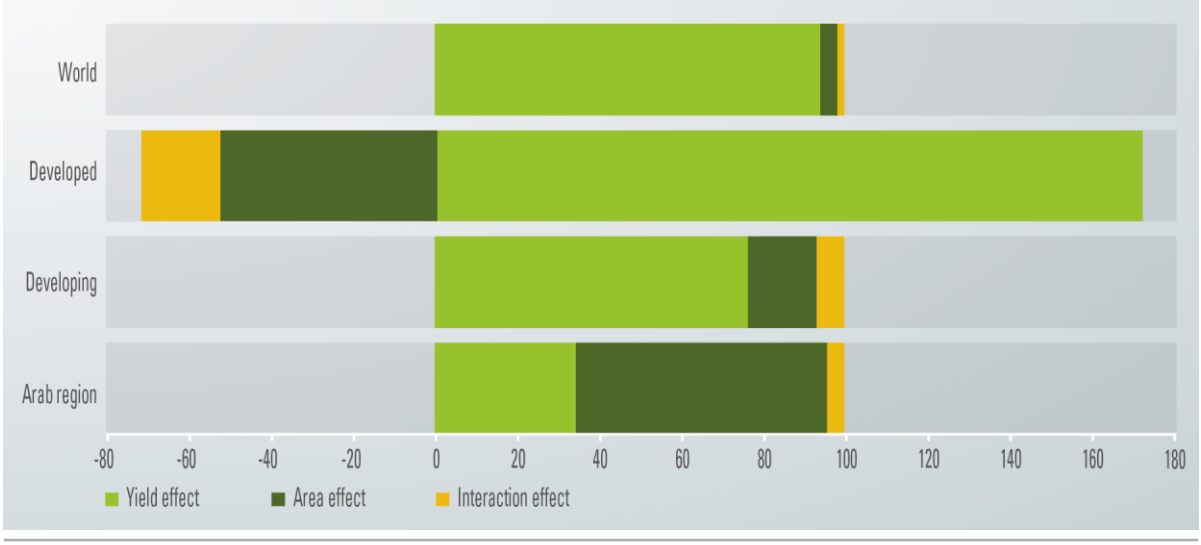
B. Cereal yields are stagnating in most parts of the region

National production of basic foodstuffs is a function of the extent of land farmed and of the yield obtained. Historically, everywhere in the world, expansion of food production has come first from increasing the area under cultivation (extensivity), followed by increasing productivity (intensivity), as areas suitable for cultivation became scarce. Figure 4.1 deconstructs the contribution of changes in area and yield to cereal production in various regions of the world.[49] Whereas, in the recent past, increases in yields have been the dominant force behind increases in production in other parts of the world, this has not been the case in the Arab region. During the 20-year period between 1990-1996 and 2010-2016, increases in area under cultivation contributed only negligibly to the growth of global cereal production, while the bulk of additional output (95 per cent) has come from increases in yield. In dramatic contrast, two thirds of the increased cereal production in the Arab region is attributed to expansion in the area cultivated, with only a third coming from improvements in yield.[50]

Figure 4.2 shows improvements in yield over time, going back to 1980. These figures are consistent with the relatively low yield increases in the Arab region, and show that regional differences in productivity trends have continued over a long period of time.

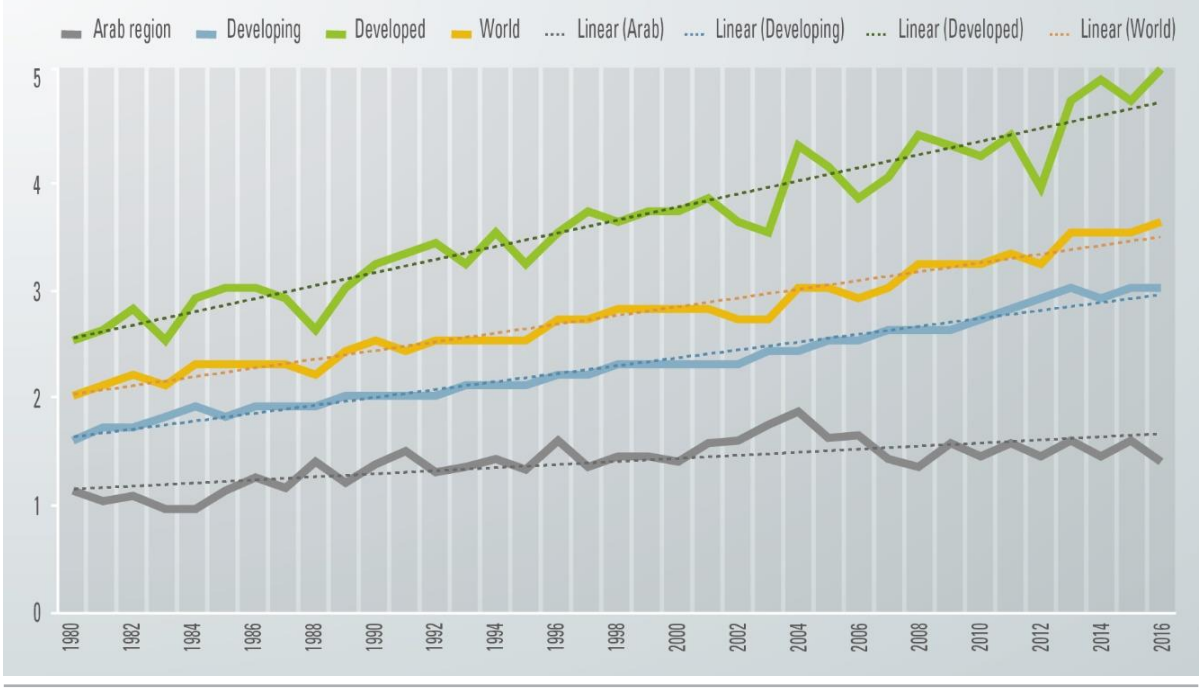
There are important differences in yield trends among the Arab subregions (figure 4.3). The Mashreq, which accounts for the bulk of the area devoted to cereal production in the region and harvests the lion's share of cereal output, has achieved yields consistently much higher than those of the other subregions. However, this performance is due specifically to Egypt, as the Mashreq without Egypt achieves much lower yields, similar to those of the other subregions. The most worrying case in the Arab region is that of the LDCs where, as underlined previously, yields have stagnated and even declined over the past decade. The experience of the GCC countries is also noteworthy. The pattern for the GCC countries is largely due to the adoption, and subsequent rejection, by Saudi Arabia of an expensive and environmentally unsustainable reliance on underground fossil water supplies.

Figure 4.1 Area and yield contribution to cereal production increases from 1990-1996 to 2010-2016 (percentage)



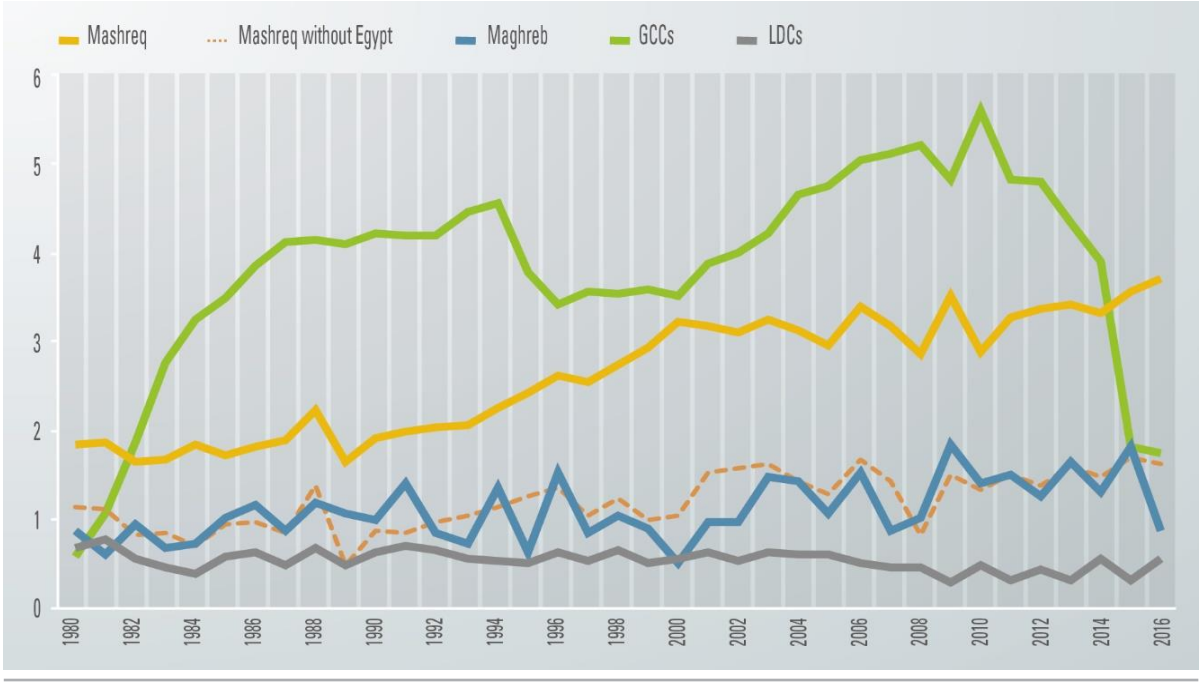
Source: Based on data from FAO GIEWS, 2017a.

Figure 4.2 Comparisons of regional trends in cereal yields (ton/ha)



Source: Based on data from FAO GIEWS, 2017a.

Figure 4.3 Trends in cereal yields by Arab subregion (ton/ha)



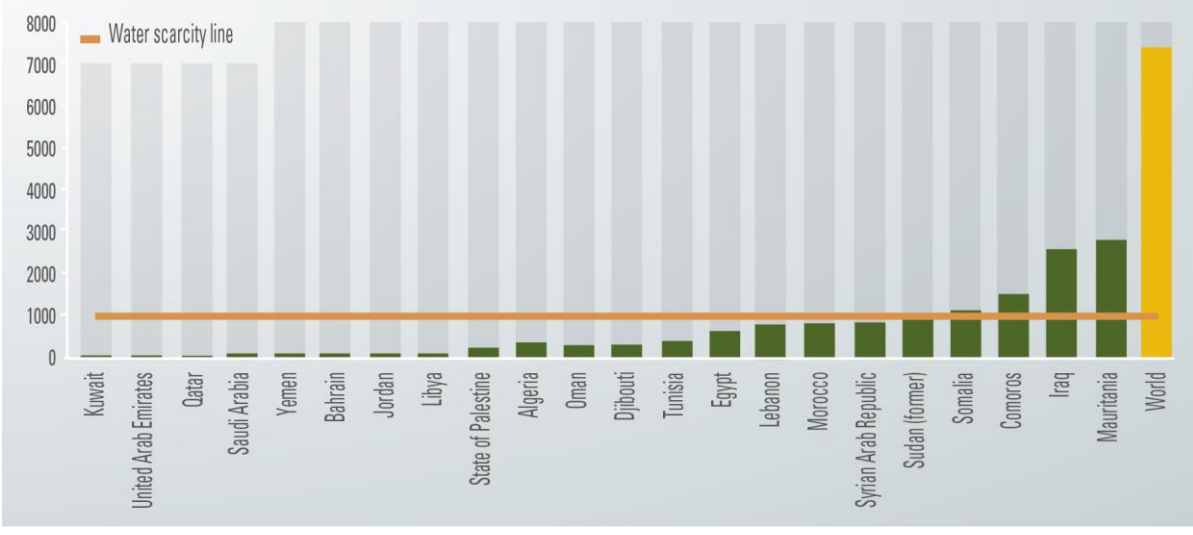
Source: Based on data from FAO GIEWS, 2017a.

C. The region faces natural resource limitations which are exacerbated by climate change

The Arab region is the most water-scarce in the world, with most countries falling below the generally accepted water scarcity line of 1,000 m^3 per capita per annum of renewable water resources (figure 4.4).[51] All Arab countries use most of their water for agriculture (table 4.1). This reflects the historic and contemporary importance of the agricultural sector and of food production, but in most countries, the fast-rising demand from other sectors is resulting in calls for water to be transferred out of agriculture. Some argue that there is an economic case to be made for transferring water out of agriculture and into higher-value municipal and industrial uses. Others cite the importance of agriculture for the income of the poorest and to protect against risks connected to global food markets. But all agree on the priority of improving management for optimal allocation and efficient use, environmental protection to prevent degradation, and adaptation to climate change.

Of the total land area of Arab countries (around 1.3 billion hectares), about 500 million hectares are arable. However, only 100 million hectares have medium or highly productive soils (map 4.1). In the Sudan, 17 per cent of the land area is considered to have high productivity. Jordan has no highly productive land, but has 60 per cent of its land area categorized as of medium productivity. At the other end of the spectrum, almost 80 per cent of Djibouti is non-arable. With the rapid rate of urbanization in the region, significant quantities of arable land are being lost to construction.[52]

Figure 4.4 Annual per capita renewable water (cubic metres)



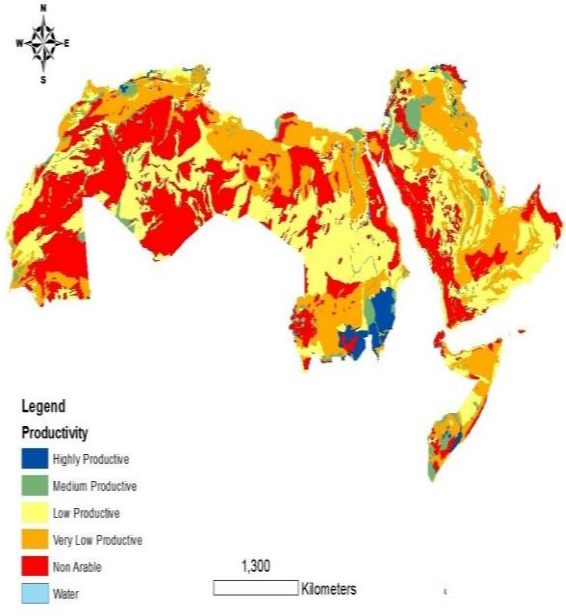
Sources: Population data is from United Nations, 2017; water data is from FAO, 2012.

Table 4.1 Shares of water by sector in selected Arab countries

Country	Percentage withdrawn by sector		
	Agriculture	Domestic	Industry
Yemen	95	4	1
Syrian Arab Republic	95	3	2
Iraq	92	3	5
Oman	90	8	2
Morocco	87	10	3
Egypt	86	8	6
Saudi Arabia	86	10	3
Libya	83	14	3
Tunisia	82	14	4
Jordan	75	21	4
Lebanon	67	33	1
Algeria	65	22	13

Source: Based on data from FAO, 2012.
Note: Withdrawal for agriculture is defined as the annual quantity of self-supplied water withdrawn for irrigation, livestock and aquaculture purposes. It can include water from primary renewable and secondary freshwater resources, as well as water from overabstraction of renewable groundwater or withdrawal from fossil groundwater, direct use of agricultural drainage water, direct use of (treated) wastewater, and desalinated water. Water for the dairy and meat industries and industrial processing of harvested agricultural products is included under industrial water withdrawal.

Map 4.1 Land capability map of the Arab region



Source: Produced using the United States Department of Agriculture model and soil information of the Digital Soil Map of the World. FAO, 2007.

Box 4.1 Examples of ongoing activities in the Arab region addressing land quality constraints

Zero tillage: Tilling has several effects on the soil that can be problematic in the context of poor land quality. Tilling can cause loss of organic matter, increased evaporation and increased vulnerability to water and wind erosion. Eliminating or minimizing tilling solves these problems. In particular, leaving the roots from previous crops protects against erosion by stabilizing the soil, while the stubble increases soil fertility and improves water holding capacity by adding organic matter. The principle approach to zero tillage involves the use of seed drills to plant and fertilize directly into unploughed soil. At about $30,000 each, imported seed drills are prohibitively expensive for smallholder farmers. A recent project by the International Centre for Agricultural Research in the Dry Areas (ICARDA) has resolved this problem by working with local farmers and craftsmen to produce and distribute almost 200 affordable seed drills, which are being used across Algeria, Iraq, Jordan, Lebanon, Morocco, the Syrian Arab Republic and Tunisia.

Soil maps: Soil data is vital to policymakers and farmers alike, but it is often outdated, of low resolution and not readily intelligible outside of academic audiences. The Amman-based Institute for 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 can be obtained from remote sensing (near-and mid-infrared spectroscopy) and field sampling. Moreover, this initiative can make use of the Global Soil Partnership system of the International Network of Soil Information Institutes.

Source: ICARDA, 2017b.

Much of the region's soil suffers from severe, ongoing degradation: in some Arab countries, the reduction in soil productivity has been estimated to be in the range of 30 to 35 per cent of potential productivity. Types and causes of degradation differ by farming system. For rain-fed systems, the primary causes are water and wind erosion. Of the region's 30 million hectares of rain-fed cropland, nearly three quarters (22 million hectares, 73 per cent) are estimated to be degraded. Recent studies have estimated the economic cost of land degradation in the region at a massive $9 billion each year (between 2 and 7 per cent of individual countries' GDP). For irrigated land, farming practices themselves are the primary cause of degradation, in the form of salinity and sodicity.[53] Losses from salinity alone across the region are estimated at $1 billion annually, equivalent to between $1,600 and $2,750 per hectare of affected land.[54]

Farmers across the region have found ways to adapt to the low quality of land and overcome the soil-limiting factors restricting crop yield and food production. In several cases, land conservation policies, programmes and incentive frameworks have succeeded in establishing sustainable management for currently cultivated lands to prevent erosion, urban expansion and soil salinity hazards. The technical methods depend on the specific land quality problem. Sandy soils are usually classified in the lowest productivity group, though they can often be cultivated if adequately cropped and properly irrigated. Low water holding capacity can be improved by organic matter, compost or polymer addition, and localized irrigation. High pH values can be treated with diluted acid additions to the irrigation water in modern pressurized irrigation systems. Salinity problems can be overcome with positive water balance and improved drainage to leach and evacuate the salts. Sodicity can be managed through chemical treatment and drainage. The use of cover crops can protect soil from the splashing effect of

rainfall, in addition to improving soil fertility by fixing nitrogen from the air and attracting small ruminants. Box 4.1 showcases several examples of ongoing activities in the Arab region that have been successfully addressing land quality constraints.

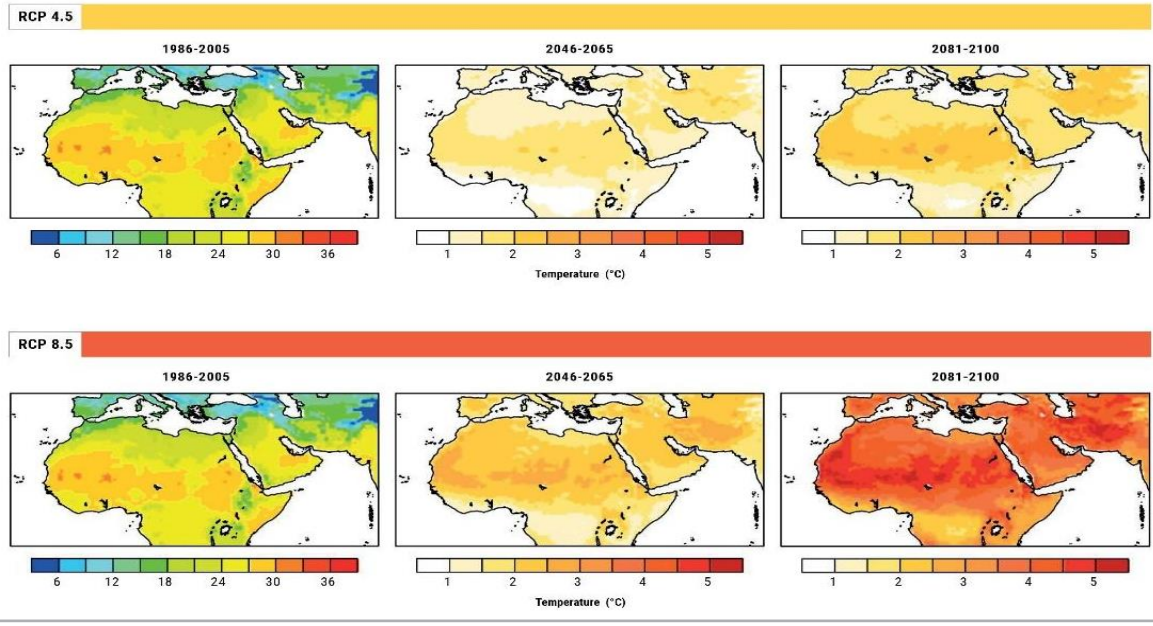
Issues of land quality are closely intertwined with issues of water. It is clear, for example, from the previous discussion that poor irrigation practices can lead to salinity and sodicity, but that these quality problems can be reversed with improved practices. Furthermore, as described above, low water holding problems can be addressed by the addition of organic matter, and proper irrigation can help make even sandy soils productive.

Any forward-looking approach to agricultural production and productivity will need to address climate change. Climate change is an especially pressing issue for the predominantly dry countries of the region, which are already prone to frequent droughts and a looming water supply shortage. Over the last century, the Arab region has experienced an increase in mean temperatures of up to 0.5°C. In some countries, such as the Sudan and parts of North Africa, precipitation has decreased by up to 10 per cent in recent decades. Most of the region is expected to become hotter and drier in the future due to climate change. Simulation models indicate that average yearly rainfall could decrease by 10 per cent in the next 50 years.[55] With higher temperatures (causing increased evaporation) and reduced precipitation, loss of surface water would be accelerated and droughts would become more frequent. The already low average yields of rain-fed crops would decline and be more variable. Agricultural output could decrease by 21 per cent by 2080.[56] All farming systems will be exposed to increased aridity and declines in water availability, with rain-fed systems being most at risk.[57] The yields of some crops could decline by up to 30 per cent in some areas as a result of increased temperatures.[58]

The results of climate simulations, for a recent regional study on the impacts of climate change on water resources and other socioeconomic sectors, project that temperatures will rise throughout the Arab region during this century. The general change in temperature for the moderate emission scenario of the Representative Concentration Pathways (RCP), namely RCP 4.5, shows an increase range of 1.2°C-1.9°C at mid-century, and 1.5°C-2.3°C by the end of the century. For the high emission scenario of RCP 8.5, temperatures are projected to increase to between 1.7°C and 2.6°C for the middle of the century and between 3.2°C and 4.8°C by the end of the century (map 4.2).

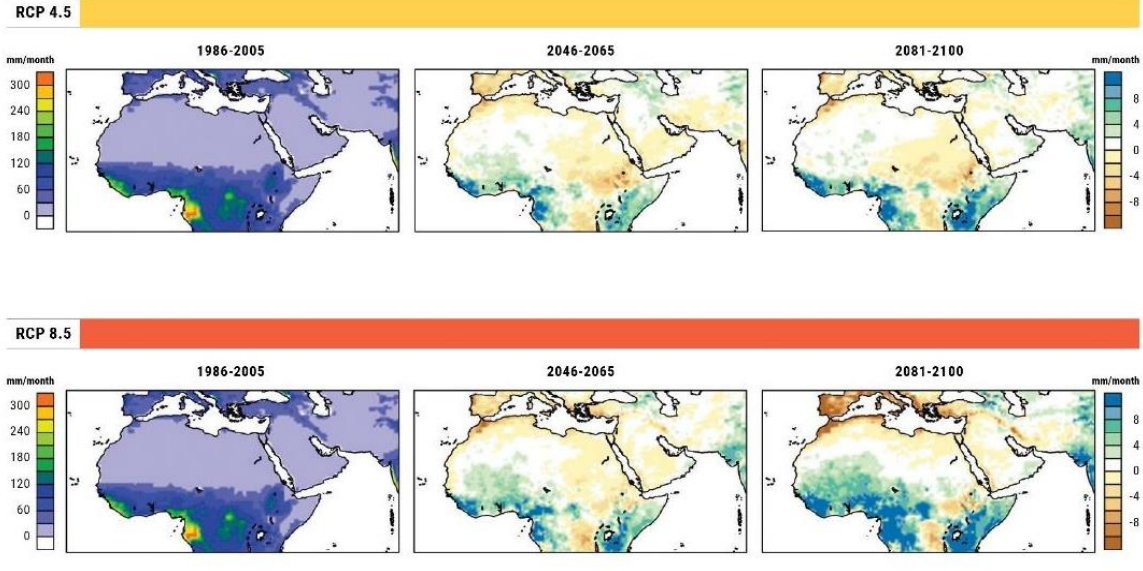
Simulation results show that precipitation changes vary considerably across the Arab region. Decreasing trends can be seen in most of the Arab region at mid-century. By the end of the century, the results from both moderate and high emission scenarios (RCP 4.5 and RCP 8.5) suggest a reduction in average monthly precipitation of 8-10 mm in the coastal areas of the Arab region, mainly around the Atlas mountains in the west and upper Euphrates and Tigris rivers in the east (map 4.2). Regarding precipitation extremes, there is significant variation across the region. Projections for dry spells suggest a trend towards drier conditions, with an increase in the number of consecutive dry days, particularly for the Mediterranean, as well as the western and northern parts of the Arabian Peninsula by the end of the century.

Map 4.2 Mean change in annual temperature (°C) for middle and end of century for an ensemble of three RCP 4.5 and RCP 8.5 projections compared to the reference period



Source: ESCWA and others, 2017.

Map 4.3 Mean change in annual precipitation (mm/month) for middle and end of century for an ensemble of three RCP 4.5 and RCP 8.5 projections compared to the reference period



Source: ESCWA and others, 2017.

As regards the impact of climate change on cropping systems in the Arab region, the study concludes that the areas containing the most productive soils are more vulnerable to climate change under the two emission scenarios (RCP 4.5 and RCP 8.5), with vulnerability increasing under the higher emission scenario and towards the end of the century. Consequently, most cereals cultivated in the region, particularly wheat and sorghum, were found to be highly vulnerable to climate change, as the majority of their cultivation areas fall under the two classes of highest vulnerability. It was concluded that wheat, sorghum and olive trees would experience yield reductions under both moderate and high emission scenarios.

Hotspot maps, derived from the climate change vulnerability assessment of the livestock sector, show that the potential impacts are mainly related to declining water and feed resources, due to recurrent droughts, degradation of rangelands and desertification. The most vulnerable areas are located along the Nile valley, the Horn of Africa and the south-western Arabian Peninsula, followed, to a lesser extent, by areas located in the Fertile Crescent and North Africa.[59]

The anticipated changes highlighted in these studies are expected to affect different farming systems in different ways (table 4.2). As aridity will increase and water is the binding constraint to agriculture in the region, governments will need to evaluate trade-offs between supporting climate change responses in agriculture and preparing parts of the rural economy for transition away from agriculture, including off-farm income.

Table 4.2 Climate change impact on farming systems of the Arab region

Farming system	Exposure: What climate change-related events will occur	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 • Salinization 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	• High vulnerability 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	• High vulnerability: desertification may reduce carrying capacity significantly • Non-farm activities, exit from farming, migration

Source: World Bank, 2013.

D. Low yields in rain-fed farming while irrigated farming is often environmentally unsustainable

To a large extent, existing differences in productivity among Arab countries are driven by differences in reliance on rain-fed versus irrigated farming systems. Rain-fed farming systems still predominate in the Maghreb, the Mashreq (other than Egypt) and the LDCs, covering more than two thirds of the region's cultivated land and providing livelihoods for nearly two thirds of the agricultural population region-wide.[60] In Algeria, Iraq, Jordan, Lebanon, Libya, Mauritania, Morocco, the Sudan, the Syrian Arab Republic, Tunisia and Yemen, rain-fed agriculture is practiced on more than half of all arable land.[61]

The biggest constraint and risk in rain-fed farming is ensuring that adequate soil moisture is available to the plant roots during the growing season. Rain-fed farmers face the challenge of unpredictable rainfall and consequent stress on plants due to inadequate soil moisture. This risk is growing with the rising variability and aridity brought by climate change. An effective approach to addressing unpredictable rainfall is water harvesting, in which farmers collect rainwater from outside their fields and then convey this water to their crops when needed. It is essentially a form of supplementary irrigation which can boost yields by two to three times over conventional rain-fed agriculture. Rainwater harvesting technologies range from basic field structures that divert water to planting pits, through more complex structures within the catchment area to divert run-off to storage or run-on to fields, to more permanent systems of terraces and dams. The historical terrace systems of the highlands of Oman and Yemen, which date back at least 3,000 years, are legendary examples of rainwater harvesting. More recently, low cost approaches to water harvesting have been developed in the Jordanian and Syrian Badia, a region with mostly semi-arid rangeland, with support from international and regional funding agencies. Other solutions to conserving and enhancing soil moisture include mulching, soil contouring, bunding and windbreaks. The cost and the accuracy of land contouring have been dramatically improved using a modified, low-cost portable laser-guided system with a tractor-mounted receiver and guidance controller.[62] Agronomic measures that further enhance the yield of rain-fed farming include selecting drought-tolerant crops or varieties, choosing shorter-cycle varieties, and adapting planting dates, among others.

Where water is unpredictable, soil fertility is absolutely essential: for soils that are naturally poor in nutrients or are degraded, maintaining and enhancing soil texture and fertility will improve crop water productivity. The most widespread response in the region has been to step up fertilizer use, although with wide variations among the different countries.[63] Despite the importance of rain-fed agricultural systems, there has never been a rain-fed 'Green Revolution' and, in many Arab countries, agricultural incentive structures have disfavoured research and investment in rain-fed systems, focusing instead on commercial and irrigated production.

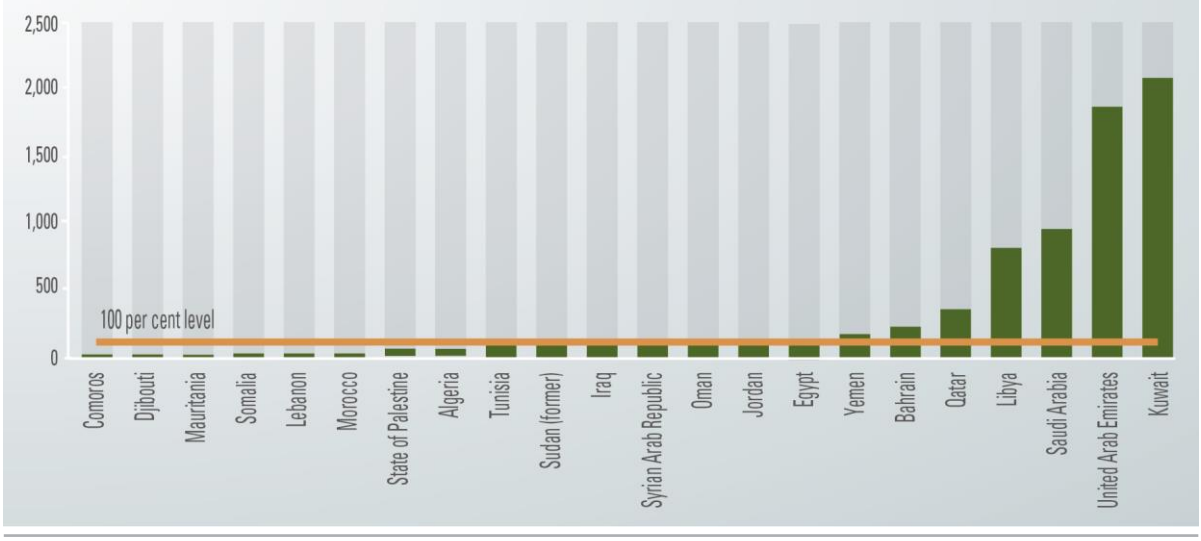
Whereas countries in the region that rely on rain-fed systems have generally low productivity, those that focus on irrigated farming systems have yields that are higher than the global average. Irrigated systems occupy less than one third of the region's cultivated area, but contribute almost half of its agricultural value, thanks to the focus on high-value added commercial crops and generally

efficient irrigation systems that result in relatively high yields.[64] Some countries are exceptionally high performers. For example, Egypt's productivity per hectare is three times the regional average.[65]

The region's irrigated agriculture has traditionally relied on the diversion of water from rivers, streams and springs. Since the introduction of the tubewell 50 years ago, however, the groundwater boom has revolutionized agriculture across the Arab region, driving the rapid growth of commercial and export-oriented high-value agriculture. Today, seven of the world's top twenty groundwater-irrigating countries are in the region. There are many reasons why groundwater development and abstraction have proved very popular with farmers throughout the region, as they have worldwide. The most important of these is its just-in-time availability close to the field. Groundwater also plays a key buffer role in maintaining optimal soil moisture during dry spells, and this role will grow with increasing climatic variability.

The key challenge of groundwater-irrigated farming systems is sustainability. Groundwater overuse has resulted in the depletion, deterioration and destruction of aquifers. Several countries in the region withdraw more than 100 per cent of their renewable water resources (figure 4.5). As described earlier, the apparently impressive yield performance of the GCC countries is mainly due to the resource-intensive and expensive production systems used in those countries, based on depleting underground fossil water supplies. However, as underground water supplies were progressively exhausted, Saudi Arabia adopted in 2008 a major shift in policy and decided to phase out all wheat production within eight years.[66] Wheat production has plummeted since then, and the country has been relying exclusively on imports since 2016.

Figure 4.5 Water withdrawal as a share of renewable water resources (percentage)



Source: AQUASTAT. FAO, 2012.
Note: The reference line is drawn at 100 per cent. Data presented is not for the same time reference across all countries, but ranges between 2000 and 2012.

E. Increased attention to water policy is key to the future of agriculture in the region

In many contexts, the sustainability challenges associated with irrigation can be mitigated by increasing efficiency. The management of irrigation occurs at two levels: water service to the field and in-field water management. Water service to the field, which applies mainly to surface irrigation schemes delivering water to many farmers, has been shown by FAO studies to be more efficient in the Arab region than the global average.[67] Nevertheless, further efficiency gains in water service to the field as well as in-field management will be required if agriculture is to continue to grow in the water-scarce Arab region.

There are several ways to assess relevant aspects of efficiency and a wide range of technical approaches available. A commonly used measure of efficiency is the proportion of water that contributes to plant growth, referred to as water-use efficiency. Even in countries with generally efficient systems, there remains much scope for improvement, as indicated by the large variations recorded, even among neighbouring farmers. In a large-scale study in Doukkala, Morocco, all farmers in a 110,000-hectare area were given the same quantity of water.[68] Although average yields across the area were excellent, yield gaps within the area were still large. For wheat, the area's average yield was twice the national average. However, the average yield of all farmers was 33 per cent below the best yields obtained on the scheme. All farmers essentially farmed in the same way, the difference was water management: the farmers with the highest yields had invested in reservoirs to store water so that it could be used when needed; others had invested in pressurized irrigation; and some had simply followed extension advice for irrigation scheduling. For maize, the area's average yield was four times the national average, while the gap between the best and the average yield obtained within the area was even larger than for wheat, at 44 per cent.

Water-use efficiency can approach 100 per cent in greenhouse environments. The more stable, controlled environment of greenhouses allows for a more targeted use of fertilizers, dramatically reduces evaporation of irrigation water, and makes pest and disease control far easier. In a project by the International Centre for Agricultural Research in the Dry Areas (ICARDA) in Oman, low-cost greenhouses were fabricated, erected and operated on marginal lands, and farmers were able to achieve yield improvements of 60 per cent.[69] Taken a step further, controlled environments can be designed for hydroponic farming. Hydroponic farming typically involves suspending the root systems of plants directly in water. Nutrients are added to the water and aeration is used to ensure oxygen availability. In many cases, hydroponic farming is prohibitively expensive for farmers. Many new farming ventures across the region have developed lower-cost hydroponic systems, which, in addition to eliminating environmentally harmful run-off, use 80 per cent less water than traditional agriculture. Using this technology, Egyptian Hydrofarms, for example, operates on marginal land outside of Cairo and provides pesticide-free herbs and salads to high-end supermarkets and hotels.

While water-use efficiency focuses on the physical efficiency of water, economic crop water productivity measures the value of crops produced per unit of water, which is a critically important objective in such a water-scarce region. Globally, the economic crop water productivity

can vary by a factor of eight and can be enhanced through soil moisture retention (for instance, zero tillage farming), the efficient timing of irrigation, and harvest and post-harvest management to reduce food loss.[70] The choice of crop is also essential. Table 4.3 provides global benchmarks for the range of possibilities found across the whole spectrum of farming systems and levels of intensification, in both irrigated and rain-fed conditions. The upper bound in each case represents the level of water productivity that can realistically be obtained under best practice conditions. This analysis has implications for trade. The concept of virtual water trade refers to the idea that when goods and services are exchanged, so is virtual water. For example, when a country imports one tonne of wheat instead of producing it domestically, it is saving about 1,300 cubic metres (m^3) of its water supply. If this country is water-scarce, the water that is 'saved' can be used towards other higher-value ends. If the exporting country is water-scarce, however, it has exported 1,300 m^3 of real water, since it has been used to grow the wheat and will no longer be available for other purposes.

Table 4.3 Physical and economic crop water productivity (CWP) ranges for selected crops

Crop	Assumed price per kg (US cents/kg)	Physical CWP (kg/m^3)	Economic CWP (US cents/m^3)
Wheat	20	0.20-1.20	4-30
Rice	31	0.15-1.60	5-18
Maize	11	0.30-2.00	3-22
Lentils	30	0.30-1.00	9-30
Fava beans	30	0.30-0.80	9-24
Potatoes	10	3.00-7.00	30-70
Tomatoes	15	5.00-20.00	75-300
Onions	10	3.00-10.00	30-100
Olives	100	1.00-3.00	100-300
Dates	200	0.40-0.80	80-160

Source: Based on Molden, 2007.

As water is the scarce factor and the binding constraint to increasing production and farm incomes in the region, increases in water-use efficiency and economic crop water productivity are essential, but they can also be usefully combined with technological advances to enhance the management of scarce water resources, and thus could increase the quantity of water available. Water harvesting, as in the above example from the Jordanian and Syrian Badia, can be expanded. Reuse of treated wastewater also has potential in the region, and successful examples can be found in Jordan and Egypt. The As-Samra Waste Water Treatment Plant in Jordan provides about 10 per cent of the water used in agriculture. The plant also generates 230,000 kilowatt hours (kWh) of power through biogas generation each day – meeting around 80 per cent of its own needs, and reducing its reliance on the national grid.[71] Drainage water reuse is a resource that has been largely neglected in the region, with the exception of Egypt, which is considered a world leader in drainage technology and practice.[72]

Appropriate incentives for water use are essential to ensure environmental sustainability and economic efficiency. Until twenty years ago, state-led development policies were pursued with a strong emphasis on self-sufficiency and irrigated farming, often accompanied by price guarantees. Although these policies were generally successful in developing agriculture, they often introduced distortions, notably the overallocation of water to agriculture; the lack of demand management through pricing or rationing, which led to reduced water-use efficiency; the lack of regulation of groundwater extraction, which led to the depletion of resources; and the production of lower-value food crops.

The distortions associated with agriculture policy were reinforced by the incentives created by energy subsidies. Energy subsidies have made it cheaper to pump water, and this has improved the financial profitability of both surface water lift pumping for irrigation and of groundwater abstraction. This has contributed to the decline of non-renewable groundwater reserves in some locations. The most extreme examples have been in the Arabian Peninsula, where cheap energy has led to massive depletion of fossil aquifers.

More recently, policies have evolved into a more market-driven approach. Most countries have developed a high-value, often export-oriented, agriculture sector, in which investment, production and marketing are private activities, underwritten by a legal and regulatory framework supporting private sector investment and controlling public good aspects such as water use. At the same time, most countries have also protected the critical role of smallholder agriculture for livelihoods, by maintaining rural development programmes and some measure of support for agriculture, primarily through research, extension, investment support (for instance, in irrigation development) and input supply. In many countries, considerable progress has been made towards integrating these two concepts of agriculture: for example, the Green Morocco Plan is designed to progressively bring smallholders into market-oriented production. Policies are also beginning to address the value of conserving ecosystems and of the environmental services provided by rural areas, such as water infiltration and soil conservation, in addition to recognizing their sociocultural services, such as the preservation of cultural heritage or traditional agriculture.

F. Policy options to enhance the role of agriculture in food security

Despite the region's geoclimatic limitations, agriculture has the potential to contribute to environmentally sustainable food availability and access. The key will be to focus on investments and incentives that promote market-oriented agriculture and maximum income per unit of water consumed. This means that the emphasis will be on production that has the highest economic value added per unit of water consumed, and on production systems and patterns that provide the highest incomes for farmers, and generate or save the most foreign exchange for the country.

Careful analysis will be needed to identify the right trade-offs and opportunities. A recent study showed that Morocco could achieve 85 per cent self-sufficiency in cereals at current yields, and that full self-sufficiency could be achieved if yields were to rise by 40 per cent. However, such self-sufficiency would come at a high cost – about $10 billion for the period of 2008-2022 – through revenue forfeited by not producing higher-value crops. If Morocco produced high-value crops instead, the $10 billion could be used to purchase a much greater quantity of imported cereals. In addition, the production of higher-value crops would create far more agricultural employment for landless labourers than cereal production.[73]

Several specific policy options merit consideration

Developing a more sustainable and resilient agriculture: This will require policies and practices that focus on the efficient use of water resources and address soil quality and climate

change. A holistic approach, including both land and water management issues, is likely to be most effective.

Investing in adaptive research to boost productivity: Studies show that even with the impact of climate change, yields, including cereal yields, can grow significantly in the region through technological adaptation. Even the negative impacts of climate change can be offset by improved water-use efficiency and water productivity. A study by the International Food Policy Research Institute found that, although output would still be below trend due to climate change, the application of productivity-enhancing measures is likely to keep yields rising through to mid-century, after which they will begin to drop under natural resource and climate change pressures.[74]

Adopting new technology: Improved agricultural techniques, selecting crop varieties for drought and heat tolerance, and improving the management of agricultural water use are likely to benefit yields. Technologies promoting water-use efficiency, such as drip irrigation, will be important, but must be tailored to specific hydrological and institutional contexts.

Using water more efficiently and productively: All farming systems need to refocus on 'more income per drop'. In irrigated agriculture, for example, investments should include physical infrastructure, such as conversion to pressurized irrigation, as well as measurement, control and monitoring systems, appropriate accountability mechanisms and capacity-building. To encourage the adoption of these technical approaches to water efficiency, cost recovery and rationing policies should be used to create the right incentives. Cost recovery policies should also consider scarcity and opportunity costs.

Exploiting comparative advantage in agriculture: This is likely to lie in the increasing commercialization of all agriculture, with a move towards more intensive production systems and crops that yield the most economic return per drop of water. Importing cereals, oilseeds and animal feed will in many cases be cheaper than local production. Instead, farming can be focused on high-value cash crops for the region's rapidly growing cities and for export.

Providing a supportive incentive framework: The development of markets and likely changes in world prices are likely to improve incentives, and these need to be supported by pro-business and pro-private enterprise policies. Increases in output and incomes are likely to come about through a combination of improved profitability and increased investor confidence.

Improving the productivity and commercial potential of rain-fed farming systems: For rain-fed farming systems, effective approaches are needed to address the region's constraints, in terms of low and variable water availability on the one hand, and soil salinity and lack of nutrients on the other. To date, relatively little attention has been paid by governments and institutions to rain-fed systems, and further research and development will be needed in order to increase yields for rain-fed crop farmers. Table 4.4 identifies a range of strategies and techniques that could be developed usefully.

Increasing integration and efficiency along the production and food chains: Productivity can be enhanced and risks managed by improving general efficiency in supply chains from farm to fork. There are different challenges in different Arab countries. In Oman, for example, post-harvest losses of 25 per cent or more could be reduced by improved in-field management and

just-in-time field chilling. The impact of heat extremes on post-harvest losses in food storage and distribution can be managed with adequate cold storage and refrigeration of food during heat extremes. Managing risks at bottlenecks in storage and transport infrastructure could increase value all along the chain. Some countries have bottlenecks in ports, while others have inefficient inland transportation systems.

Applying policies and programmes to protect poor and marginal producers and production systems: Small, poor producers in remote, marginal environments will be particularly vulnerable to climate change and extreme weather events. Pastoralism – a system traditionally adapted to drought – will remain an important source of animal products, but will increasingly rely on purchased animal feed and proactive drought management to manage climate risks. Support for the development of modern rangeland management systems and investment in infrastructure will be needed in order to increase productivity and sustainability. In the most marginal environments, households will need to be supported in their transition out of farming.

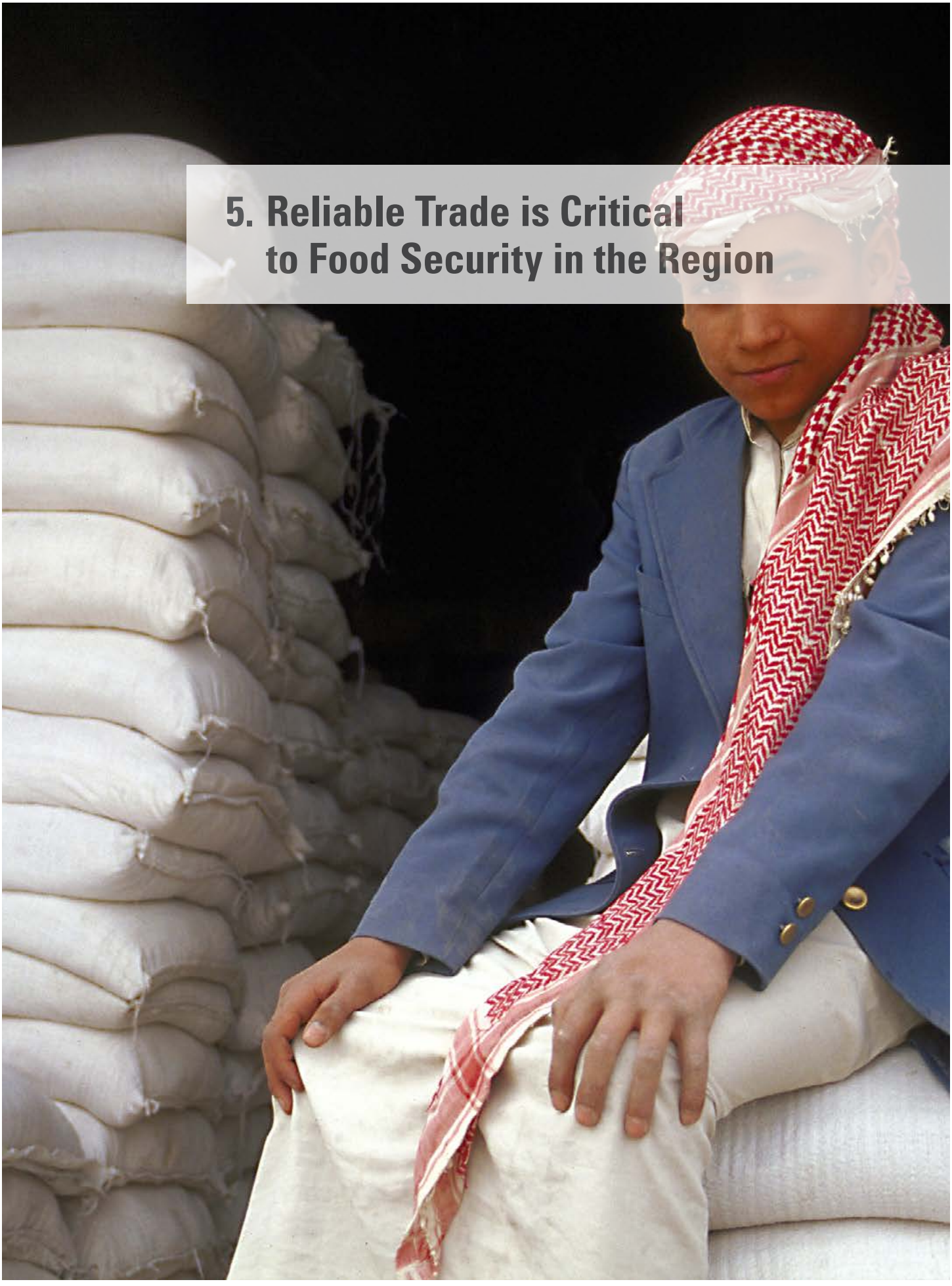
Table 4.4 Strategies and techniques for improving rain-fed productivity

Aim	Agricultural water management strategy	Purpose	Techniques
Improve water-use efficiency by increasing water available to the plant roots	Soil and water conservation	Concentrate rainfall around crop roots	Planting pits
		Maximize rainwater infiltration	Terracing, contour cultivation, conservation agriculture, dead furrows and staggered trenches
	Water harvesting	Mitigate dry spells, protect springs, extend growing season, enable off-season irrigation	Surface dams, subsurface tanks, farm ponds, diversion and recharging structures
	Evaporation management	Reduce non-productive evaporation	Dry planting, mulching, conservation agriculture, inter-cropping, windbreaks, agroforestry, early plant vigour and vegetative bunds
Improve water productivity by increasing productivity per unit of water consumed	Integrated soil, crop and water management	Increase proportion of evapotranspiration (ET) flowing as productive transpiration and so obtain 'more crop per drop'	Increase plant water uptake capacity through conservation agriculture, dry planting (early), improved crop varieties, optimum crop spacing, soil fertility management, optimum crop rotation, intercropping, pest control and organic matter management

Source: Adapted from Molden, 2007.

Improving the productivity and sustainability of the livestock sector: The sector is challenged by the scarcity of natural resources in terms of feed and water, the lack of supporting infrastructure and services, and a history of poor policies. It is today particularly vulnerable to the effects of climate change and water scarcity. Nonetheless, there remains potential for growth. In addition to support for pastoral systems (see above), mixed systems can be improved through better animal health, financial and infrastructure services, along with access to alternative cheap feed resources such as food industry by-products. For intensive systems, a regulatory framework is needed, in order to control their negative impact on natural resources and public health, along with the adoption of new technology to improve productivity.

5. Reliable Trade is Critical to Food Security in the Region



5. Reliable Trade is Critical to Food Security in the Region

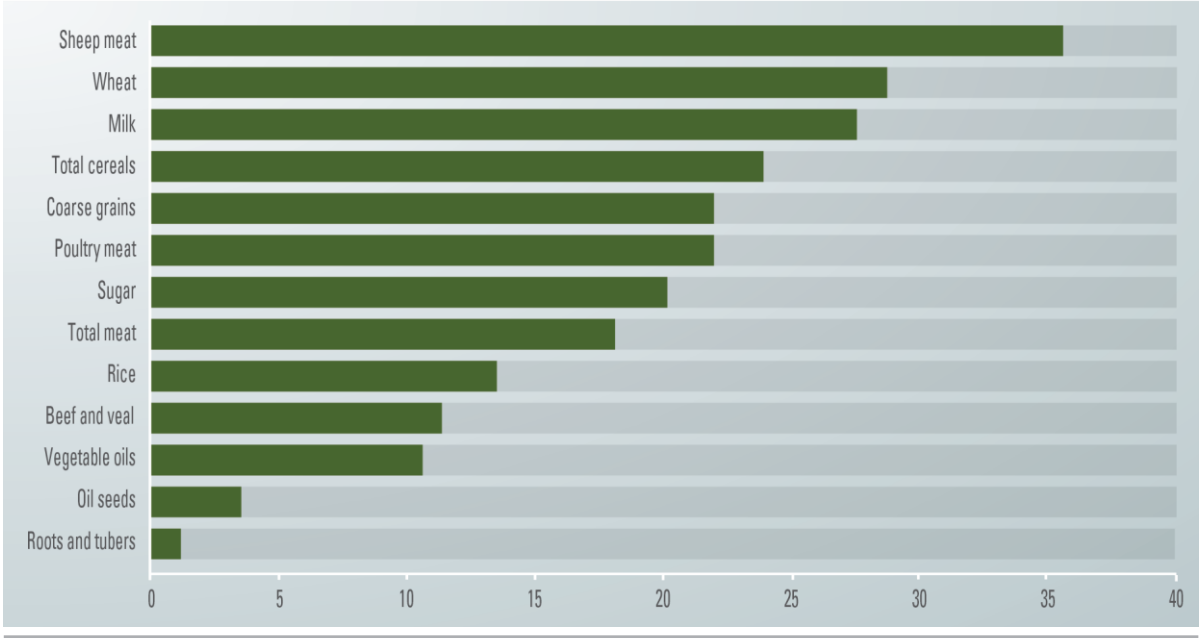
The idea of self-sufficiency in food evokes strong emotional reactions, based on natural instinct and patriotic attachment to the land, as well as fears of being exploited by exporting countries. Nevertheless, many countries have been successfully managing their food security through partial or complete dependence on world markets for many years. As an important pillar of the means of implementation of the 2030 Agenda for Sustainable Development, target 10 of SDG 17 on trade calls for "a universal, rules-based, open, non-discriminatory and equitable multilateral trading system". More specifically on food, target C of SDG 2 endorses the adoption of "measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility". With these targets in mind, this chapter provides an analysis that could help the Arab region enhance its food security through measures to manage both supply and price risks associated with increasing reliance on food imports.

A. The Arab region imports a large and growing share of its food

As a consequence of its high population growth rates, increasing urbanization and growth in incomes, demand for food in the Arab region has witnessed high growth rates over the past decades. With domestic production lagging well behind consumption requirements, the region is increasingly dependent on world markets for its basic food needs. Increasing imports also reflect increased income in several oil-rich countries. Taken as a whole, the Arab region is a major buyer on world food markets (figure 5.1). The region, while representing only around 5 per cent of the world population, imports more than one third of all sheep meat and more than one quarter of all wheat and milk on world markets.

Trends in the growing gap between food consumption and production in the region were presented in the chapter on food availability, where it was shown that consumption has been increasing much faster than production for many key food commodities. The import gap in actual tonnage was presented in terms of self-sufficiency ratios, which for several commodities are declining rapidly (refer to figure 1.6 on specific commodities and subregions). This section expands on that discussion, focusing on the financial implications of the region's dependence on imports. The Arab region's imports of food and animal products have been growing exponentially since the 2000s, reaching over $90 billion in 2013, the last year for which comprehensive trade value data is available from the FAOSTAT database. During the same period, the region's food exports also increased, but modestly, resulting in an overall trade deficit for food and animal products of some $75 billion.

Figure 5.1 Arab imports as a share of world markets, 2014-2016 (percentage)



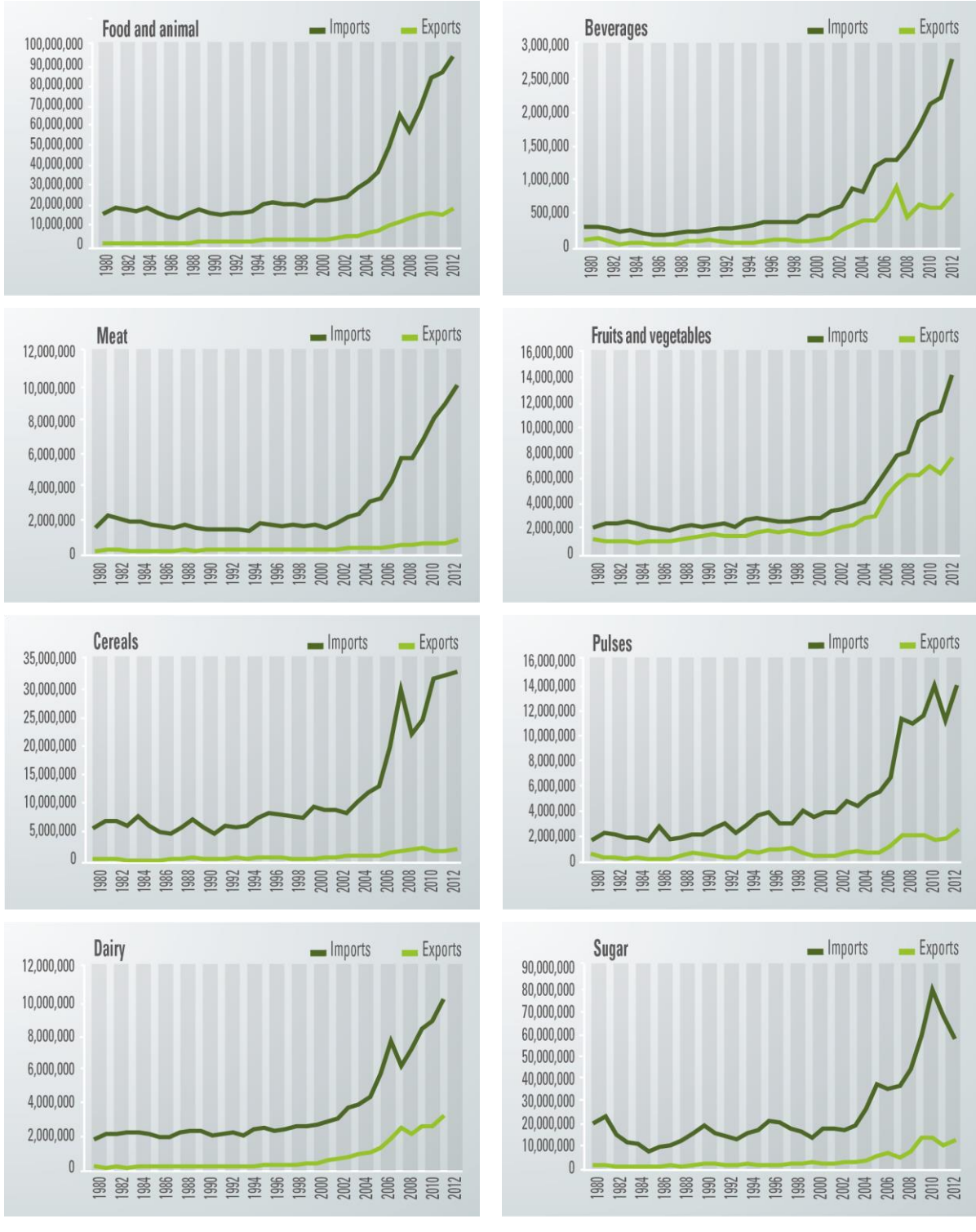
Source: FAO CCBS database; FAO GIEWS, 2017a.

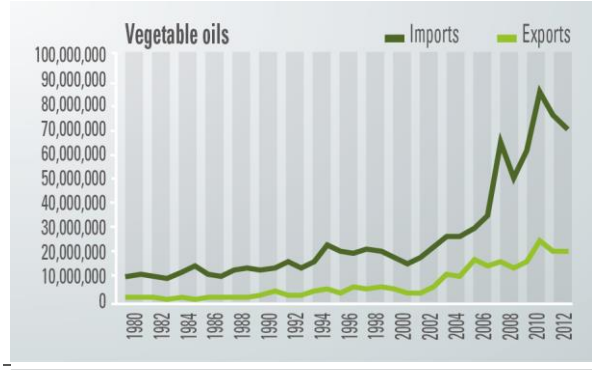
Cereals are by far the leading item in the food import basket, with a trade deficit of over $30 billion in recent years (figure 5.2). Cereals are followed by meat products, with an imbalance of over $9 billion, dairy products ($7 billion), sugar ($6 billion), vegetable oils, fruits and vegetables ($5 billion each), beverages ($2 billion), and pulses ($1.2 billion), with all other products amounting to some $8 billion in trade deficit.

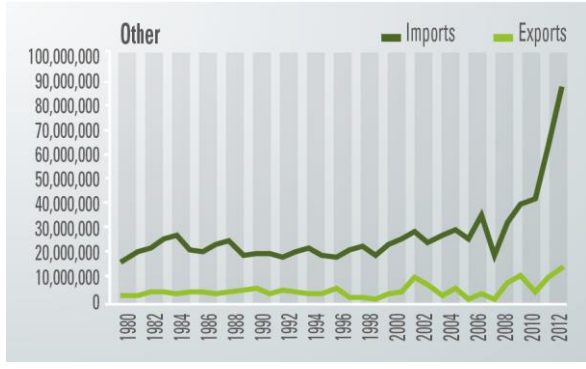
For nearly all food commodities, the region has been witnessing an accelerating rise in spending on food imports (figure 5.2). During the 15-year period between 1995-1998 and 2010-2013, annual growth rates of food and animal imports in the Arab region were of nearly 15 per cent, compared to less than 2 per cent during the previous 15-year period (from 1980-1983 to 1995-1998). The same double-digit annual growth rates have been recorded for all food commodity groups, with beverages and meat topping the list at 19 per cent and 18 per cent annual growth rates, respectively, during the 1995-1998 to 2010-2013 period.

Without exception, all Arab countries experienced a negative aggregate food trade balance in 2010-2013, as had also been the case in earlier years (figure 5.3). Among those countries with the highest food trade deficit are most of the oil-rich GCC countries, Saudi Arabia being at the top, with a food trade deficit of close to $15 billion in 2010-2013 (one fifth of the region's overall food trade deficit). The United Arab Emirates and Algeria follow, at about $8 billion each, then Iraq at close to $6 billion. Among the countries with large food deficits in absolute terms are also some large non-oil rich countries, among them Egypt, but also Jordan, Lebanon, Morocco, the Syrian Arab Republic and Yemen.

Figure 5.2 Trade balances of food commodities in the Arab region ($1,000)







Source: FAOSTAT Data, FAO, 2017a.

Table 5.1 Annual import growth rates in the Arab region

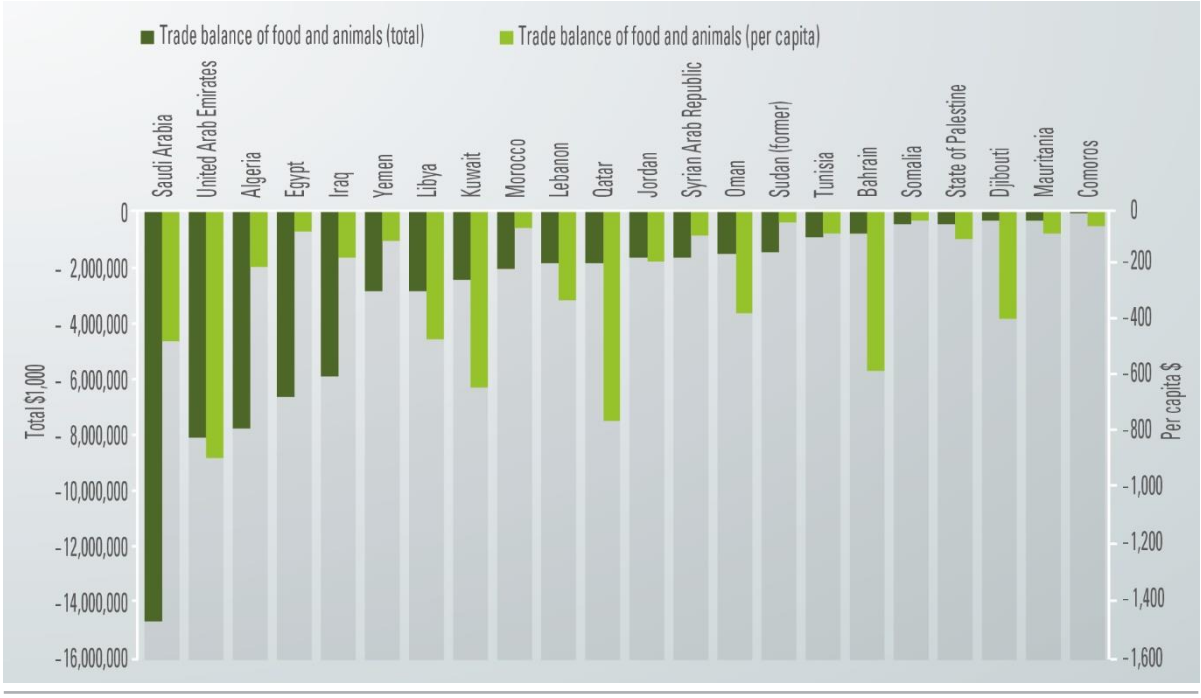
Category	Growth 1980-1983 to 1995-1998 (*percentage*)	Growth 1995-1998 to 2010-2013 (*percentage*)
Food and animal	1.6	14.5
Beverages	2.5	19.3
Meat	-1.4	18.1
Fruits and vegetables	1.3	15.6
Cereals	1.9	14.4
Pulses	5.5	14.0
Dairy	1.4	13.9
Sugar	0.7	13.7
Vegetable oils	7.6	13.4
Other	-0.5	11.7

Source: FAOSTAT Data, FAO, 2017a.

B. Burden of import dependence heaviest for countries spending a large share of their foreign exchange earnings on food imports

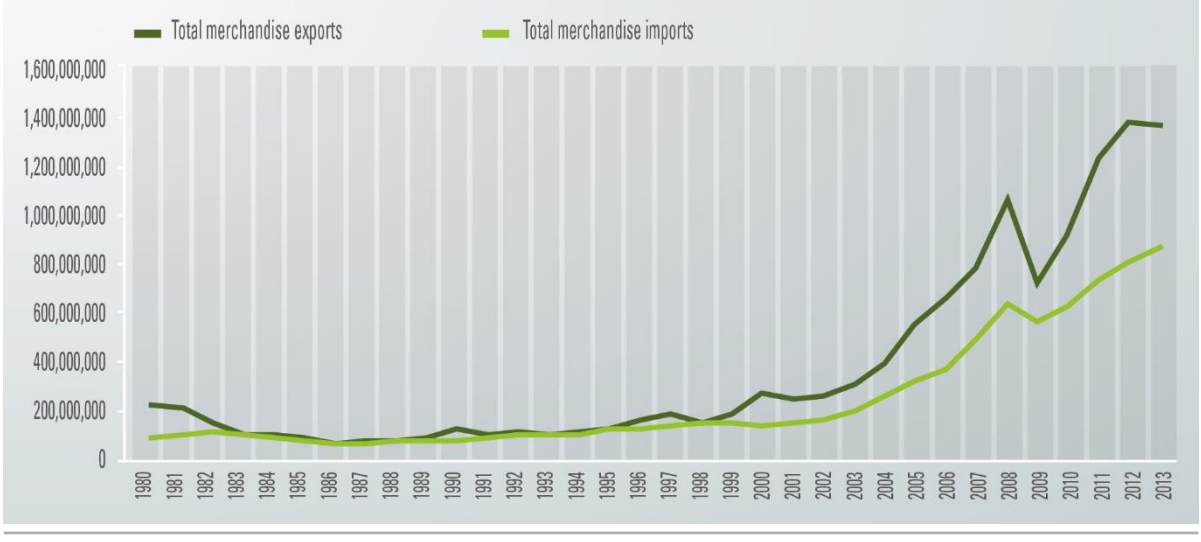
In itself, a deficit in food trade is not a problem for food security at the national level: many countries all over the world meet their food demand through a partial or complete dependence on world markets. As discussed in chapter 1, food availability can be achieved through imports, and financed by exports of other commodities and services. In effect, for the region as a whole, the balance of total merchandise trade has been consistently positive over several decades, and even more so after the late 1990s (figure 5.4). The overall trade surplus of total merchandise trade for the region stood at some $360 billion in 2013, having risen from about $30 billion 10 years earlier and roughly zero 20 years ago in the early 1990s.

Figure 5.3 Trade deficits in food in the Arab region by country in 2010-2013 ($)



Source: FAOSTAT Data, FAO, 2017a.

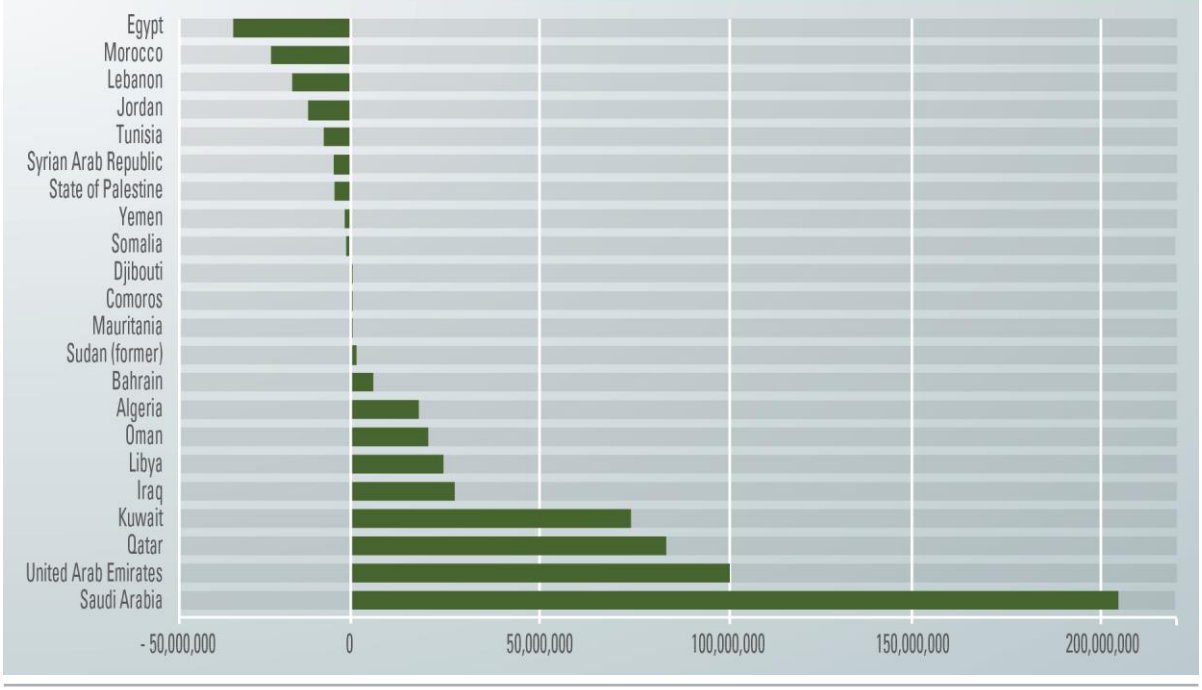
Figure 5.4 Aggregate merchandise trade trends in the Arab region ($1,000)



Source: FAOSTAT Data, FAO, 2017a.

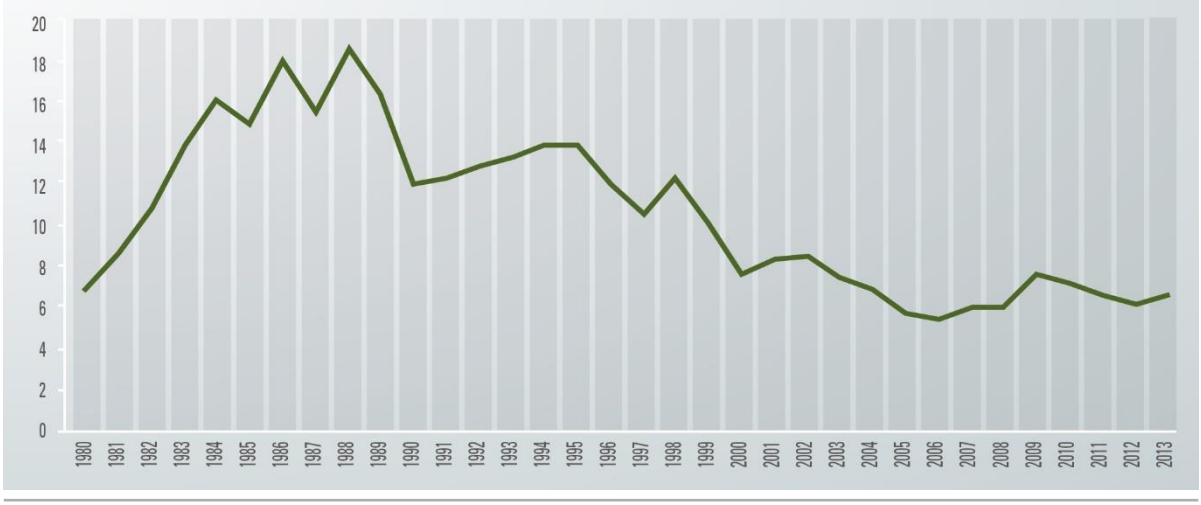
However, this overall positive evolution in the aggregate external trade balance of the Arab region masks huge differences among individual countries (figure 5.5). In fact, the overall trade surplus has been driven largely by oil and gas exports, and benefits only the handful of countries endowed with oil and gas resources. Just four countries – Kuwait, Qatar, Saudi Arabia and the United Arab Emirates – account for 83 per cent of the region's surplus in total merchandise trade in 2010-2013. In other words, the combined trade surplus of these four countries amounts to nearly five times the combined trade deficit of all the countries in the region, with Saudi Arabia's surplus alone amounting to more than twice the latter. Countries in the region with an overall trade deficit include Egypt, Morocco, Lebanon, Jordan, Tunisia, the Syrian Arab Republic and the State of Palestine. Since most of these countries have been identified above as also having large food trade deficits, they are considered to be in a precarious situation, in terms of being able to sustain their food security.

Figure 5.5 Net merchandise trade (exports-imports) in the Arab region in 2010-2013 ($1,000)



Source: FAOSTAT Data, FAO, 2017a.

Figure 5.6 Share of food and animal imports in total merchandise exports in the Arab region (percentage)



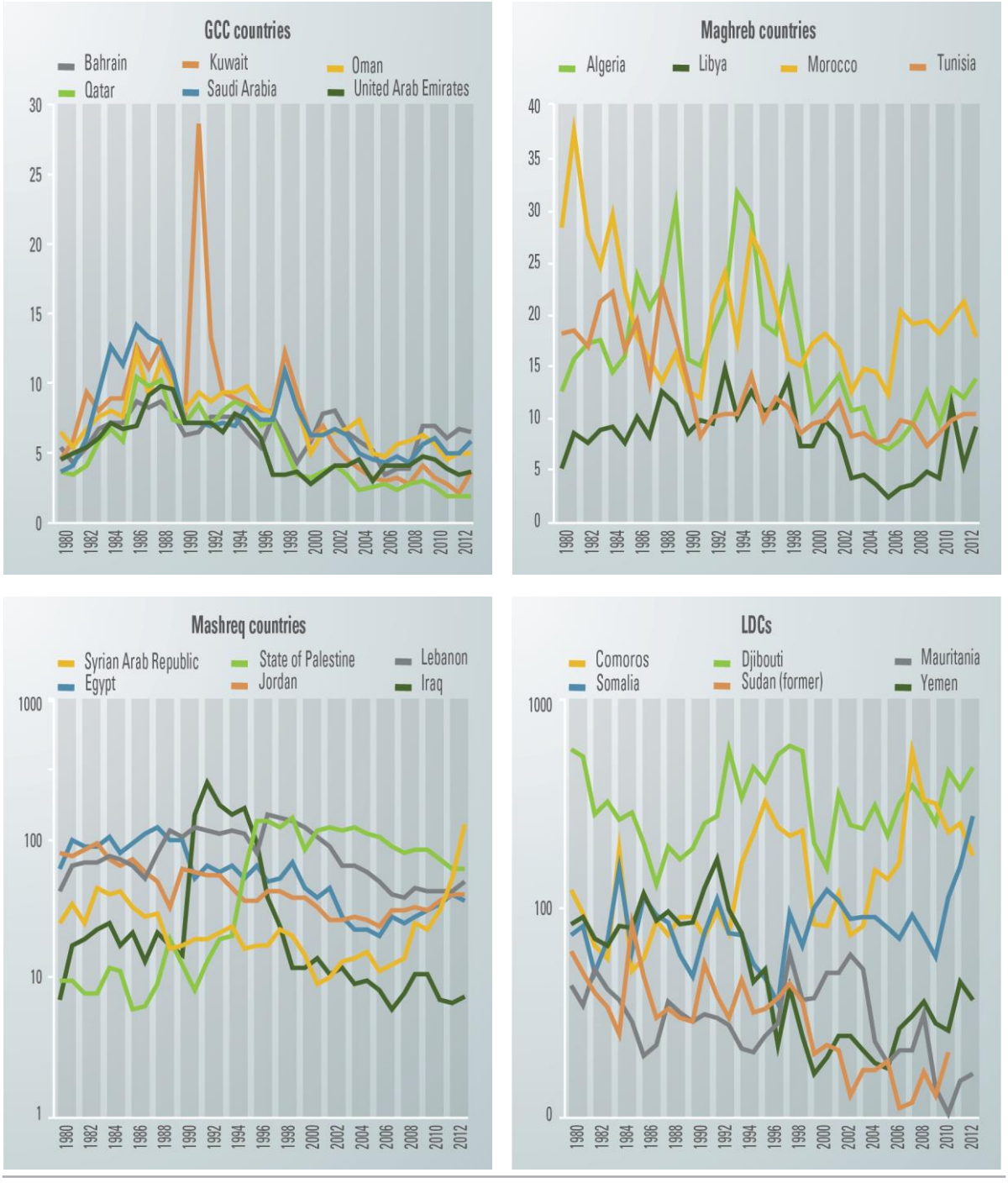
Source: FAOSTAT Data, FAO, 2017a.

Perhaps one of the most relevant indicators for assessing the ability to sustain food imports is the share of total merchandise export earnings spent on food imports. This indicator assesses the extent of self-reliance of a country. When food imports account for a small and stable share of export earnings, a country is considered capable of sustaining food imports. Conversely, when food imports account for a large and unstable share of export earnings, a country should be concerned about its ability to sustain food imports. For the world as a whole, this share is less than 5 per cent. The Arab region average has hovered around 7 per cent in recent years, and has shown a downward trend from earlier years: the share was as high as 18 per cent in the late 1980s (figure 5.6).

However, as with other statistics, the regional average hides huge differences between subregions and individual countries. As would be anticipated, the GCC countries have low ratios converging at around 5 per cent and, as a group, have seen a steady decline in this ratio over the years (figure 5.7). Also, aside from Kuwait during the war years, their ratios have been relatively stable, within the context of a general downward trend. Ratios for the Maghreb as a group are about double those of the GCC countries and are also more volatile. Among the Maghreb countries, Morocco stands out as having a much higher and more variable ratio than the other three.

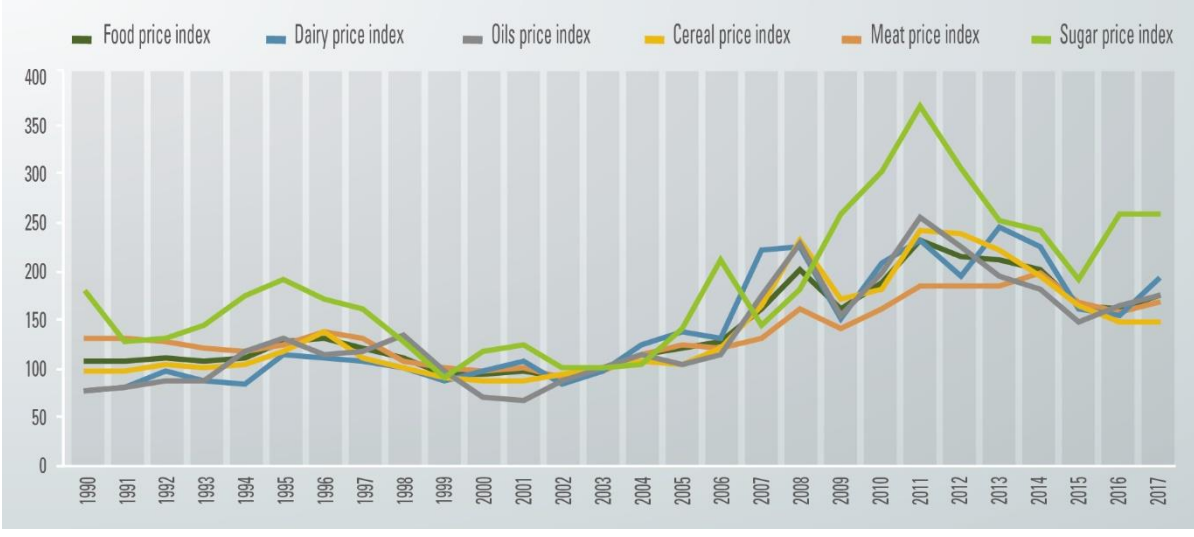
The situation in some of the Mashreq countries is more worrisome. As a result of the ongoing conflict, the Syrian Arab Republic is currently importing more food than the total value of all of its merchandise exports, a situation that has worsened dramatically as the crisis has developed. Other countries in the subregion have ratios that currently fall below 100 per cent, but are nevertheless problematic. Lebanon has a long-standing problem, spending over 40 per cent of its export receipts on food. The State of Palestine has been spending the bulk of its export receipts on food since 1995 – a dramatic increase from ratios below 20 per cent in the previous period.

Figure 5.7 Share of food and animal imports in total merchandise exports by subregion (percentage)



Source: FAOSTAT Data, FAO, 2017a.

Figure 5.8 World food commodity prices



Source: AMIS, 2015.

The most problematic of all is the situation in the LDC subregion. Djibouti, whose imports of food are consistently above the total value of all of its merchandise exports, has seen its ratio reach 400 per cent several times in recent history. The Comoros and Somalia also have high and volatile ratios, exceeding 100 per cent, and recurrently reaching over 200 per cent. These countries are heavily reliant on international grants and loans, including food aid, as well as remittances.[75] The other countries in the LDC subregion may have lower ratios, but those remain highly volatile: the stability of food security is compromised because, in some years, consumption is curtailed due to the very high burden of food imports.

Clearly, there are risks associated with food import dependency, including the volatility of world prices for commodities exported by these countries, as well as terms of trade considerations. Particularly for countries whose share of total merchandise export earnings spent on food imports is high and volatile, the sustainability of food security is a major concern. Even if their export earnings can be maintained, these countries are highly vulnerable to increases in world food prices and/or increases in the volume of food imported, due to a sharp drop in their domestic food production and associated policy changes, as well as macroeconomic and fiscal developments. The implications of such vulnerability were painfully realized during the 2007/2008 global food crisis, when prices spiked dramatically (figure 5.8). At that time, the disruptions caused by weather disturbances were exacerbated by the imposition of export restrictions in several key supplying countries. The importing countries of the world, including the Arab region, were faced with high prices impacting household and government budgets, and putting food security at risk. While world food commodity markets have since returned to normality, the experience of the crisis brought increased attention to the vulnerabilities of importing countries, particularly countries such as the Comoros, Djibouti and Somalia,

for whom food imports constitute large and volatile shares of their total export earnings.

C. Highest vulnerability for countries with high import dependency and high concentration in the sourcing of supplies

An additional risk associated with food import dependency is the degree of concentration in the sources of imported food supplies. In particular, a country that has a high dependency on imports, and sources those imports from a few suppliers, is much more vulnerable than a country that has a lower import dependency, and sources those imports from many exporting countries (table 5.2).

The concept of import dependency ratio (the opposite of self-sufficiency ratio) is the share of total calories consumed that are imported. The concentration of imports coefficient is similar to the Gini coefficient (ranging from 0 to 1), which is commonly used in the field of income and poverty analysis, but can also be used to measure inequality in any statistical distribution. In the context of the distribution of the sources of food imports, this ratio would have a value of 0 if a country received its imported calories in equal proportions from all exporting countries and, at the other extreme, a value of 1 if a country received the totality of its calories from one single supplier.

The Arab region as a whole had an import dependency ratio (in terms of aggregate calories consumed) of 0.56 in 2013-2014, ranging from 0.41 for the Mashreq to 0.86 for the GCC countries. At the same time, the region has a high degree of concentration in sourcing its food imports (a coefficient of 0.89), as roughly four-fifths of the region's imported calories originate in only fivesuppliers. Individual subregions are not substantially different, with the Mashreq and the Maghreb (at 0.91 and 0.90, respectively) having a marginally greater concentration of imports than the LDCs and the GCC countries (both at 0.87).

In general, if a country has a high concentration of imports but a low import dependency, its exposure to world markets may be manageable. The same may apply if a country has a high import dependency but a low concentration of imports. Conversely, vulnerability from a country's exposure to world markets would be high in cases when a high import dependency is coupled with a high concentration of imports. Thus, an overall measure of vulnerability can be obtained by combining these two individual indicators. On the basis of this combined overall exposure indicator, the vulnerability of countries in the Arab region ranges from 0.37 for the Mashreq subregion to 0.75 for the GCC subregion (table 5.2). The lower vulnerability of the former is largely on account of its lower import dependency, not its concentration of imports, which, as discussed above, is in fact marginally higher for the Mashreq. Of course, this analysis does not take into account the relative ability of the different subregions to import food, an issue discussed above. However, taken at face value, these levels of vulnerability for the Arab region, as a result of its exposure to world markets, are well above those of other countries. If one considers the FAO category of 75 net food-importing developing countries, which actually includes 9 countries from the Arab region, their overall exposure indicator is 0.22, largely due to a low (0.25) average import dependency ratio, while their average concentration of imports coefficient (at 0.90) is marginally higher than the average for the Arab region.

Table 5.2 Exposure of Arab countries to world food markets (average 2013-2014)

Country/subregion	Imports	Exports	Production	Import dependency (ratio)	Concentration of imports (coefficient)	Overall exposure (indicator)
	kcal (billions)					
Egypt	8,052,52	95,360	1,296,337	0.35	0.93	0.33
Iraq	259,226	4,456	273,285	0.48	0.90	0.44
Jordan	123,822	2,579	27,955	0.81	0.88	0.72
Lebanon	82,008	10,646	29,679	0.71	0.86	0.61
Palestine	23,676	717	13,490	0.63	0.94	0.59
Syrian Arab Republic	128,379	4,297	220,094	0.36	0.86	0.31
Mashreq total	1,422,363	118,055	1,860,840	0.41	0.91	0.37
Mashreq without Egypt	617,111	22,695	564,503	0.51	0.89	0.45
Algeria	611,925	18,835	362,736	0.62	0.91	0.57
Libya	147,422	905	43,002	0.77	0.86	0.67
Morocco	333,781	17,542	495,041	0.39	0.91	0.36
Tunisia	163,156	25,211	138,073	0.50	0.86	0.43
Maghreb total	1256284	62,493	1,038,852	0.53	0.90	0.48
Comoros	2,466	122	5,092	0.32	0.86	0.27
Djibouti	65,274	623	525	0.99	0.88	0.87
Mauritania	36,923	31	19,803	0.65	0.86	0.56
Somalia	40,012	3,470	40,219	0.48	0.85	0.40
Yemen	239,605	6,533	62,001	0.79	0.88	0.69
LDC total	384,280	10,779	127,640	0.75	0.87	0.65
Bahrain	21,528	3,079	1,670	0.92	0.92	0.84
Kuwait	80,298	7,340	18,726	0.80	0.88	0.70
Oman	83,792	26,554	14,222	0.80	0.87	0.70
Qatar	30,884	489	2,362	0.93	0.90	0.83
Saudi Arabia	738,546	17,764	140,470	0.84	0.86	0.72
United Arab Emirates	397,912	105,674	21,074	0.93	0.88	0.82
GCC total	1,352,960	160,900	198,524	0.86	0.87	0.75
Arab region	4,415,887	352,227	3,225,856	0.56	0.89	0.50

Source: Information compiled by the Trade and Markets Division of FAO.
Note: Indicators were converted to kcal content to allow comparability.

D. Policy options to enhance trade aspects of food security

Countries in the Arab region that import a large share of their food needs from world markets, potentially face two interconnected risks: (i) supply risk, where supplies may not be available on world markets for countries to import; and (ii) price risk, where world market prices may increase above levels that an importing country is able to afford.[76]

The broad consensus among food commodity experts is that global supplies of food and agricultural commodities are likely to become less abundant in the future due to several factors,[77] including the scarcity of land and water resources, climate change,[78] decreasing returns on investments in productivity, and higher energy prices.[79] Volatility has always been a basic characteristic of agricultural markets, and adjustments from short-term events have been quick. However, the global

food crisis of 2007/2008 generated new concerns, including the increasingly close links between food prices and fuel prices. Hitherto, links with the energy sector had been mainly on the production side, with energy being an input to agriculture and food production (fertilizer and fuel for machinery, for example). Since the crisis, however, those links have been extended to both the input and the output side of agricultural production. Biofuel production has played a major role in strengthening food prices in recent years, although there are diverse views about the relative importance of subsidies and high-energy prices for the growth of the biofuel industry.[80] The 2007/2008 crisis also gave rise to additional concerns for the global food system, particularly regarding speculative activity in future food markets, which may amplify price movements in the short term, even though there may not be any longer-term systemic effects on volatility.

Several instruments are available for managing vulnerabilities stemming from dependence on food imports. Some of these are of relevance to net food importing countries, and efforts to strengthen their effectiveness are essential to improving food security, especially in the most vulnerable countries. The rest of this section describes some of these instruments, available at national, regional and global levels.

1. National-level instruments

At a national level, this includes: increasing production in countries where it is economically profitable and environmentally sustainable; targeting investment towards food production and related infrastructure in other countries to gain direct access to supplies; reducing the cost of importing food; and reducing the impact of world market shocks.

Increasing domestic production: Governments of countries with potential for increasing food production can invest in agriculture (for instance, research and development for new crop varieties and targeted support for poor farmers). The issue of providing support for agriculture, including targeted support for farmers, is not so much its permissibility within World Trade Organization (WTO) agreements. The more important constraints are countries' own natural resource endowments – particularly in terms of the environmental sustainability of groundwater use – and, for the poorest countries of the region, their inability to provide such support due to budgetary constraints.

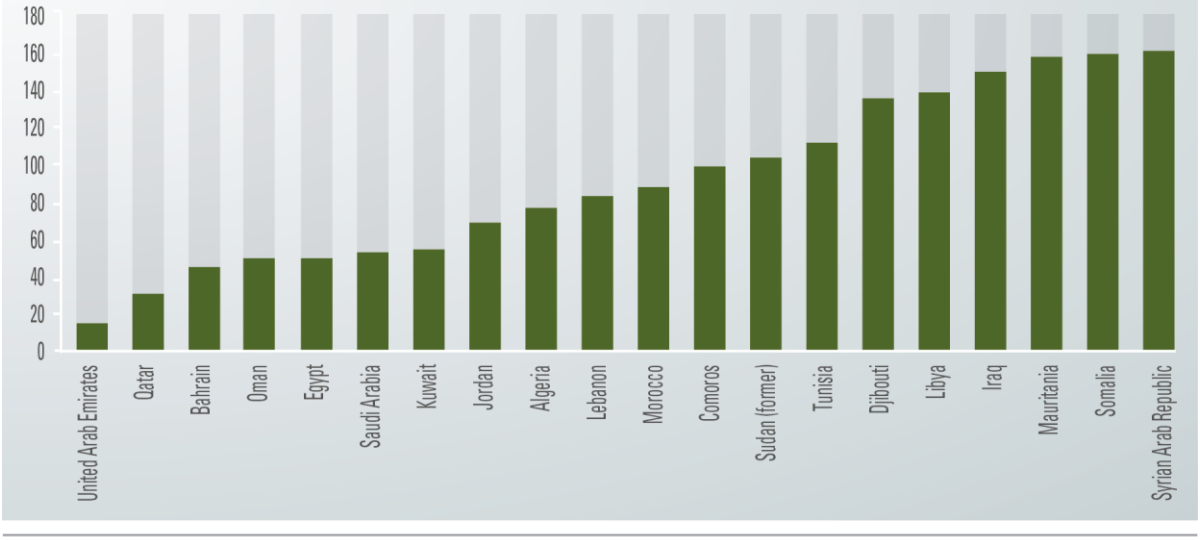
As discussed in the previous chapter, investment in domestic production should consider crop water productivity. As things stand, not only investments but also pricing policies are needed to provide appropriate incentives. By encouraging the production of crops for which the country has a natural comparative advantage, and discouraging low value-added, high water-intensive crops, trade can help conserve precious water resources.

Investing in other countries to gain direct access to supplies: In addition to directly addressing production domestically, several countries in the region have taken steps to directly control production beyond their borders, by investing in land-abundant countries through purchase or lease of land, so as to have secure access to food produced on such land. The largest land acquisitions have been by GCC countries (Saudi Arabia and United Arab Emirates in particular) in the Sudan. The 'outsourcing' of food production to poor, generally food-insecure, countries has been an important but controversial development. While they are often presented as win-win undertakings, concerns

have been raised about the appropriateness and sustainability of projects based on land acquisition. In practice, the real concerns are not so much about the desirability of such investments, as about how the investment flow could be regulated to maximize both economic and social benefits, while minimizing risks. There are potentially mutual benefits from such transactions, as long as certain principles are adhered to, inter alia as regards tenure rights, compensation, employment creation, distribution of harvests and other benefits.[81] Careful planning by both recipient and investing countries is needed for land acquisition projects to be successful and fair to both parties.

Reducing the cost of food imports: Because the primary factor constraining imports is affordability, anything that can reduce the cost of imports can support food security. There is considerable scope to reduce the cost of imported food by investing in infrastructure to store and transport food, and generally improving the management and logistics of the import chain. There are significant differences in performance among import supply chains across the region, with some countries experiencing bottlenecks at ports, while others have inefficient inland transportation systems. Overall, the Arab region scores poorly on the World Bank's Logistics Performance Index (figure 5.9), in which three of the lowest ranking countries in the world are from the Arab region. Specifically, in terms of the importation of wheat, average import supply chain costs in 2009 were $40 per metric ton for 10 Arab countries – four times the average of the Netherlands.[82] Bottlenecks at the port and poor domestic transport were identified as key problems. Initiating awareness and educational programmes about food loss and waste reduction has some potential for reducing the demand in food, and thus having an indirect impact on the need for expanding domestic agricultural production or increasing the volume of imports.

Figure 5.9 Logistics Performance Index, 2016 (ranking out of a total of 160 countries)



Source: Logistics Performance Index; World Bank, 2016.

Reducing the impact of world market shocks: The food crisis of 2007/2008 raised awareness of the supply and price stability risks associated with dependence on world markets. One way of responding to supply risks is through a greater diversification of trading partners. In general, for most countries, historical trade ties determine the bulk of both imports and exports. As a result, some countries concentrate their trade with a small number of suppliers, which renders them vulnerable to supply risk. Diversification in the sourcing of imported supplies is an effective way to reduce such exposure. The very common practice of sourcing supplies in bulk generally involves a public tendering process, whereby supplies are obtained from the most competitive bidders. The more transparent and open-to-entry this process is, the more it encourages a broader participation of traders, and favours a greater diversification of suppliers.

There are also ways of responding to price risks and generally smoothing out the price paid for imports over time. First, the price risk can be transferred to exporting trading partners through long-term arrangements, including forward contracts or options for the delivery of a certain quantity of a particular commodity at a certain price. Secondly, the price risk can be hedged, through the use of financial market instruments, by paying a premium proportional to the degree of protection desired. Thirdly, countries can invest in physical stocks of food. Prices stabilization stocks (often referred to as buffer stocks) require the public sector to buy commodities when prices are low, and release its stocks into the market when prices are high (thus mitigating scarcity-induced price increases). Food security stocks in the Arab region, at the national and/or subregional level, have been a frequently raised option in recent years, and indeed some countries have already implemented plans to maintain sizable food security stocks (for instance, Saudi Arabia has a wheat reserve to cover some eight months of national needs, and has been aiming to increase this to a 12-month coverage). Because stocks are expensive, tying up capital and often resulting in food waste and loss, their careful management is of critical importance. This issue will be discussed in more detail in the chapter on modeling future scenarios.

2. Regional-level instruments

A variety of instruments are also available at the regional level that can help countries in the region respond to the common challenge of their growing dependence on imports. These include expanding intraregional trade, coordinating on information and coordinating on physical stocks and food-related funds.

Expanding intraregional trade: Intraregional trade among Arab countries is significantly lower than would be expected based on the economic, cultural and geographic characteristics of the region. For most countries in the region, intraregional trade accounts for less than 10 per cent of total trade.[83] It has been estimated that limited regional integration results in 1-2 per cent of forgone GDP growth. Some limited steps have been taken, including the removal of intraregional tariffs under the Greater Arab Free Trade Area (GAFTA) agreement, as well as some investments in roads and telecommunications that reduce the cost of trade. However, there is enormous untapped potential, especially in reforming non-tariff measures and harmonizing regulatory frameworks, covering, for instance, phytosanitary and technical regulations, testing and certification. Several countries in the region, as members of the WTO, have signed the new Trade Facilitation Agreement (TFA), which

entered into force in February 2017. TFA seeks to expedite the movement, release and clearance of goods across borders by streamlining and standardizing clearance procedures and practices, to allow for reduced fees and formalities connected with the import/export of goods, as well as faster clearance procedures and enhanced conditions for freedom of transit for goods.[84] Reducing the time that food supplies spend in transit is of critical importance to food security, both in terms of reducing the size of total supplies in the pipeline, and of responding more quickly to market needs and emergencies. Such measures also work in the other direction, by facilitating the movement of exported products and making them more competitive in world markets.

Coordinating on information: By taking advantage of economies of scale, regional coordination of information collection could reduce the cost for all participating countries. Recent episodes of price volatility revealed major shortcomings in the ability of governments to assess the situation on the ground and respond quickly to impeding market shocks. Market information on basic foodstuffs at a regional level was inadequate and slow, creating uncertainty and panic among consumers. Improving the information base would entail developing a regional early-warning system, as a means of obtaining more reliable estimates of regional stocks, domestic production and movement of food supplies, as well as a mechanism for coordinated policy responses. A regional system could complement the Agricultural Market Information System (AMIS),[85] of which Saudi Arabia and Egypt are members.

Coordinating on physical stocks and food-related funds: Regional cooperation and coordination can also reduce investment costs for physical stocks of food. The constitution of such regional reserves could simply entail earmarking a certain percentage of each country's national reserve into the regional food reserve. In addition to the benefits of economies of scale, regional food stocks provide greater price stability, facilitate the movement of supplies across borders, and make coordination of market information easier. An Arab food security fund was proposed by various international organizations and United Nations agencies, as well as by the League of Arab States, but these proposals have not been implemented. Such a fund could be designed exclusively to provide relief during food shortages or emergencies, and to ensure a rapid response, without the need to secure additional resources as is currently the case for international humanitarian action.

3. Global-level instruments

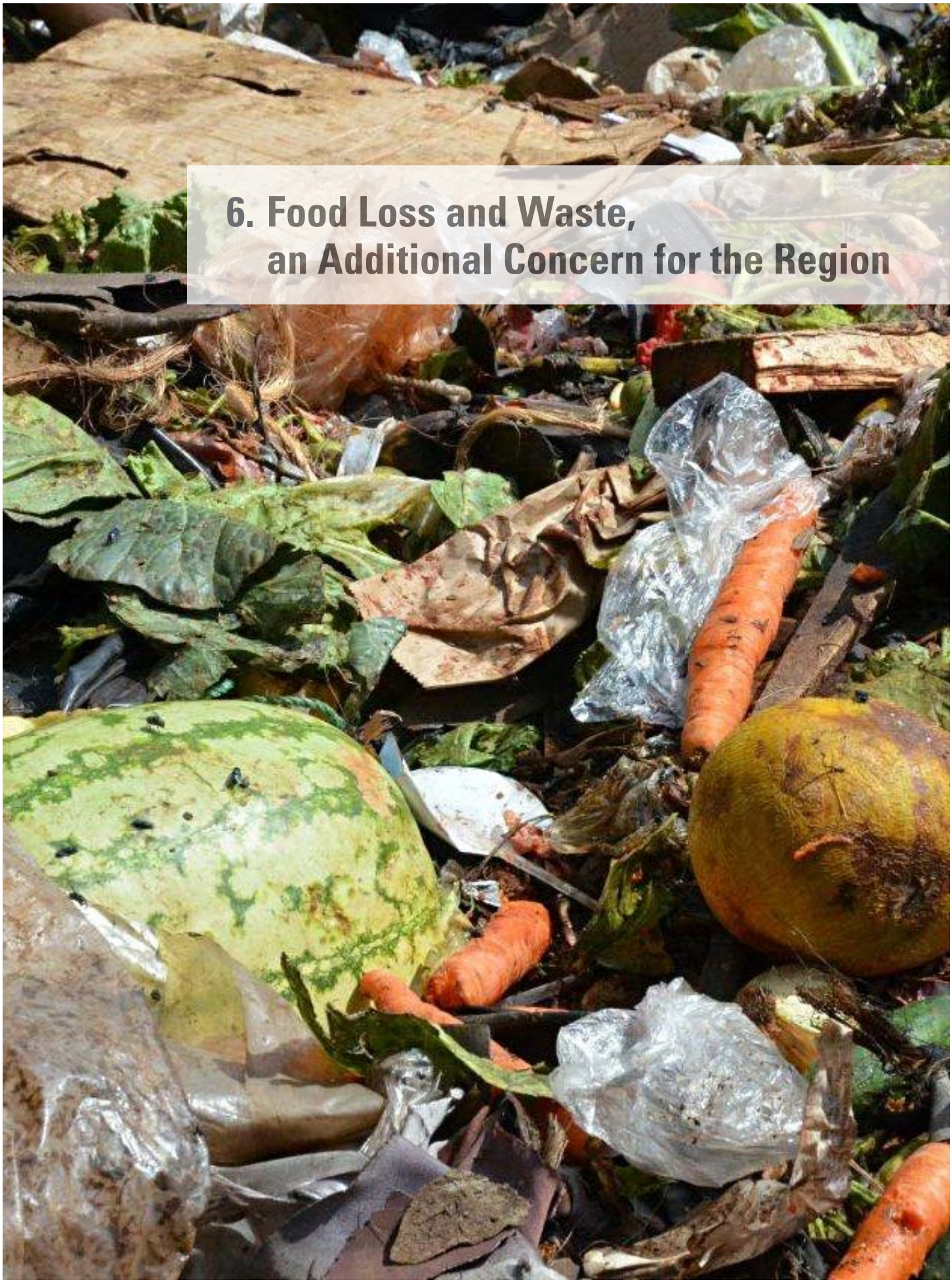
Finally, at the global level, action by the international community can greatly contribute to improving the food security of the region, especially as regards expectations for a reliable global food market. In particular, there is considerable scope for improvements and expansion in global trade agreements and food assistance programmes that could benefit the Arab region as well as the world at large.

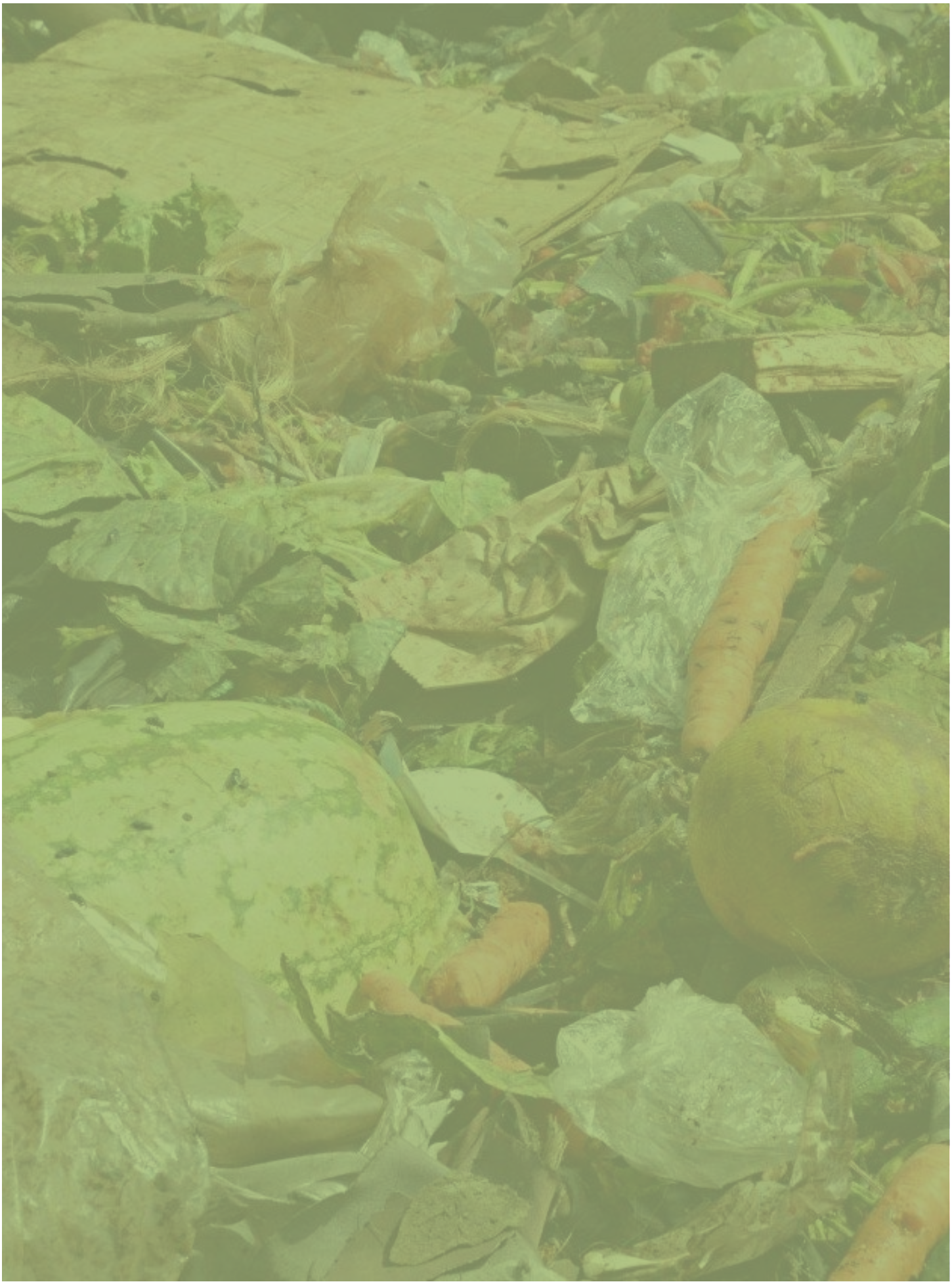
Trade agreements: Greater trade liberalization, including in agricultural products, has been the trend in the last two to three decades, and the process is ongoing under WTO auspices. While there is currently uncertainty about the pace and substance of multilateral trade negotiations, the issues that have bedevilled the WTO membership for nearly two decades will not go away, and will eventually have to be addressed under the Doha Round, or what may supersede it. Much attention has been paid, at the WTO, to

disciplining import policies, but far less to export policies. In particular, export prohibitions and restrictions have proven to be a very common policy response in several exporting and trading countries during the recent period of world food price increase. While the rise in domestic prices may be somewhat contained in countries imposing export restrictions, the adjustment burden is carried by other countries and naturally occurring shocks can become globally magnified. The asymmetry between disciplinary action on imports versus exports was pointed out during the Doha Round of WTO negotiations on agriculture, and proposals have been made for developing stronger rules on exports. From the perspective of countries in the Arab region, this is an issue of great importance, and one that deserves greater and more substantive involvement on their part in the relevant processes at WTO. More generally, multilateral trade issues, especially in the food sector, need to be viewed in a broader regional context, given the similarities in trade profiles and existing regional integration agreements, such as GAFTA, aimed at harmonizing trade policies. Working out a common regional position on trade issues would be highly desirable, both for increasing the predictability of world food markets, on which the region depends so much, and for expanding and facilitating intraregional food trade.

Food assistance programmes: In view of their high import dependence, and the frequent emergencies they face due to conflicts and other adversities, vulnerable Arab countries and their populations will continue to need international food assistance. In-kind government-to-government grant food assistance programmes have benefitted several countries in the region in earlier years, including Egypt, as well as during crises in recent years. Considering the growing incidence of emergency situations, including in the Arab region, a broadening of the food aid donor base under the Food Assistance Convention, beyond traditional contributors, would allow established multilateral institutions such as WFP to expand their food assistance to the region. One other form of assistance was envisaged in the Marrakesh Decision of the Uruguay Round Agreement in 1994, specifically for net food-importing developing countries and for LDCs. These countries may be eligible to draw on the resources of international financial institutions under existing facilities, or such facilities as may be established, within the context of adjustment programmes to address financing difficulties in importing food. Existing facilities (such as the International Monetary Fund Cereal Import Facility), have proven of marginal usefulness for affected countries. An alternative proposal by FAO and the United Nations Conference on Trade and Development (UNCTAD) called for the creation of a food import financing facility from which eligible countries could get short-term credit guarantees to import food in the event of soaring food import bills.

6. Food Loss and Waste, an Additional Concern for the Region



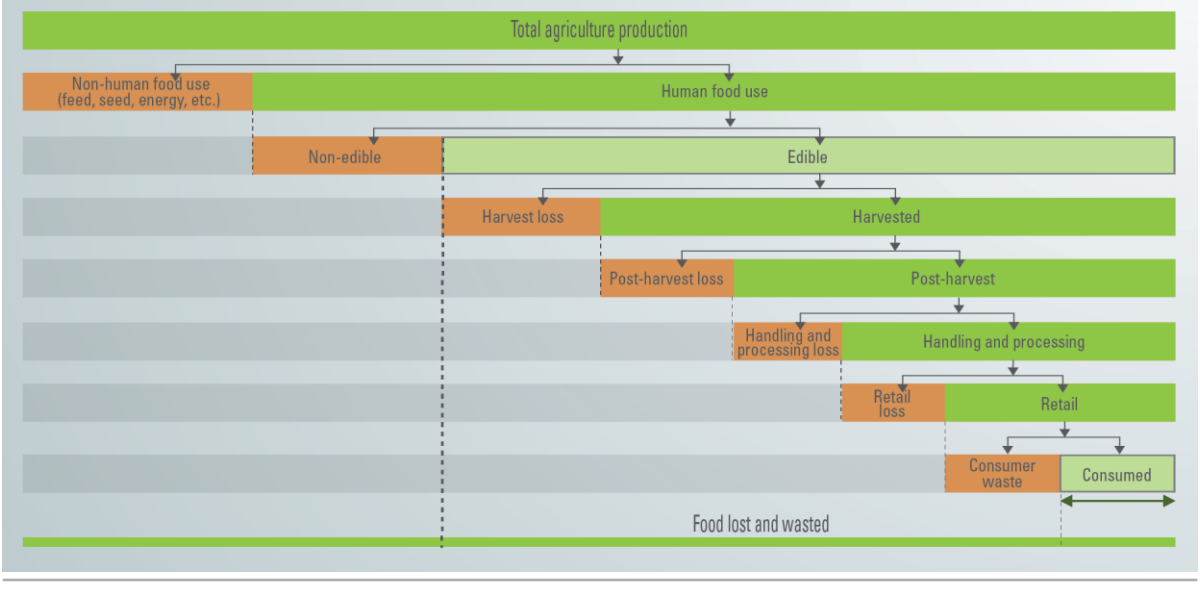


6. Food Loss and Waste, an Additional Concern for the Region

A. What is food loss and waste? How is it measured?

Food loss refers to decreases in food mass occurring during the stages of production/harvest, post-harvest handling and storage, processing and retail until prior to consumption, as a result of inadequate practices and technology. Food waste refers to decreases in food mass occurring at the consumption stage at the end of the food supply chain, usually as a result of consumer behaviour (figure 6.1). Food loss and waste have significant impacts on food security, as they lead to reduced quantities of food being physically available and accessible, due to inadequate handling, storage and processing, as well as food degradation, contamination or deterioration. Food loss and waste lead to reduced income and revenue for food producers, and increased prices for consumers, and they exacerbate the depletion of water, energy and soil nutrients, as production is increased to compensate for losses and wastes. It is estimated that, in weight terms, about one third of the food produced globally is lost or wasted, which corresponds to about one quarter of the global food produced in caloric terms.

Figure 6.1 Food loss and waste along the supply chain



Source: Adapted from HLPE, 2014.

Food loss and waste are receiving increasing attention at national, regional and global levels. The issue came to the forefront of debate on food security during the 2008 food crisis, when it was recognized that the negative impact of price shocks on food availability and access would have been dramatically reduced if less food had been lost and wasted. Food loss and waste are addressed in the SDGs under Goal 12, "ensuring sustainable consumption and production patterns". More specifically, target 12.3 calls, by 2030, for countries "to halve per capita global food waste at the retail and consumer levels, and reduce food losses along production and supply chains, including post-harvest losses".[86]

Perhaps unsurprisingly, given how recently the issue has been recognized, the measurement of food loss and waste has not yet been standardized, and data collection efforts are in their infancy. There are two principal aspects of such measurement that have been the subject of debate: the appropriate units of measurement, and the methodology to be used for obtaining estimates. Most commonly, food loss and waste has been assessed in units of weight. Measuring based on weight is problematic, because food items with a high water content, including fruit and vegetables, will account for the bulk of food loss and waste. In recent years, attempts have been made to express food loss and waste based on caloric or nutrient content, which tilts the heaviest losses towards cereals; or in economic terms, which puts more emphasis on high-value foodstuff such as animal products. The use of nutrient content measures has the advantage of affording a close link to food access and utilization issues, while the use of economic measures has the advantage of accounting for implications in terms of expenditure and revenue.

To date, two separate methodologies are being used to arrive at estimates of food loss and waste: entity-based and supply chain-based. Local and national entities, including trade boards, wholesalers, restaurants and supermarkets, can provide data that is then aggregated to obtain national estimates. Alternatively, the structure of major supply chains, such as cereals, meat and dairy commodities, can be followed. Entity-based methodologies will miss important data in countries that are dominated by small farmers, wholesalers and retailers. The supply chain-based methodology provides more accurate and detailed data, but is time-consuming and costly, given the large number of different commodities.[87]

FAO is helping to standardize the measurement of food loss and waste. For the purposes of SDGs, monitoring is expected to be conducted using the so-called Global Food Loss Index. The index would be volume- and price-based; it is the prices-weighted sum of the ratio of current food loss and waste to a base period. Food loss and waste would be measured along the food supply chain, between harvest and retail, prior to consumption. In view of this, it is anticipated that the index will be sensitive to actions and policies – or the lack thereof – that impact the food supply chain, while being unresponsive to changes such as improvements in consumer behaviours.[88]

B. The drivers of food loss and waste in the Arab region vary by country

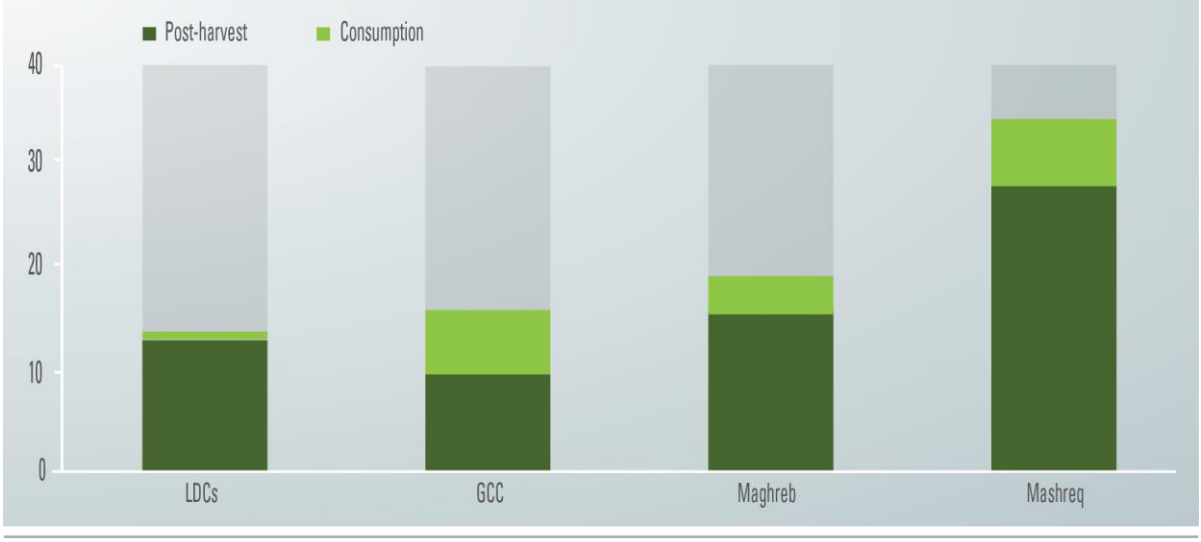
In the region, food losses are largely driven by poor farming; inappropriate and deficient post-harvest practices and technologies for handling, transporting and processing; and rodent and

pest infestations during storage. Food loss at the retail level is a result of deficient market infrastructures, including inadequate refrigeration, poor transportation and reliance on open air stalls, where food products are exposed to pollution, heat, humidity and sunlight, which accelerate the rate of food degradation. At the consumption level, food waste is due to overstocking and oversupply. However, other food loss and waste drivers may include: marketing deficiencies, high transaction costs, inadequate financing and investment, and deficiencies in sanitation and energy supply.[89]

The higher temperatures associated with climate change will only add to these challenges. For example, post-harvest losses may increase, if humidity increases fungal or pest infestation. The continuity of the cold chain will become increasingly essential.

At the subregional level, the Mashreq accounts for the largest amount of food loss and waste, followed by the Maghreb, and then the GCC and LDCs subregions (figure 6.2). Food waste in the LDCs remains relatively low compared to other subregions. In the low- and middle-income countries of the region, food loss and waste are in large part caused by improper food handling, inadequate infrastructure and the use of non-adapted practices and technologies. Investments in infrastructure, including roads, water and sanitation, storage and handling facilities, adequate processing and packaging, and energy provision for refrigeration, among others, would greatly impact the level of food loss and waste.[90] In the high-income GCC countries, and increasingly in the upper-middle income countries of the Maghreb and Mashreq subregions, a substantial amount of the food loss and waste occurs in the late stages of retail and consumption, largely as a result of food spoilage and excess volumes of food bought or prepared.

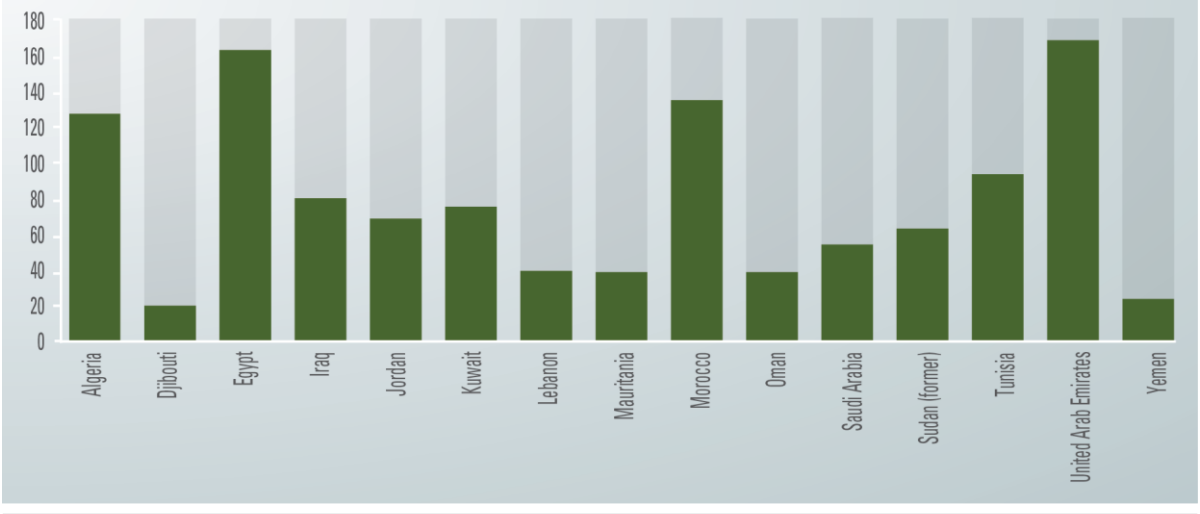
Figure 6.2 Food loss and waste by Arab subregion (million tons/year)



Source: Adapted from FAO, 2011.

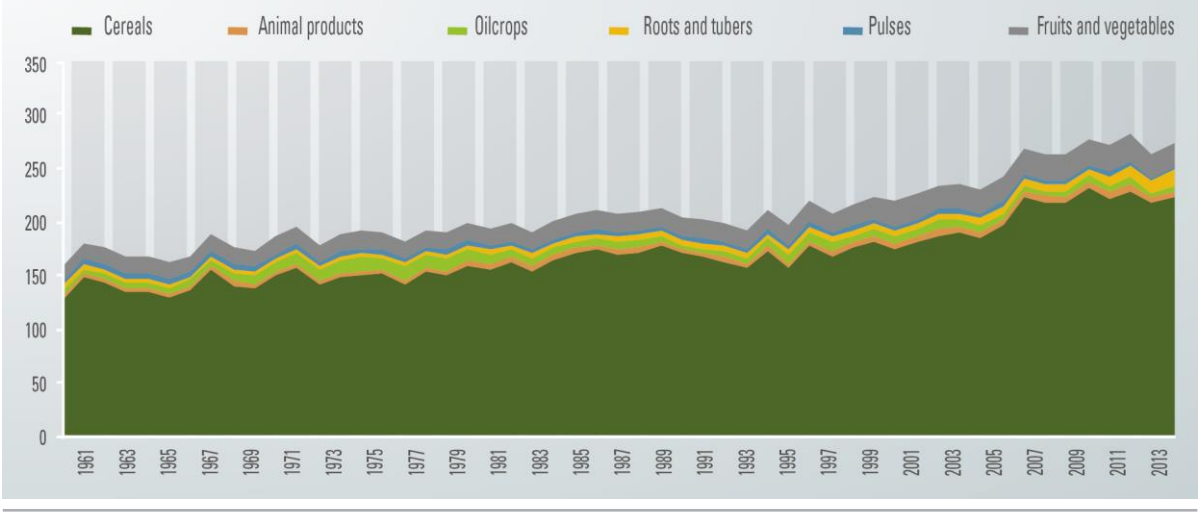
Estimates at a national level have been compiled by FAO for some countries in the region. According to these estimates, the highest levels of food loss and waste are found in the United Arab Emirates and Egypt, while the lowest levels are found in Djibouti and Yemen (figure 6.3). Because of the measurement concerns raised above, these estimates should be interpreted with care: differences between countries may be due to incomplete data or inconsistent methodologies.

Figure 6.3 Food loss and waste by country, average 2011-2013 (1,000 kcal/capita/year)



Source: FAO, 2017a; United Nations, 2015.
Note: Data for the Sudan includes South Sudan and is for the 2009-2011 period.

Figure 6.4 Food loss and waste by commodity group (kcal/capita/day)



Source: FAOSTAT Data, FAO, 2017a.

At the regional level, the above measurements show that the commodity group contributing most to the observed food loss and waste is that of cereals, followed by fruits and vegetables, and then roots and tubers (figure 6.4). It should be noted however that, as a result of gaps in the data, the aggregate level of food loss and waste is well below recent estimates of more than 700 kcal/capita/day for the region of North Africa, West and Central Asia.[91]

C. Several Arab countries are successfully reducing food loss and waste

As awareness has grown, several countries in the Arab region have begun adopting mechanisms to reduce food waste and loss. During a recent conference on food loss and waste held at the Arab Organization for Agricultural Development (AOAD), experts highlighted a few of the achievements made at the country level to reduce food loss and waste. It was emphasized that some countries were exerting substantial efforts and making investments to reduce their food loss and waste. In Iraq, for example, the government introduced new and better adapted cereal varieties, and supported the adoption of more modern harvesting practices to replace the traditional manual system. In Oman and Saudi Arabia, efforts are being made to reduce losses and waste in the fish supply chain, by providing training to stakeholders on improved handling of products and making investments to enhance the cold chain both for storage and transport. In the Sudan, a new grain handling and storage system was introduced in Port Sudan that uses silo bags, which allows for storing the grain in an airtight system, devoid of sunlight and in which the temperature, CO_2 levels, humidity and grain moisture are easily controlled and monitored, while also being safe, economic and preserving the grain at an optimal quality for an extended period of time (see also box 6.1 on storage practices). In Egypt, a food bank initiative has been set up to take advantage of the food residue from hotels and restaurants, by sorting, repackaging and redistributing it to the needy. The food bank has partnered with the Egyptian Hotel Association to reach about 400 hotels, restaurants and local coffee shops, and is now serving more than 17 million meals per month (see also box 6.2 on the role of the hospitality sector).

Box 6.1 Egypt's experience with post-harvest storage

Egypt has been at the forefront in terms of reducing food loss through post-harvest storage. Horizontal silage field bags are a lower-cost, flexible storage solution for in situ processing and storage, and one that offers a rapidly deployable response to local and regional storage issues. Suffering from up to 25 per cent grain storage loss, and keen to reduce its dependency on international grain markets, Egypt successfully tested their effectiveness in storing some 2,000 tons of wheat in its Dakahlia province. The costs were found to be significantly lower than for both burlap and metal silo storage systems. Changes in CO_2 levels inside the silo bags, grain moisture content, fungal and total microbial load count, percentage of aflatoxins, insect count, and physical, mechanical and other qualitative changes to the grain were monitored over one season, with minimal losses in grain quality and quantity reported. Long distances between production areas, ports and processing facilities also make horizontal wheat silo bags an important tool for expanding national and regional storage capability and efficiency. It also has considerable potential for reducing storage losses affecting other grains and legumes.

Sources: El-Kholy, 2015; AOAD, 2016.

Box 6.2 Food loss and waste reducing programmes in the United Arab Emirates

With over 30 per cent of all food loss and waste in the region estimated to take place at the consumption stage alone, initiatives from the United Arab Emirates have strived to raise awareness on the issue, against a backdrop of wasteful cultural and social habits among consumers. The "I'MPERFECT campaign", launched in 2015 by the Ministry of Climate Change and Environment with the support of the Food and Agriculture Organization (FAO), is one of the leading programmes showing recognition of the problem. The campaign aims at using fruits and vegetables of imperfect shapes or sizes, yet of uncompromised nutritional value, to reduce food waste and increase food surplus. The campaign also seeks to highlight the importance of food safety, irrespective of imperfectly-shaped produce, and the sustainability of local production, as well as the hierarchy of waste management, from waste reduction to reuse, segregation and recycling.

"Food Forward UAE" is another national initiative, aimed at channelling excess/surplus food from households and social events to delivery mechanisms that reach those in need. Civil society groups, like the General Women's Union in the United Arab Emirates, are promoting sustainable consumption, including through nutrition education in schools, while the Dubai municipality Food Safety Department is working through the "Grow Your Food Campaign" to promote a culture of freshness and healthy living, by encouraging residents to grow their own vegetables and herbs.

Additionally, within the country's strong hospitality sector, roundtable discussions among hotel owners and caterers were launched on World Food Day 2014, highlighting best practices, citing awareness-raising in schools, and underscoring the need to sustain such programmes over the long term in order to change consumer habits and reduce waste.

The Dubai municipality has recently teamed up with United Kingdom-based Winnow, a start-up that provides smart meters for hotels, which help kitchens cut food waste in half by automatically measuring everything that goes in the trash bin. This collaboration is taking place under the Dubai Future Accelerators programme, which allows the private sector to work closely with public entities to co-create breakthrough solutions benefiting the public good. Under the smart system, a meter placed under the trash bin is connected to an iPad that records the top five areas and items of waste, helping chefs make better decisions and manage waste. On average, hotel kitchens waste up to 20 per cent of the food purchased, and that number doubles during the holy month of Ramadan, due to daily lavish *Iftar* and *Suhoor* buffets.

Source: LeanPath Food Waste Prevention, 2017; Zakaria, 2017.

D. Policy options for enhancing food security by reducing food loss and waste

Appreciation of the potential for reduction in food waste and loss, to achieve target 12.3 of SDG 12 and contribute to the overall goal of food security, is a very recent phenomenon. As with any emerging field, the primary focus needs to be on improving data and raising awareness of the issue. More accurate measurement of the problem, at all stages of the food supply chain and at the retail and consumption stages, is needed on a country-by-country basis. The development of new and more efficient methods to reduce food waste and loss is also needed along the entire food supply chain, from both the private and public sectors. Equipped with better information, policymakers, the private sector and consumers can then mobilize efforts.

Box 6.3 New approaches to harvest and post-harvest operations in sub-Saharan Africa

In sub-Saharan Africa, food loss occurs most significantly during harvest and post-harvest operations, and is estimated to account for about 30 per cent of the food produced, far exceeding the food aid received by the region. To address these deficiencies, analyses were conducted to identify where, why and how the losses occurred, and below are the main results and scalable solutions that were identified and are being proposed to farmers and other stakeholders of the food supply chain, in order to improve overall efficiency:

- Adopting technologies to improve crop handling, transport, storage and processing. For example, the use of dryers helps reduce losses during the storage and transport of maize and cassava, while the use of hermetic bags and silos on the farm helps reduce pest infestations. Fruits can be covered with an organic solution that forms an ultra-thin coating shield, which helps maintain quality for longer periods of times, without the risk of fruit ripening too fast or losing its flavour. In addition, innovative storage systems are used to extend the shelf-life of fruits and vegetables by two to three weeks, without the need for an expensive cold storage unit. The use of crates and ultra-resistant plastic bags helps improve the handling of products during transport, which minimizes losses substantially;
- Linking farmers to buyers who are able to invest in solutions to reduce post-harvest losses. This helps strengthen the food supply chain without placing too heavy a burden on small farmers. Buyers are also able to pressure farmers, wholesalers, handlers and transporters to improve their practices, which helps decrease losses significantly;
- Linking farmers to a wider range of buyers, in order to allow for the sale of excess or non-conforming (lower quality) produce. The availability of additional buyers also helps stabilize prices, which encourages farmers to invest in post-harvest technologies, in addition to exposing them to a wider range of standards;
- Supporting farmers to operate in groups. This helps ease the adoption of improved post-harvest management skills and technologies, and better meet the requirements of markets, both in terms of quality and quantity.

Source: Adapted from Randall, 2015.

The adoption of appropriate technologies will be needed in the upstream stages of the food supply chain, including agricultural production and harvest, post-harvest storage and handling, as well as processing. For the Arab region to effectively reduce food loss and waste, it needs to adopt technological and innovative approaches, and learn from successful initiatives in other regions of the world. In sub-Saharan Africa, where more food is lost during harvest than is received in food aid, approaches are being piloted that promote the adoption of technology as well as increased coordination among farmers and between farmers and buyers (box 6.3).

Government and relevant private-sector entities involved in food logistics and food assistance programmes can effectively support food waste and loss reduction by addressing structural deficiencies, including bureaucratic red tape, taxes and regulations. At the retail level, food loss can be addressed through improved business techniques, such as inventory and production management. And at the consumption level, reforming policies, such as by discontinuing non-targeted subsidies, can also support the reduction of food waste.
In Egypt, the amount of bread wasted had reached alarming levels, which was attributed to widespread subsidies. To remedy the

problem, the government introduced a smartcard system, in which each family is entitled to a limited number of subsidized rolls of bread per day. Families not using their full allotment gain points, which can then be used to purchase other food or non-food items in government stores. It has been reported that this system led to a drop in the demand for bread of between 15 and 20 per cent, and thus to a substantial reduction in bread waste.[92] Box 6.4 provides other examples of innovative approaches at the retail and consumer levels: the European Union has developed ways to address retail-level loss by improving food product labels, while South Korea is addressing consumer-level waste by increasing the cost of household trash disposal.

Box 6.4 Innovative approaches at the retail and consumer levels: examples from the European Union and South Korea

European Union

With more than 80 million tons of food wasted every year, representing about 20 per cent of the food produced and costing more than 140 billion euros, the European Union (EU) has begun pushing for the implementation of food waste prevention measures to strengthen the sustainability of its food system. In 2012, an integrated action plan to tackle food waste was elaborated, as part of an initiative which aims to promote the use of Europe's resource base in a more sustainable manner.

Among the leading causes of food waste at retail and consumer levels are the date markings on food product labels. More than half of consumers (58 per cent) check date markings on food labels (namely, "use by" and "best before") when shopping or preparing meals, but only about one in two understand their meaning. The resulting confusion about these date markings determines the quantity of food wasted at retail and home levels. New ways of presenting these dates are being developed, to prevent food which might still be safe and edible from being discarded throughout the food supply chain. Other options being considered include extending the list of products on which there would be no date markings on labels, as is the case for vinegar, sugar, or salt, as long as there are no food safety concerns.

South Korea

Food waste at the consumer level is a significant problem in South Korea, and the government has developed several important initiatives. Under the volume-based charge scheme, introduced in 2010, households are charged a fee based on the amount of food waste they generate. Municipalities were given the option to choose among three "pay-as-you-throw" solutions, which are: paying for standard plastic bags to be used to discard food, buying stickers to attach to food-waste bins (which are not emptied if they do not carry a sticker), and the use of food-waste bins with magnetic card-readers that households must use when disposing of their waste.

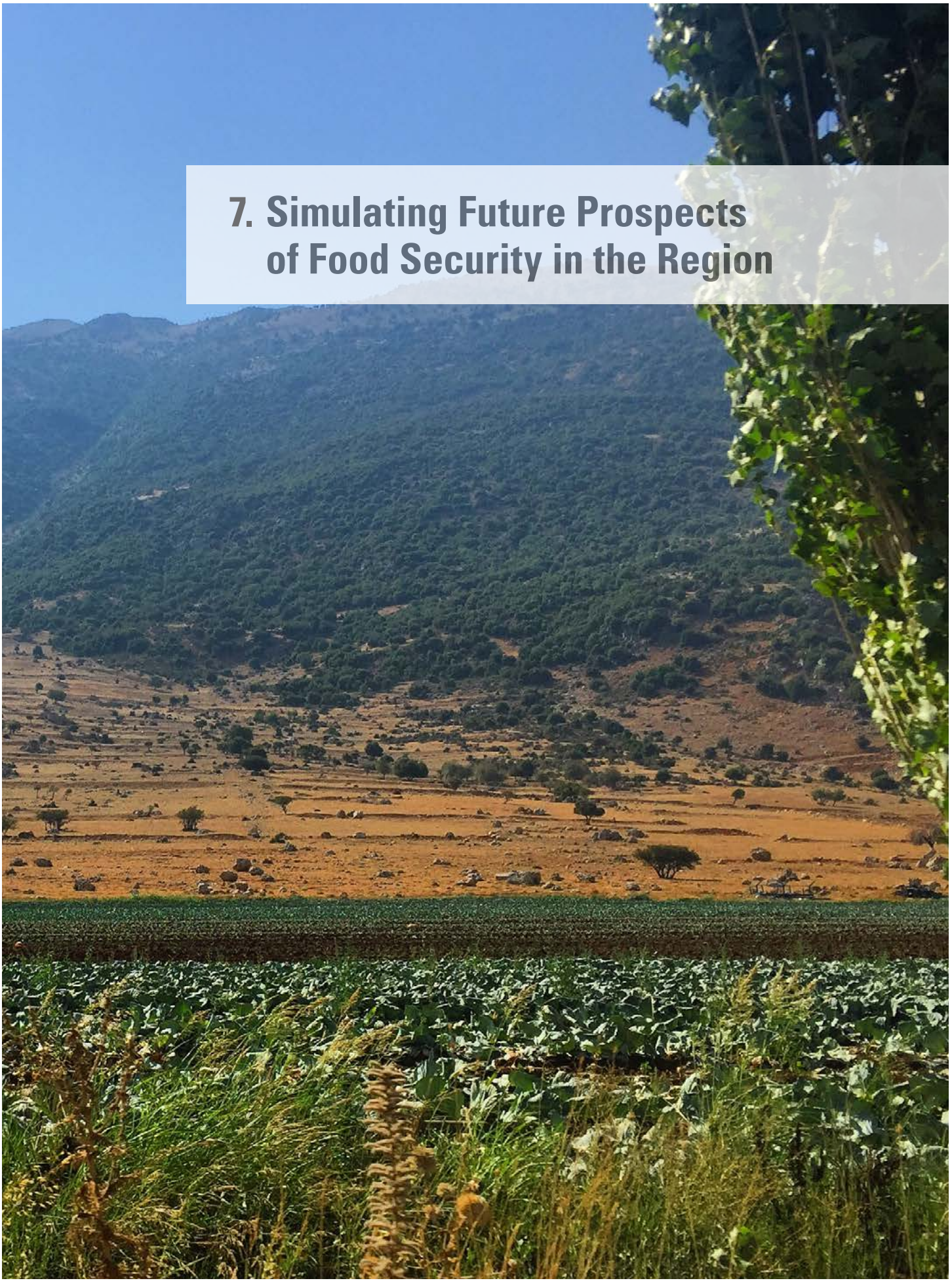
As a result of official initiatives and cooperation with various stakeholders, including restaurants, hotels and schools, the recycling rate of food waste in South Korea has risen from 2 per cent in 1995 to 95 per cent in 2009. As a result, food waste to landfills has considerably decreased, with more food waste being turned into compost or livestock feed, as well as biomass and biofuel.

Source: Adapted from European Commission, 2016; Ng, 2013.

Given the key role women play in the food supply chain, notably in food production, processing, retail and consumption, additional efforts need to be made to remove all barriers hindering their participation and contribution. They still lack adequate knowledge on good practices, and lack access to capital and resources that could help them reduce food loss and waste. The policymaking process needs to be reconsidered, in order to give more prominence to gender issues, particularly as relates to the food sector, which is usually a challenging endeavour in the Arab region.

To effectively address food loss and waste, and identify specific measures for each stage of the food supply chain, integrated approaches are needed, not only to come up with technical solutions, but also to incorporate other technological, behavioural and policy considerations. On the technology front, the aim is to prevent food loss, notably through contamination and quality degradation, by relying on cold chains, improved handling and storage, smart packaging, and improved infrastructure and communication technologies. On the behavioural front, greater education and training of stakeholders throughout the value chain will be needed, together with awareness campaigns such as on food labelling, purchase planning, in-home storage practices, portion sizes, better food preparation and so on. Finally, at the policy level, governments will need to use a combination of incentives, including subsidies, financial support and infrastructure, and disincentives, such as taxes and penalties, in order to decrease wasteful consumer behaviour.

7. Simulating Future Prospects of Food Security in the Region



7. Simulating Future Prospects of Food Security in the Region

The previous chapters explored main challenges to food availability in the Arab region and outlined a variety of actions that can address those challenges, so as to enhance the potential for achieving the targets of associated SDGs and improved food security conditions in Arab countries by 2030. Chapter 4 examined the challenges associated with the domestic production of food – notably the region's arid climate and slow improvement in yields. The chapter outlined possible avenues for increasing yields, as well as options for increasing the economic value of crops produced per unit of water. Chapter 5 addressed the vulnerabilities of the Arab region resulting from its reliance on food imports. The chapter outlined options for reducing the total quantity of food imported, as well as ways to reduce vulnerability to global price shocks. Chapter 6 examined the negative consequences of food loss (during production, harvest, handling and retail) and food waste (during consumption). For net importers, a category that includes all Arab countries, a reduction in food loss and waste would mean that smaller quantities of food would need to be imported, with positive impacts on availability and access.

The present chapter expands on the issues raised in the preceding chapters, by exploring the potential future of food security in the Arab region by 2030. In the first section, projections are made assuming a continuation of current trends, including government policies. These business-as-usual projections provide a baseline against which alternatives can be compared. They assume the continuation of technical progress on the supply side, and of consumption patterns and preferences on the demand side.

The subsequent sections develop three alternative futures. The first alternative future examines the potential impacts of increasing yields in the Arab region. The second alternative future examines the potential impacts of changing consumption patterns if the diet of the average Arab citizen becomes healthier. The final alternative future examines the potential implications of using strategic stocks of wheat to stabilize domestic prices, in the event of a global price shock.

The baseline projections and alternative future scenarios are developed using an economic model of supply and demand of world agriculture. The Aglink-Cosimo model was developed by FAO and OECD, and is used to generate outlook simulations and analyse various policy scenarios. Aglink-Cosimo is a recursive-dynamic, partial equilibrium model, based on assumptions of competitive world markets, homogenous commodities, and exogenous non-agricultural markets.

Figure 7.1 Calories from animal and vegetal sources in the Arab region in 2014-2016 and 2030 (kcal/capita/day)

Source: FAO, Aglink-Cosimo model projections.

A. What if we continue with business as usual?

The baseline projections provide a plausible scenario for medium-term trends in the region. The underlying assumptions project the current economic, political and technological patterns into the coming decade.

1. Total food availability

The baseline projections foresee considerable improvements in food availability in the region. The average daily calorie availability per person, which includes losses and waste, is currently estimated at about 3,000 calories, and is projected to reach about 3,100 calories by 2030.

Existing differences between the subregions are projected to continue. The GCC subregion would continue to have the highest level of food availability, reaching as high as 3,600 calories per capita per day in 2030. The LDC subregion, with currently about 2,400 calories per day, would make significant progress, increasing its daily calorie availability to 2,600 calories in 2030, which nonetheless remains significantly below that of the other subregions. The levels in the Maghreb and Mashreq subregions fall between those of the GCC countries and the LDCs, and their overall food availability would increase slightly by 2030. Calories from vegetal sources in the Arab region would continue to comprise most of the daily intake, well above the levels of both developed and developing country averages (figure 7.1).

2. Consumption

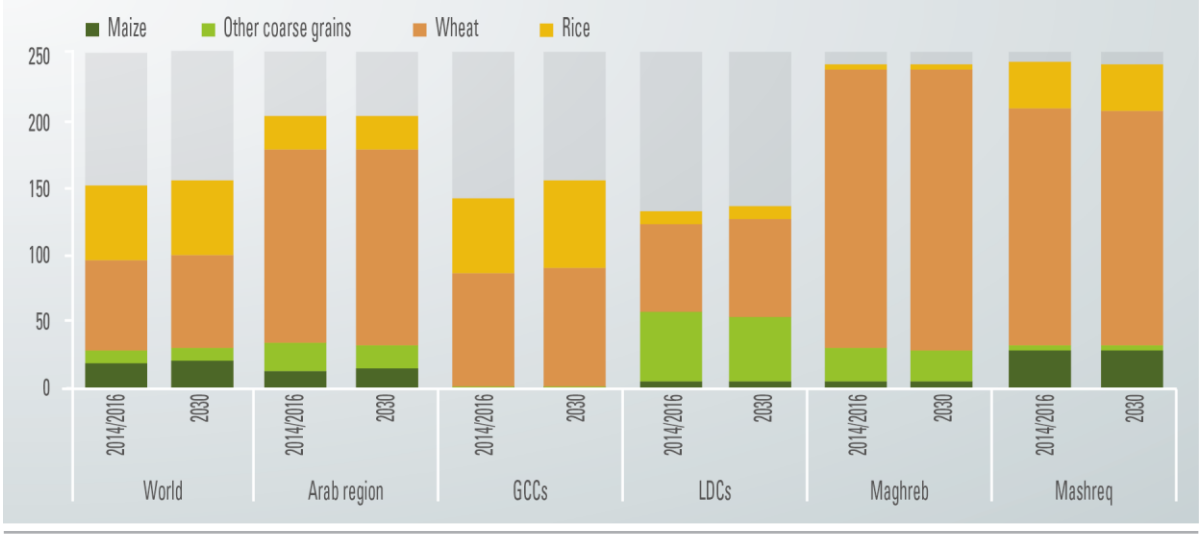
Arab diets are characterized by a very high share of vegetal foods, ranging from 84 per cent in the GCC countries to 91 per cent in the Mashreq subregion. Cereals represent the main component of the diet. Based on slower population growth and already high levels of intake, the average annual growth rate of total

cereal consumption (1.7 per cent) is expected to be slower than in the previous decade (3 per cent). Consumption differs significantly by subregion, based on income levels and dietary preferences. In the LDCs, the level of cereal consumption remains the lowest within the Arab region, but the gap is expected to narrow further in the coming years (figure 7.2).

Wheat would account for 71 per cent of the total consumption of cereals in the region throughout the projection period. Coarse grains, such as millet and maize, the second most important staple items, which have declined in per capita consumption in the LDCs, would decrease in favour of other cereals, mainly wheat, a trend observed in the whole Arab region. Maize consumption is significant primarily in the Mashreq subregion, where the current consumption level of 27 kg per year is expected to remain largely unchanged until 2030. Rice has traditionally played a minor role in the region. However, per capita consumption of rice in the GCC subregion has been significant, and the level is expected to increase further, from 54 kg to 65 kg per year during the projection period, reflecting the increasing number of migrants from South-East Asian countries.

Per capita sugar consumption in the Arab region, at 31 kg per year, already exceeds the global average of 24 kg per year. Despite this already high level, per capita consumption is expected to expand by around 0.9 per cent annually, and by 2030, the average consumption would be 37 kg of sugar per year. The highest consumption levels are foreseen in the Maghreb and the Mashreq, the middle-income subregions. Nevertheless, most of the increases in consumption are expected to come from the GCC and LDC subregions.

Figure 7.2 Cereals continue to provide the bulk of calories in the Arab region in 2014-2016 and 2030 (kg/capita/year)



Source: FAO, Aglink-Cosimo model projections.

Population growth is foreseen to be the main driver of additional vegetable oil demand in the region. However, based on income gains, the average per capita consumption would also increase slightly, from 20.5 to 22 kg per year, reaching a level just below the global average. Considerable variations would be observed, however, in consumption levels across the subregions, as the GCC subregion continues its fast growth, increasing per capita consumption by 1.6 per cent annually to reach almost 20 kg per year by 2030. Meanwhile, per capita consumption in the LDC subregion would remain at 10 kg per year per person in 2030, even after increasing the domestic availability by half a kilogram per capita annually, reflecting the subregion's low per capita income level. The Mashreq is the subregion with the highest per capita consumption, and it is expected to remain so by 2030, despite growing only at 0.3 per cent annually. A similar development is expected to occur in the Maghreb, where per capita consumption increases slightly faster, at 0.7 per cent per year. This can be partly explained by a lower saturation level compared to the Mashreq. The varying levels of per capita consumption and its growth across subregions is also due to their differing levels of urbanization, in which out-of-home consumption becomes more common and access to processed foods containing oil is much greater than in rural areas.

While calories from animal sources make up a relatively small share of the total calorie intake in the Arab region, dairy products are becoming an increasingly important nutritional component in the region, and over the projection period, consumption would grow at 2.6 per cent annually, faster than the global average of 2.3 per cent per year. Per capita consumption of dairy products would increase over the projection period, at a faster rate than in the previous decade, except for the GCC subregion, where a large increase in dairy consumption has already occurred in recent years. The biggest increase in dairy consumption, mainly in fresh forms, is projected for the LDC subregion, where consumption would reach 18.1 kg (dry equivalent) by 2030 – the highest in the region and above the global average. Per capita availability would reach 15 kg in the Maghreb, 10 kg in the Mashreq and 14 kg in the GCC countries. Despite a lower per capita consumption of total dairy products, the GCC subregion would consume much more processed dairy products: butter (14 per cent), cheese (43 per cent) and powders (44 per cent). Milk powders would continue to make up a significant share of dairy consumption in the Maghreb, especially due to their use in the domestic production of fresh dairy products. Butter and cheese consumption is mainly relevant in the Mashreq subregion.

The Arab region consumes about 28.8 kg per person of meat per year, a figure which by 2030 would increase to about 30 kg per year. However, there are large differences in the levels and types of meat consumed across the subregions. The GCC subregion has a per capita demand of 64 kg of meat per year, with poultry accounting for 73 per cent of this demand, while the demand in the LDC subregion amounts to only 17 kg per year, with sheep meat accounting for almost 46 per cent of the total, and beef and veal accounting for 35 per cent. These differences in demand reflect socioeconomic conditions: the GCC subregion is characterized by urbanization and high per capita income, while in the LDCs, cattle are an important asset and means to store wealth. By 2030, the per capita meat demand in the GCC countries would increase by almost 7 kg per year, while in the LDCs, the consumption would remain virtually unchanged. In the Maghreb and Mashreq subregions, increasing

per capita income is expected to stimulate poultry consumption, while consumption of other types of meat would remain virtually unchanged.

Protein intake is expected to increase, most notably in the GCC subregion, where higher demand for dairy and meat products is foreseen, driven by income gains. The lowest growth is expected in the Mashreq subregion, because of small gains in the demand for animal products. The average daily protein availability in the Arab region is projected to reach 90 g per person by 2030. However, large differences would remain among countries in the region, as the level of availability rises to almost 105 g per person in the GCC countries, but remains at 72 g per person in the LDCs, maintaining a considerable consumption gap within the region.

3. Domestic food production

The share of cereals in total cultivated land is expected to remain high over the projection period. Wheat production is expected to increase by 5.6 million metric tons, to reach close to 30 million metric tons by 2030, driven by yield gains. The Mashreq subregion is expected to remain the largest producer, mainly due to Egypt, which will remain the single largest producer in the region. Maize production is closely linked to the development of the feed industry in the region. Its share of the total cereal area is projected to remain constant, at around 5 per cent, over the projection period. Yields in the Arab region are currently 4.3 metric tons/ha on average, below the world average of 4.9 metric tons/ha. By 2030, yields in the Arab region could reach 5.6 metric tons/ha. Other coarse grains, mainly millet, make up a smaller share in terms of food consumption, but account for close to 60 per cent of the total cereal area harvested in the region. Average yields in the Arab region are projected to reach 0.8 metric tons/ha by 2030. Rice production would remain marginal, at around 2.5 per cent of the total cereal area in the region.

The expansion of sugar production is projected to be faster than that of cereals and oilseeds, growing at 3 per cent annually and reaching close to 5.4 million metric tons by 2030. Nevertheless, sugar imports would increase to about three times the level of domestic production by 2030.

Oilseeds crush is projected to grow by around 1 per cent annually over the projection period, a considerable slowdown compared with the previous decade, which had witnessed a growth of 6 per cent per year. The exception here would be Egypt, where domestic crush demand is likely to be boosted by the country's expanding poultry and beef sectors. Overall, the projected growth in feed demand would still outpace growth in domestic production.

Only a very small share of the vegetable oil (not counting olive oil) consumed in the Arab region would be produced domestically. By 2030, more than 10 million metric tons, out of the projected 11.5 million metric tons of domestic demand, are expected to be imported.

Total milk production in the Arab region is projected to expand by around 2.3 per cent annually, above the projected global rate (1.9 per cent) but below the developing countries average (2.7 per cent). Most of the additional production would come from an expansion of the dairy herd, which would grow by 14 per cent over the projection period. As is the case with the agricultural sector overall, however, access to resources and challenging weather conditions are likely to constrain future expansion of milk

production in the region. Moreover, despite annual yield gains of 1.2 per cent, production in the region is expected to remain at the level of low inputs – low yields and, without structural changes in the dairy sector, the yield level is expected to remain well below the global average. Aggregate dairy consumption in the region would thus outgrow production, and the gap between supply and demand would be bridged through trade, which is expected to grow by 2 per cent annually.

Meat production in the Arab region is expected to expand by 1.6 per cent per year. Within the Arab region, the distribution of the meat supply across subregions is projected to remain unchanged. Despite production being constrained by the scarcity of water and pasture land, output of sheep meat is expected to continue its rapid expansion. Poultry accounts for around 50 per cent of the total meat production in the region, and its share is expected to increase further. This rapid expansion would also be responsible for the increasing demand for feed grains, particularly maize. Although meat production in the region is expected to expand at a rate above the global level, this would not be sufficient to cover the increase in domestic demand. As a result, meat imports, which currently amount to about 4.1 million metric tons, would increase to around 6 million metric tons by 2030.

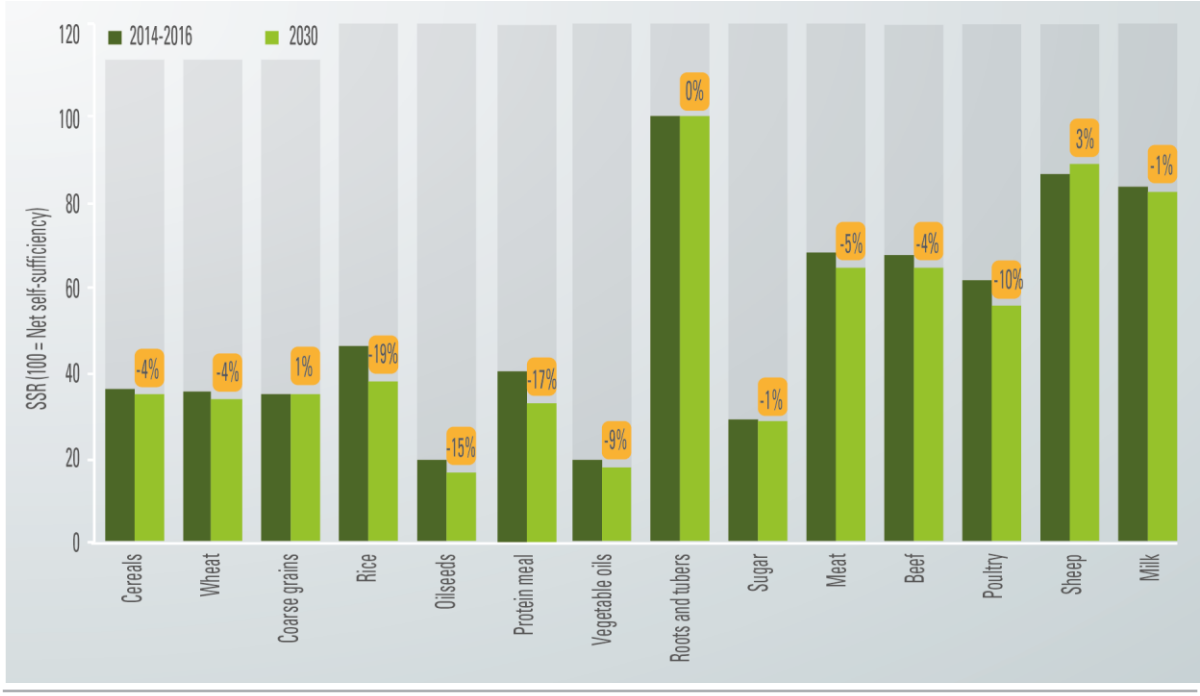
4. Food imports

Food self-sufficiency ratios in the Arab region, which have been declining, are projected to continue their decreasing trend due to the widening gap between domestic supply and demand. Consequently, the Arab region as a whole would increasingly rely on imports to meet its food needs. The highest dependency by 2030 would be in oilseeds and vegetable oils, with self-sufficiency ratios remaining below 20 per cent (figure 7.3). For cereals, the ratio remains at around 34 per cent and, for sugar, at 28 per cent. Animal products, with current self-sufficiency ratios of around 83 per cent for dairy and 66 per cent for meat, are also projected to see their ratios decrease over the projection period to 78 per cent and 63 per cent, respectively, as domestic production would not be able to keep pace with the strong growth in demand.

The large differences in self-sufficiency ratios across animal and vegetal products reflect the efforts of several governments in the region to reduce import dependency on value-added livestock products through an import substitution policy, which also explains the increasing dependency on feedstuffs used in meat and dairy production. An additional rationale is that livestock and dairy products are harder to transport over long distances, and that they represent an important source of income for many small farmers in the region.

The trade balance for cereals, which had been negative in the past, is expected to continue to worsen. By 2030, net imports of wheat into the Arab region would be twice the aggregate regional production, and the region would account for one-third of total world wheat imports, while projected to constitute only 6 per cent of the world population. Net imports of coarse grains in the region are expected to account for around 22 per cent of total world imports in 2030, with GCC countries accounting for the largest share, due to growing livestock production in their subregion. While the wheat trade deficit would largely be due to population growth, increasing imports of coarse grains would be primarily used to feed the growing livestock sector, with commercial poultry production absorbing the largest share of imported feedstuff.

Figure 7.3 Self-sufficiency ratios in the Arab region in 2014-2016 and 2030



Source: FAO, Aglink-Cosimo model projections.

B. Alternative scenarios

The baseline or business-as-usual projections provide an overview of agricultural markets, assuming the continuation of previous trends and normal conditions. They, therefore, provide a plausible scenario for medium-term trends in the region. However, it is also possible to assume an alternative path for one or more variables of interest, which would provide a different outcome or alternative future scenario, the results of which can be compared against the baseline. The following sections analyse alternative scenarios that were simulated with the Aglink-Cosimo model. Quantitative analyses were conducted on the basis of national accounts, no household or farm level studies were included.

C. What if we improve cereal yields?

Chapter 4 explored in detail the factors that determine food production in the Arab region. That chapter explained that, whereas in most of the world, increases in production generally come from increasing yields, production increases in the Arab region have come primarily from the expansion of the area under cultivation. Yield improvements for the region as a whole have been well below world averages.[93] The chapter showed the significant potential for yield increases in the region, and offered examples of approaches, currently being used in specific locations, which could be scaled up. Achieving such progress would require substantially improved seeds, combined with further investments into productivity and intensification, mainly irrigation, where possible.[94]

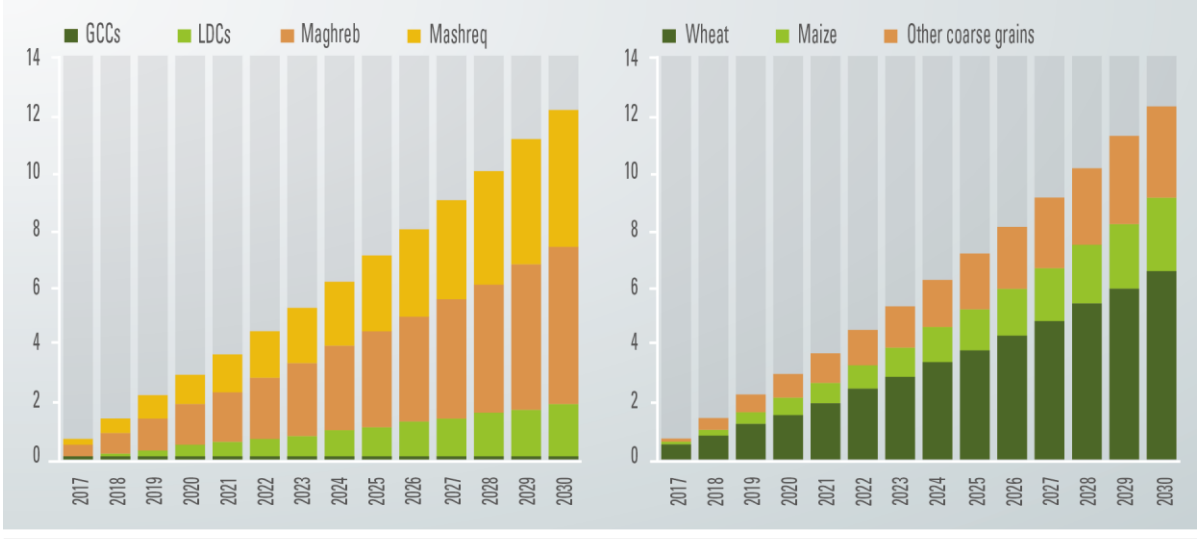
To illustrate the potential implications of yield improvements above the trend growth assumed in the baseline, yields of wheat, maize and other coarse grains are gradually increased over the projection period, to reach values 25 per cent higher than their baseline values by 2030 (figure 7.4).[95]

For the target year 2030, such an improvement is projected to increase annual cereal production in the Arab region from 54 to 66 million metric tons. The increased area productivity in Arab countries results in only slightly lower domestic and international cereal prices.

Figure 7.4 Projected cereal yields in the Arab subregions (MT/ha)

Source: FAO, Aglink-Cosimo model projections.

Figure 7.5 Production gains by subregion (left) and by crop (right) over the projection period (million MTs)



Source: FAO, Aglink-Cosimo model projections.

By crop, wheat output expands by 6.5 million metric tons, and the production of coarse grains (maize and other coarse grains) by 5.7 million metric tons (figure 7.5). By subregion, the Maghreb and the Mashreq, the two main grain-producing areas, account for 84 per cent of the production increase in the Arab region. The remaining 16 per cent increase would be in the LDCs, since there is no significant production in the GCC subregion.

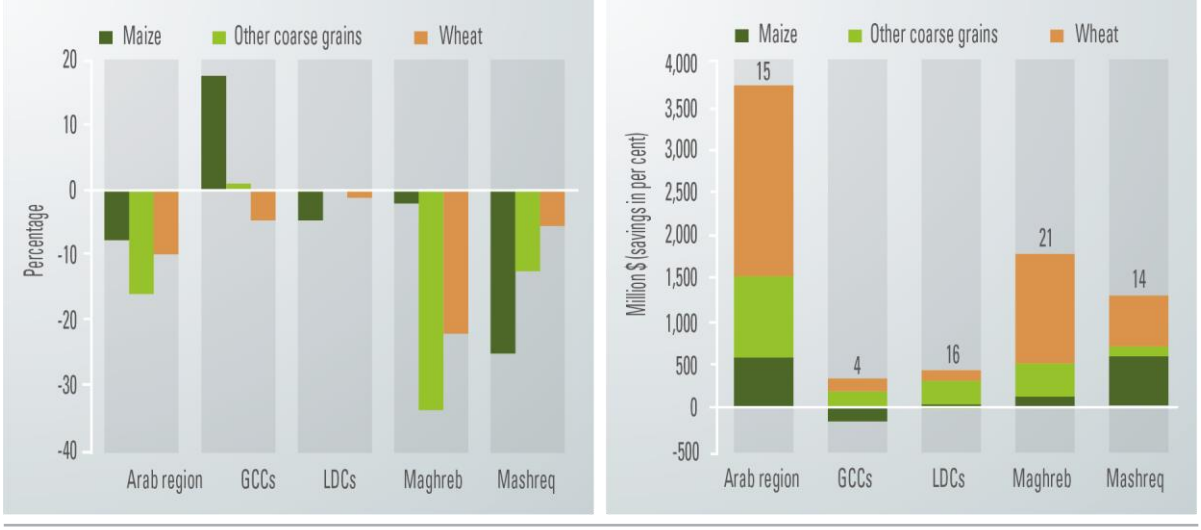
The additional production reduces imports by almost the same amount, because domestic cereal consumption increases only marginally. This means that Arab region import volumes are reduced by 10 per cent for wheat, 8 per cent for maize and 16 per cent for other coarse grains. All subregions follow a similar pattern of import reduction, with the exception of the GCC subregion, where net imports of maize and other coarse grains increase. Coarse grain production in the GCC subregion is negligible, so lower global prices induce higher imports. Therefore, the GCC region indirectly benefits from yield increases in other subregions (figure 7.6, left).

In 2030, efforts to improve cereal yields beyond baseline assumptions would reduce the value of cereal imports into the Arab region by about 14.5 per cent, equivalent to $3.8 billion. The Maghreb subregion would reduce the value of its imports by around 21 per cent, as would the Mashreq subregion, by 14 per cent, reaching close to $3.1 billion combined. The remaining savings would be achieved in the LDC ($0.5 billion) and GCC ($0.2 billion) subregions (figure 7.6, right).

Compared to the baseline, the Arab region's self-sufficiency ratio for cereals increases from 34 per cent to 41 per cent by 2030 (figure 7.7, left). The impact by subregion is similar to the overall impact, with the

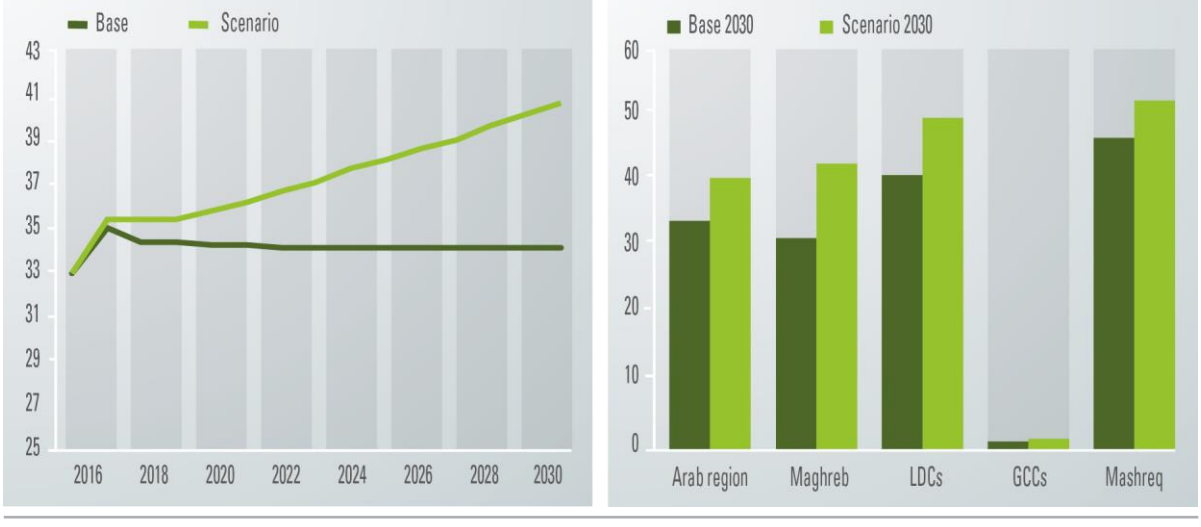
largest change projected for the Maghreb subregion, where the self-sufficiency ratio rises by about 35 per cent, whereas the impact on the GCC subregion is near zero, due to a very low level of base production (figure 7.7, right).

Figure 7.6 Impact of yield improvements on trade in 2030



Source: FAO, Aglink-Cosimo model projections.

Figure 7.7 Impact of yield improvements on cereal self-sufficiency ratios in the Arab region (percentage of production/consumption)



Source: FAO, Aglink-Cosimo model projections.

The baseline assumes continued yield gains, in line with historic trends. The additional yield improvements in the scenario are sizeable, and would be challenging to achieve in the medium-term. Such increases would require considerable investments in productivity and infrastructure by the public and/or private sectors. Farmers may not have sufficient incentives to undertake such investments, as the competitiveness of domestic production relative to imports may not be assured, making investment very risky. Protection or support from national governments would be necessary to either give incentives to the private sector or provide direct public-sector investments. Governments may support access to high-yield seed varieties, fertilizers and other chemicals, as well as the upgrading of irrigation systems and storage facilities. Countries may also consider using public procurement systems to buy cereals at above-market prices. Alternatively, protective tariffs could be imposed to increase domestic prices, which, however, would have to be offset by additional subsidies to avoid burdening consumers.

The scenario is based on an analysis of the primary agricultural sector that does not take macroeconomic variables like national per capita income into account. No income effect on food security can be quantified, but it can be assumed that an increase in cereal yields would improve food security if it is achieved through an increase in labour productivity resulting in higher farm incomes. The additional income would enhance economic access to food in rural areas. Moreover, the higher volumes of domestic production could also have a multiplier effect along the value chain, leading to expansions in the processing sector in rural areas. However, the scenario does not consider farm level income or implications for the processing sector explicitly.

Policymakers may also be motivated to invest in raising average cereal yield levels in order to increase supply stability. In the past, harvest failures in major exporting countries have led to export restrictions, creating difficulties for the Arab region to ensure sufficient import volumes. Increasing domestic production can thus be an option for reducing exposure to supply variability in world markets. In the wake of the food price crisis of 2007-2008, the Arab region increased its emphasis on food security by strengthening food sovereignty. Nevertheless, such strategies should be carefully evaluated for their long-term viability, while individual projects should also be assessed for their efficiency and sustainability. For example, energy-intensive seawater desalinization or deep well groundwater extraction may provide the additional water needed to sustain high cereal yields in the short term, but they most probably will not be economically feasible or environmentally sustainable in the long run.

The scenario shows that pushing cereal yields above trend would boost domestic production and reduce import dependency in the region. Policy decisions to support yield improvement programmes should be motivated by objectives such as reducing import supply uncertainties and promoting rural income growth. Besides efforts to improve the productivity of traditional crops, the diversification of farms along value chains, as well as into alternative commodities, are additional options to generate income and strengthen resilience in rural areas. A holistic approach guiding strategic investments by both the public and private sectors would have the ability to achieve inclusive growth and shared prosperity. While public investments into infrastructure, research and extension are critical, creating an enabling environment that would promote private investment is certain to

pay off, in ways that would be able to stimulate continued economic transformation.

D. What if we shift to healthier diets?

At its current level of around 3,000 kcal per day, food availability in the Arab region is well above those of developing countries (2,796 kcal per day) and the world (2903 kcal per day). The increase in food availability over time, however, has not been accompanied by a commensurate increase in food variety, due to income constraints and dietary preferences. The diet in the region consists, to a large extent, of cereals, sugar and oil, and heavily subsidized cereals accounted for up to 60 per cent of the total caloric intake during the period between 2009 and 2011.[96] A diet excessively high in sugar and fat, combined with insufficient physical activity, can increase the risk of overweight, obesity and related non-communicable diseases, and the region already exhibits some of the highest levels of prevalence of obesity in the world.

As there is no single definition of a healthy diet, the projection builds on two references to derive a healthy diet for the scenario exercise: the Food-based Dietary Guidelines for the Arab Gulf Countries[97] and the Dietary Guidelines for Americans 2015-2020, issued by the United States Departments of Agriculture (USDA) and Health and Human Services (HHS).[98] The first provides ranges of daily intake for various groups of food, reflecting cultural preferences in the region. It does not, however, provide specific intake quantities for each food group based on specific eating patterns and calorie intake level, making it difficult to determine the concrete shares of each food group for the scenario exercise. The HHS-USDA guidelines present three specific eating patterns (United States-style, Mediterranean-style and vegetarian), along with the corresponding intake levels in caloric terms. A diet of 2,200 kcal was selected for the scenario, as it closely reflects the daily recommended caloric intake of an adult.[99] Among the three eating patterns presented in the HHS-USDA guidelines, the United States-style eating pattern was chosen as one most closely in line with the ranges provided by the Dietary Guidelines for the Arab Gulf Countries. The scenario exercise introduced a small modification to the United States-style pattern provided in the HHS-USDA guidelines, reducing dairy consumption by 70 grams a day, to allow the set-up to account for sugar consumption, fixed at 10 per cent of the total energy intake, as per WHO/FAO recommendations for maximum amount of sugar intake.[100] Finally, a waste factor[101] of 30 per cent was added to food consumption, to arrive at the simulated per capita food availability of 2860 kcal per day. The proposed healthy diet is summarized in table 7.1.

Based on these general recommended eating patterns for major food groups, eating patterns are derived, at the country level, using the baseline consumption shares of the foods included in the Aglink-Cosimo model. The scenario assumes that the transition to the new dietary pattern takes place over the period of 2017 to 2026, after which it is held constant up to 2030, with the total demand adjusted in relation to population growth (table 7.2). The healthy diet requirements include a significant increase in meat consumption: for the Maghreb, Mashreq and GCC subregions, the growth in the consumption of red meat, poultry and eggs is kept proportional to their share of total meat consumption in the baseline, assuming a continuation of historical trends in consumer preferences for specific types of meat, and the production systems in which each subregion or country has specialized. However, for the LDC

subregion, maintaining the baseline shares of different meat groups would require an increase in red meat consumption that exceeds the recommended daily intake of 71 grams, as per the Dietary Guidelines for the Arab Gulf Countries. Therefore, in the LDC subregion, red meat consumption is set up to reach the maximum recommended level in 2026-2030, with the remaining increase accounted for by poultry and eggs.

The purpose of the scenario exercise is not to offer concrete recommendations of dietary patterns that should be followed by countries in the region. Rather, by simulating a shift towards a diet which exchanges cereals for animal products – commonly considered healthier by various authorities on diet and nutrition – the exercise seeks to shed light on the potential agricultural market and trade impacts of this shift, and highlight their implications for the agricultural sector and related policies.

The scenario does not take into account any farm or household-level implications. Consumers are assumed to have the income needed to afford the dietary transition. Due to data limitations, the scenario focuses only on the basic food commodities included in the OECD-FAO Agricultural Outlook.[102] The new healthy diet assumes a large increase in fruit and vegetable (including pulses) consumption, but implications for their markets, such as potentially higher prices, are not accounted for in the model.

Table 7.1 Healthy diet set-up based on Food-based Dietary Guidelines for the Arab Gulf Countries and HHS-USDA Dietary Guidelines

Food group	Arab Gulf Countries Dietary Guidelines (grams/day/capita) Recommended food consumption		Adapted USDA healthy diet 2,200 kcal/day (grams/day/capita)	Adapted USDA healthy diet 2,200 kcal/day (kg/year/capita)	Proposed healthy diet 2,860 kcal/day (kg/year)
	Minimum	Maximum	Food consumption	Food consumption	Food availability[e]
Cereals	180	330	198	72.4	94.2
Dairy	750	1,250	680	248.2	322.6
Meat, poultry and eggs[a]	100	200	128	46.6	60.5
Vegetable oil	-	-	30	11.0	14.2
Sugar[b]	-	-	59	21.5	28.0
Vegetables[c,d]	600	1,000	1,020	372.3	484.0
Fruits[d]	400	800	680	248.2	322.7
Fish	-	-	36	13.3	17.3
Oil-crops	-	-	20	7.4	9.6
Other	-	-	16	5.9	7.6

Source: Musaiger and others, 2012; HHS and USDA, 2015.
[a] The Arab Gulf Countries Dietary Guidelines include fish and oil-crops under recommendations for meat, poultry and eggs.
[b] Sugar is calculated based on FAO/WHO recommendations.
[c] Vegetables include pulses.
[d] Treated as exogenous in the model.
[e] Refers to food availability with a factor of 1.3 to account for waste.

Table 7.2 Required food availability (million tons) by food group: actual (baseline year: 2016) and assumed by scenario (scenario year: 2030)

Region	Food availability	Cereals	Red meat	Poultry and eggs	Dairy (milk equivalent)	Sugar	Vegetable oil
Mashreq	Actual	39.10	2.00	2.68	1.67	5.45	4.19
	Scenario	21.00	4.94	7.28	10.95	6.69	3.17
Mashreq without Egypt	Actual	13.50	0.63	1.39	0.62	1.94	2.24
	Scenario	10.00	1.34	3.79	4.61	3.41	1.50
Maghreb	Actual	22.20	1.19	2.23	1.35	3.34	2.05
	Scenario	10.20	2.49	4.05	5.03	3.03	1.54
GCC	Actual	7.50	0.88	2.97	0.81	1.34	1.07
	Scenario	5.90	1.12	3.95	3.28	1.31	0.95
LDCs	Actual	12.60	1.31	0.41	1.53	2.78	0.91
	Scenario	12.50	4.36	3.67	6.18	3.72	1.89
Arab region	Actual	81.50	5.39	8.29	5.36	12.90	8.21
	Scenario	49.60	12.92	18.96	25.45	14.74	7.55

Source: FAO, Aglink-Cosimo model projections.

The model assumes the continuation of economic principles that currently define the agricultural sector in the Arab region into the future. External factors that determine the relative role of domestic production and imports in the region, which shape the baseline projections, also apply to the scenario. The simulated domestic production response, relative to an expansion of imports, results from these assumptions and describes one possible scenario. The scenario does not assume significant structural changes stemming from resource constraints, nor does it assume that policy objectives, such as set self-sufficiency ratios, influence the results. Such considerations would have to be addressed in a separate study. The extent to which local production should be pursued to support the dietary change needs to be based on a thorough assessment of relevant local conditions along the entire value chain. This simulation exercise offers only an overarching scenario to support such analysis.

Although the healthy diet scenario assumes a significant reduction in cereal consumption, the total demand for cereals in the region in 2030 is expected to be in line with the baseline projections. A considerable increase in cereal feed use, in response to the expanding livestock and dairy sectors, would offset the reduction in food demand. Cereal feed demand would grow at a rate close to six times faster than in the baseline projections, reaching by 2030 nearly 150 per cent of the values observed in 2014-2016.

The increase in feed demand would also reshape the consumption share of different cereals. The share of feed grains, particularly maize, would increase, whereas those of wheat and rice would decline. The share of coarse grains in total cereal consumption would increase from 42 per cent in the 2014-2016 period to 63 per cent in 2030, according to model estimates, based on the expected expansion of domestic livestock production. Such increase in coarse grain demand would necessitate a change in crop production, increasing the production of coarse grains significantly by 2030, at the expense of wheat and rice. However, this transition from wheat

and rice to maize production would not be a seamless process, and total cereal production in the Arab region would grow at a slower rate, namely at 21 per cent by 2030, compared to the baseline projection of 23 per cent. Consequently, additional imports would be needed to meet higher feed demands and, as a result, the region's self-sufficiency ratio would be lower than projected in the baseline.

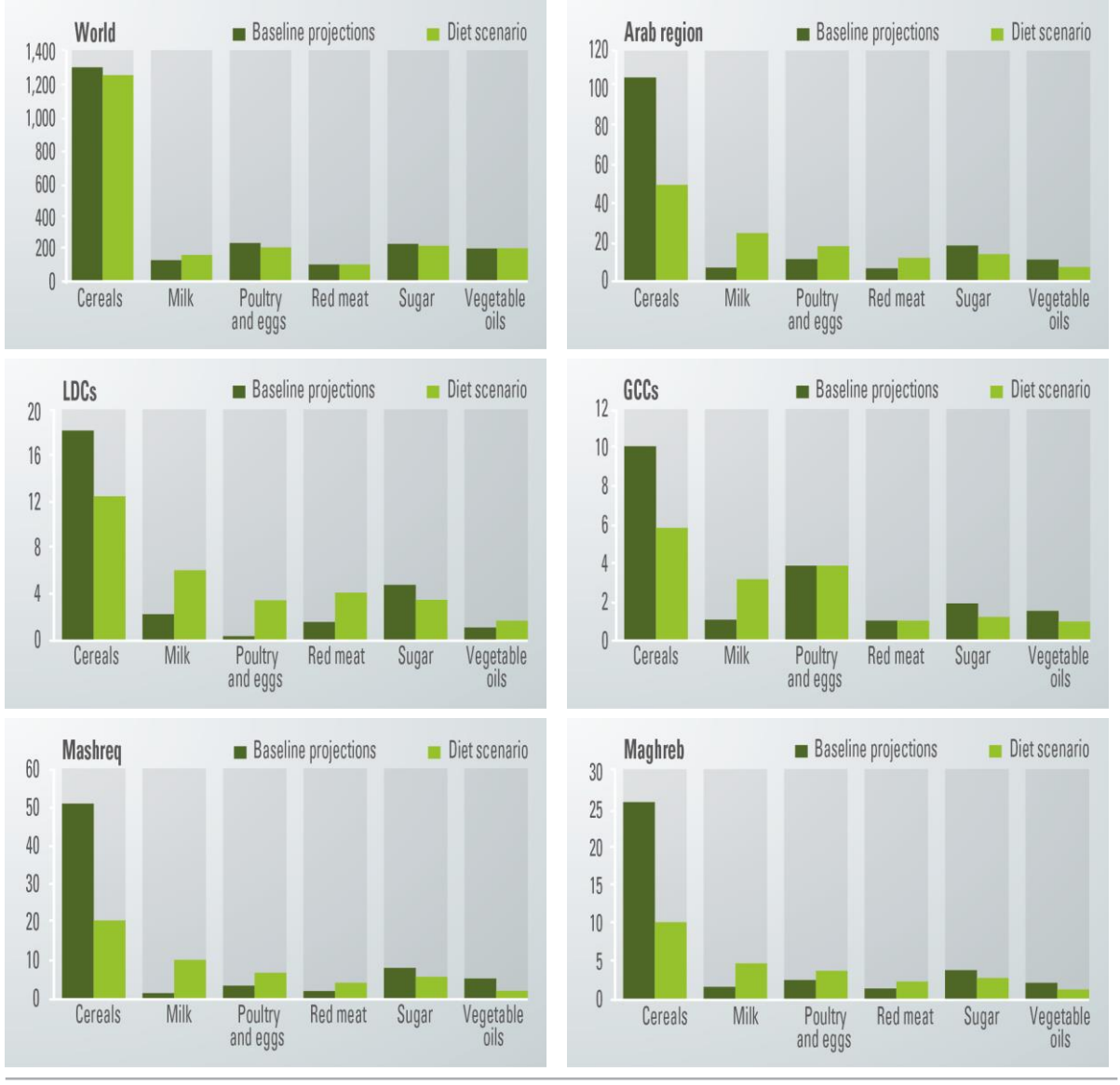
Under the current assumptions, total cereal consumption in the LDCs would grow at a slower pace compared to the baseline projections, as livestock production in the subregion would continue to rely predominantly on extensive pastoral farming, with lower cereal feed requirements. Thus, the reduction in cereal food consumption would not be offset by an increase in feed use at the levels observed in other subregions. Feed use in the LDCs currently accounts for less than 10 per cent of their total cereal consumption, and even though the scenario projects a strong increase, the absolute magnitude of such an increase would be small compared to other subregions, as it would be growing out of a much smaller base.

Dairy consumption in the Arab region would increase from 5 million metric tons (fluid milk equivalent) at present to over 25 million metric tons by 2030. Assuming that the current dairy product consumption patterns persist into the future and that trade in fresh dairy products remains limited, the Arab dairy sector would need to achieve a considerable expansion to accommodate the dietary transition in the region. Increases in dairy production would be needed in all subregions, but particularly in the LDCs and the Mashreq, where production would need to double compared to the base period. The increase in processed dairy consumption would still outpace production, such that the region would need to import 10.6 million metric tons in 2030, around six times the level in the base period of 2014-2016.

Assuming a continuation of the current market structure in most of the Arab meat, poultry and egg sectors, the shift to a more protein-based diet in the region would increase local meat, poultry and egg production to about 22 million metric tons by 2030, a significant increase compared to the 12 million metric tons in the baseline. Although higher domestic prices (particularly in the poultry market) would stimulate domestic production, the latter would not keep up with the increase in demand, thus raising imports. The scenario assumes that such an increase is feasible. However, if production factor limitations hold growth below the simulated level, meat, poultry and egg imports would need to fill the larger gap, including for fresh eggs, which are currently assumed to be non-tradable. As in the case of dairy, the LDC and Mashreq subregions have the largest consumption growth to achieve, as their current level of meat, poultry and egg consumption is lower than that of the Maghreb, in stark contrast to the GCC subregion, where current meat, poultry and egg consumption is not far below the scenario target level.

The healthy diet requirements would reduce the level of vegetable oil consumption in the Arab region, particularly in Maghreb and Mashreq countries. Contrary to the baseline, which expects total consumption to grow by 39 per cent, in the healthy diet scenario, vegetable oil consumption in the Arab region would decrease by 6 per cent in 2030 compared to 2014-2016. This reduction in consumption would decrease imports, considerably enhancing the self-sufficiency ratio. The LDCs would be an exception, as for example Somalia and Yemen would increase their per capita consumption, beginning from a level far below the recommended intake (figure 7.8).

Figure 7.8 World, regional and subregional required food availability by food group in 2030 (million MTs)



Source: FAO, Aglink-Cosimo model projections.

The healthy diet scenario would also require a reduction in per capita sugar consumption in Maghreb and, to a lesser extent, Mashreq countries, where consumption currently exceeds the recommended level. In contrast, for per capita consumption in the LDCs, where the current level of sugar intake is at the recommended level, no further increase would be observed. In GCC countries, per capita sugar consumption would grow over the next decade,

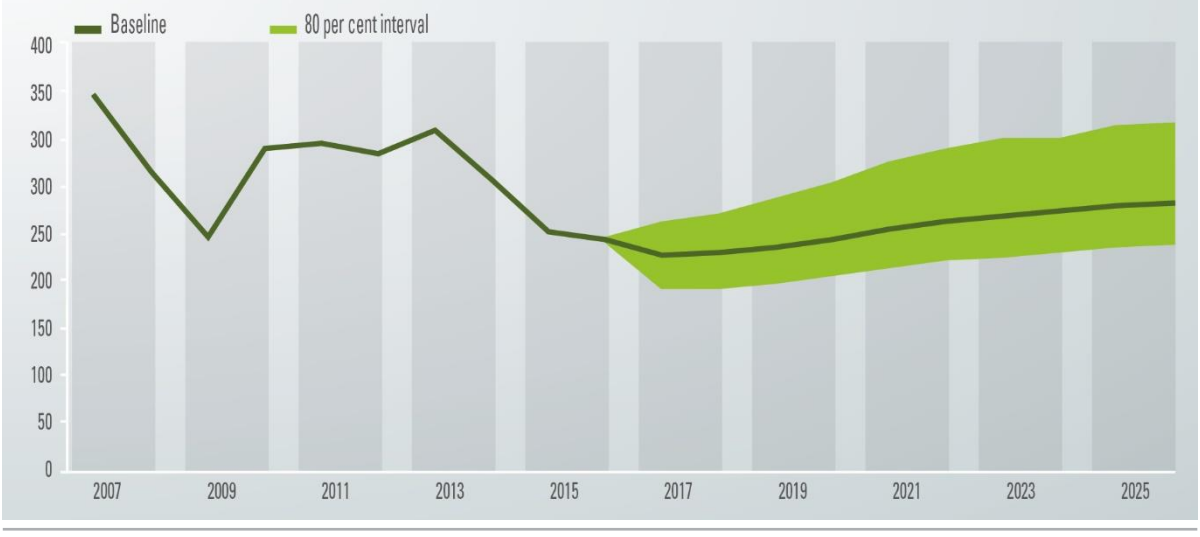
albeit at a slower pace than in the baseline. Total sugar consumption in the Arab region would increase considerably less than projected in the baseline. The slowdown in sugar consumption growth would also reduce the need to import, consequently increasing the self-sufficiency ratio in the region from 28 per cent in the 2014-2016 period to 33 per cent in 2030.

As outlined earlier, the scenario exercise is designed to illustrate the possible implications of a substantial dietary transition in the Arab region on agricultural commodity markets. Promoting a healthy diet in the region is an important social objective, but as the scenario exercise demonstrates, even well-intended dietary transformations could have far-reaching implications for agriculture and related sectors. Particularly in a region which faces significant natural resource constraints, any policies to guide such a process would thus need to carefully consider costs and benefits.

E. What if we establish and maintain national strategic wheat stocks?

Wheat is the main staple food in most countries in the Arab region, providing between 21 per cent and 43 per cent of the total of calories consumed by humans directly. It is also widely used as animal feed, with precise levels varying across the subregions. Due to natural and economic resource constraints, domestic supply covers only about 60 per cent of domestic demand, and under the baseline scenario, this gap is expected to remain in 2030. As a result, any significant shock in the world wheat price would have a direct impact on domestic markets and subsequently affect short-term national food security. One instrument to protect consumers against food price spikes is for governments to hold strategic stocks of commodities and release them into the domestic market when prices are high.

Figure 7.9 Results of stochastic analysis of nominal wheat price ($/ton)



Source: FAO, Aglink-Cosimo model projections.

The baseline projections foresee global prices for cereals falling slightly in real terms over the coming decade. Additional uncertainty analysis gives an indication of the range of possible outcomes around the baseline, given the variability observed in previous years for key agricultural and macroeconomic drivers. The results are based on past variations in yields and macroeconomic drivers. However, past trends may not continue into the future. Climate change could bring about greater variations in yields, and economic growth patterns observed in the recent past may change. Figure 7.9 shows the range of estimated variability in the international reference price for wheat.

To illustrate the close linkages between world and domestic wheat markets, three alternative market scenarios are simulated using the Aglink-Cosimo model. The objective is to demonstrate how domestic and global wheat markets are linked, and to assess the effectiveness of releasing wheat stocks into the domestic market at times of global supply shortfall. The Aglink-Cosimo model is used to simulate a one-time shock in the world market for wheat in the year 2022, caused by a shortfall in the production of main wheat-exporting countries. Three alternative responses to this shock are analysed: in scenario A, market conditions, including stocks, are the same as in the baseline; scenario B simulates each country in the Arab region releasing stocks equivalent to three months of its wheat consumption into its domestic market in 2022; and scenario C assumes the release of stocks equivalent to six months of wheat consumption in response to the global price shock. The availability of these stocks is taken as a given, and the costs of procurement, storage and distribution are not taken into account. For all scenarios, the deviations of prices, production, consumption and trade from the baseline outcome are calculated for Arab countries and for world markets.

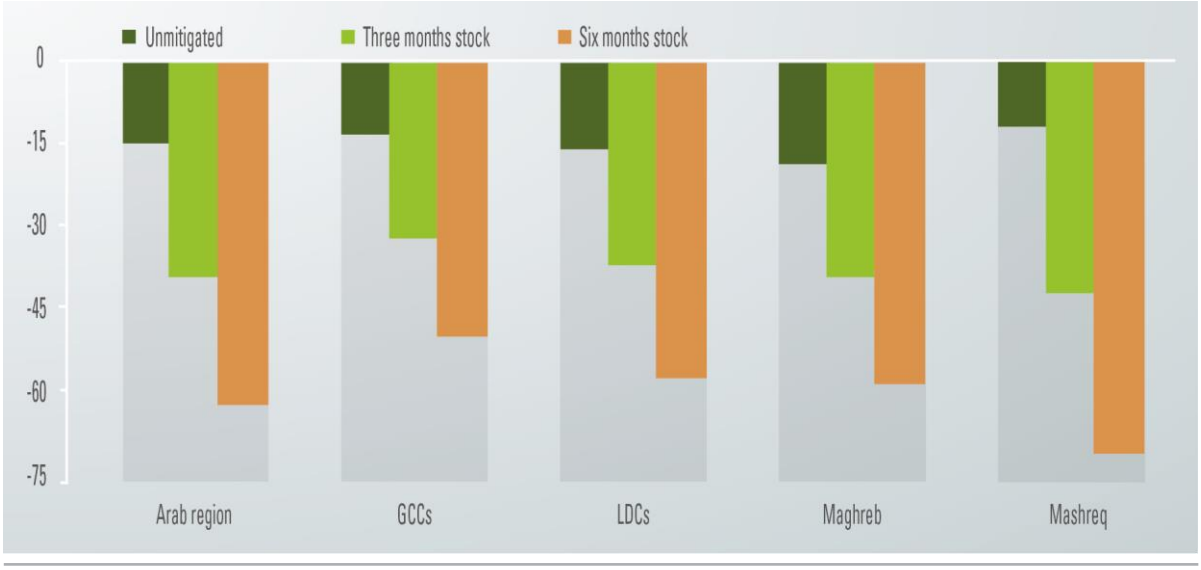
The simulated production shortfall in the main wheat exporting countries in 2022 causes a reduction in global wheat exports of 8.5 per cent. Without any mitigating measures (scenario A), it causes a spike in the world price of around 60 per cent that year, from $232 per metric ton in the baseline to $374 per metric ton (figure 7.11).

If no specific measures are taken to counteract the price spike (scenario A), the impact is nearly fully transmitted to the domestic markets of Arab countries, depressing their wheat consumption. Consequently, imports into the region are reduced between 11 per cent and 18 per cent, varying by subregion (figure 7.10). The resultant increase in domestic prices boosts domestic production in each subregion by about 10 per cent, which, however, in absolute terms, is small compared to the reduction in imports. As a result, despite an increase in food expenditures, total domestic consumption is reduced.

In order to protect consumers from these higher food costs, governments may consider releasing wheat stocks into their domestic markets to boost domestic supply, thereby reducing the need for high-priced imports. In scenarios B and C, the simulated import requirements are reduced considerably as a result of such action (figure 7.10).

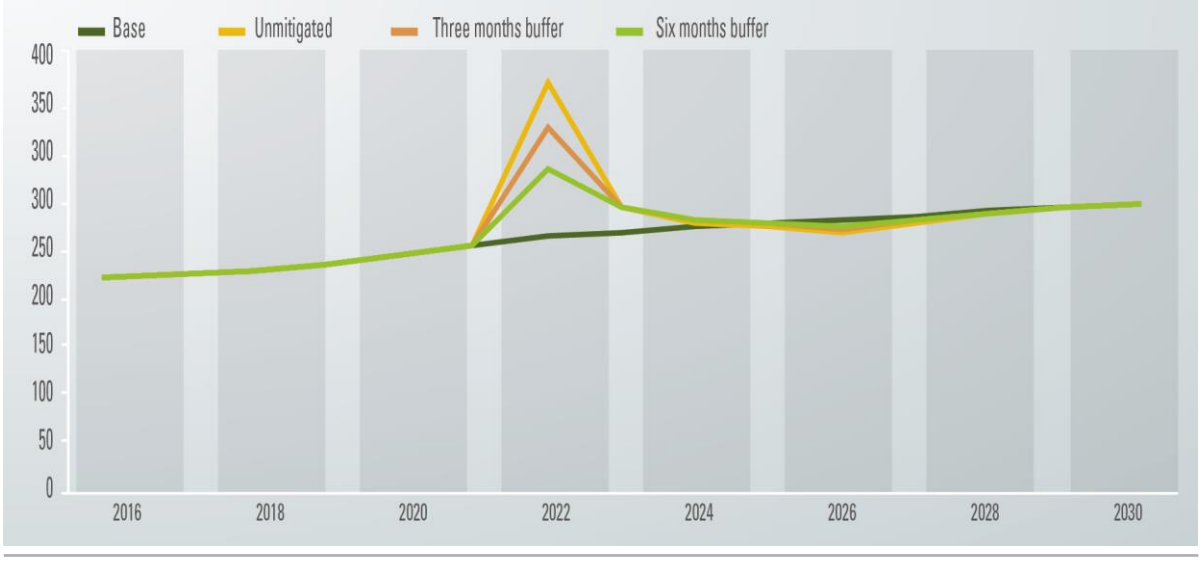
The additional supply of wheat from the stock release and the resulting import reduction in the Arab region also mitigates the world price spike in 2022. The world price rises to $331 per metric ton in scenario B, and to only $295 per metric ton in scenario C, smaller increases compared to $374 per metric ton under scenario A (figure 7.11).

Figure 7.10 Impact of a global price shock in 2022 on Arab wheat imports (percentage)



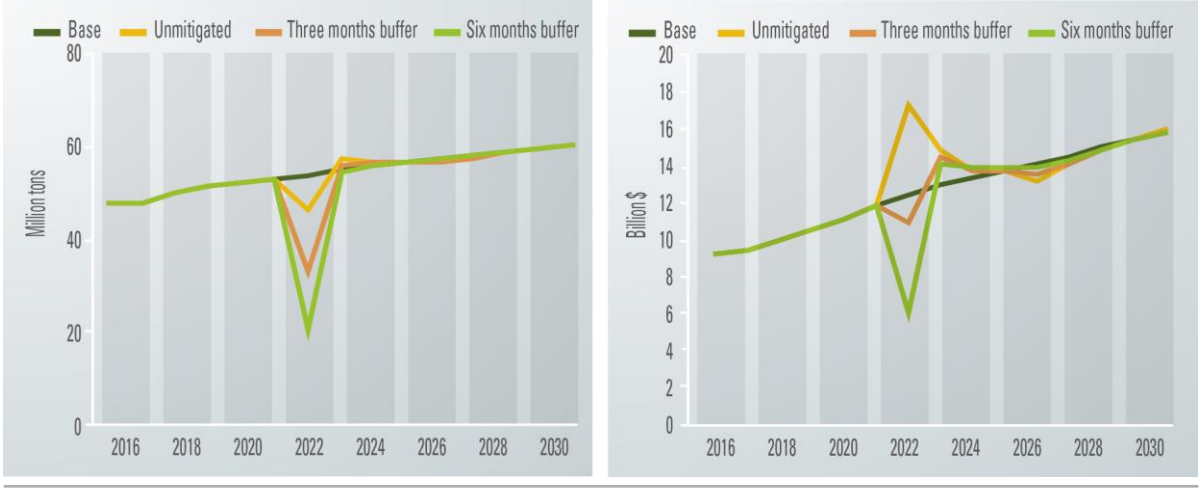
Source: FAO, Aglink-Cosimo model projections.

Figure 7.11 World price response to a global supply shock and alternative stock releases in the Arab region ($/ton)



Source: FAO, Aglink-Cosimo model projections.

Figure 7.12 Impact of global price shock in 2022 on volume (left) and cost (right) of Arab wheat imports



Source: FAO, Aglink-Cosimo model projections.

By bolstering the market with a well-timed stock release, the Arab region would not only import less, but also pay comparatively less for these imports (figure 7.12).

In the baseline scenario, producer prices in Arab countries are assumed to be linked to the global market and price signals are fully transmitted to the region. Releasing stocks into the domestic market breaks this link and limits the increase in domestic prices. This price dampening effect is due to the substitution of government-released domestic stocks for high-priced imports. The extent of the price mitigation impact of the stock release is proportionate to its share of the domestic supply. In scenario B, the increase in producer prices in the subregions is contained to 50-70 per cent of the unmitigated shock. In scenario C, the price increase is further mitigated in all regions and almost prevented in countries with higher self-sufficiency ratios.

Consumer prices are less affected in percentage terms, since marketing/processing margins are largely insulated from the shock. Within the region, consumer prices are lowest in the GCC countries, and highest in the LDCs and the Mashreq countries. In general, the impact depends on local market conditions, where marketing margins/costs vary considerably, given the different income-related processing cost profiles of countries in the region. The increase in consumer prices is most pronounced in countries with high levels of imports, lower levels of development and/or a lower domestic supply response, as in the case of countries in the LDC and Mashreq subregions.

In the unmitigated projection (scenario A), the world price spike reduces domestic wheat consumption in the Arab region by 2.5 per cent on average in 2022 (figure 7.13). Among the subregions, the LDCs would experience the largest reduction, at 4 per cent, because poorer consumers cannot absorb the higher prices and have to reduce their consumption due to budget constraints. For the Maghreb and Mashreq countries, the decrease would be of about 2 per cent, while the impact on the wealthy GCC countries would be negligible.

Figure 7.13 Impact of a global price shock in 2022 on wheat consumption (percentage)

Source: FAO, Aglink-Cosimo model projections.

The consumption impact of the external price shock is reduced considerably through the release of stocks to support domestic consumers. In the Arab region as a whole, the reduction in consumption is limited to about 1.5 per cent under scenario B, and to about 0.5 per cent under scenario C. Even under scenario C, however, in the LDCS, wheat consumption is reduced by about 1 per cent in 2022.

The simulation illustrates how the use of a stock release to mitigate an external price spike can be effective in containing domestic price increases and consumption drops. However, stockholding and release is not without cost and there are important trade-offs involved. The practical application of such policies raises a number of issues, both institutional and financial: (i) maintaining physical stocks of wheat in a country necessitates precise rules for their accumulation and release into the market; and (ii) in countries with a substantial domestic production base, managing the domestic market with a stock policy may adversely affect the incentive structure for domestic food production. Such considerations were not taken into account in the scenario simulations.

The other critical consideration, beyond the need for a solid institutional and logistic set-up to implement an effective stock policy, is the cost associated with holding stocks. There are the costs of building quality storage facilities, opportunity costs of the capital being tied up in stocks, costs of ensuring a periodic stock turnover to maintain quality, losses due to pests and humidity, and more. A full accounting of all costs involved is likely to reveal a very expensive undertaking, as is known to be the case in countries in the Arab region and elsewhere that carry substantial food security stocks. In effect, the costs of a food security policy based on holding stocks and intervening in the domestic market are high, because there are important and unavoidable externalities to such a policy. By maintaining food security

stocks and releasing them indiscriminately into their domestic markets, Arab countries, rich or poor, would not only be subsidizing their entire population regardless of need, but also the rest of the world, by partially buffering the global price increase in the event of a shock in the market.

While in the final analysis, the choice of putting in place a stocking policy is usually made on the basis of wider considerations that go beyond monetary costs and benefits, due attention needs to be paid to alternative policies, which may be more sustainable and effective from the perspective of strengthening food security.

In this context, a country could consider compensating only vulnerable segments of the population with cash subsidies during periods of world price spikes. Some countries already use programmes specifically targeted towards poor consumers, with, for example, direct cash transfers in Yemen, or subsidized wheat flour for selected bakeries in Egypt. Such programmes may have to be significantly improved and expanded, inter alia by refining eligibility criteria and market conditions under which additional assistance would be provided, so as to allow for some predictability in their budgetary implications and fiscal sustainability in the long term.

Summary and Recommendations

Summary and Recommendations

This report provided an overview of food security in the Arab region, offered detailed analysis of key issues, and simulated several alternative future scenarios for the region. In Part I, the report assessed the current situation with regard to the three components of food security: food availability, access to food and utilization of food, integrating stability issues into each section. Part II analysed selected themes in food security, including the role of agriculture, trade and food loss and waste. The report also provided a range of forward-looking recommendations, including examples of existing approaches that are worth considering for adoption and scaling-up across the region.

Main findings

- The gap between food consumption and domestic food production has been widening as a result of a growing population and stagnant crop yields. The gap between consumption and domestic food production is met by imports and, as the gap grows, the Arab region is increasingly reliant on world markets to meet its basic food needs. Although many countries all over the world manage their food security through a partial or complete dependence on world markets, such reliance is seen as a concern by some countries in the region;
- Food availability at the national level does not ensure access at the household level. The most important factor constraining access to food is poverty, which varies widely across the region: some Arab countries are considered among the richest in the world, while others are among the poorest. Several other factors are also crucial, and in countries suffering from conflicts and low infrastructure development, physical access to food cannot be taken for granted;
- Child malnutrition rates are extremely high in the Comoros, Djibouti, Somalia and Yemen, and micronutrient deficiencies are common even in the wealthier countries of the region. Furthermore, without access to clean water, sanitation and health care, nutritional diseases and infections are common, even if food consumption levels are otherwise adequate. The region is unique in that malnutrition exists there side by side with obesity. Obesity rates in the Arab region are among the highest in the world, with the issue impacting nearly one-quarter of the population – double the world average – and particularly women. The region's nutritional problems – both malnutrition and obesity – are not only due to the quantity of food consumed, but also to the poor quality of diets and to lifestyle issues;
- The region faces natural limitations when it comes to food production, in terms of the scarcity of water and productive land, as well as the impacts of climate change. The Arab region is the most water-scarce region in the world. Some argue that water should be transferred out of agriculture towards higher-value municipal and industrial uses, while others argue that it is important

to maintain domestic production, in order to protect against vulnerability to global food markets and because of agriculture's importance for the income of the poorest. All agree, however, on the priority of improving the efficiency of water use;

- The region is progressively becoming more reliant on food imports, as consumption is increasing much faster than domestic production. Under the right circumstances, trade can help reduce the weather-related risks associated with domestic production. Many countries meet their food requirements through a partial or complete reliance on world markets, and stable food availability can be achieved if food imports account for a small and stable share of export, or foreign exchange, earnings. However, some countries in the region – notably the Comoros, Djibouti and Somalia – suffer from serious vulnerabilities, as the value of their food imports periodically reach over 200 per cent of that of their earnings from merchandise exports;
- At the subregional level, the Mashreq accounts for the largest amount of food loss and waste, while the least food loss and waste occur in the LDCs. In the low- and middle-income countries of the region, food loss and waste are in large part caused by improper food handling, inadequate infrastructure, and the use of non-adapted practices and technologies. In the high-income GCC countries, and increasingly in the upper-middle income countries of the Maghreb and Mashreq subregions, a substantial amount of the food loss and waste occurs in the late stages of retail and consumption, largely as a result of food spoilage and of excess quantities of food being bought or prepared;
- The business-as-usual projection of the Aglink-Cosimo model foresees gradual increases in domestic food production, and an increasing dependency on imports through to 2030. The first alternative scenario looks at the implications of increasing the region's low cereal yields by 25 per cent. In this scenario, self-sufficiency ratios increase from 34 per cent to 41 per cent, with particularly significant benefits for the LDCs. The second alternative scenario examines the implications of shifting towards a healthier diet, by reducing the consumption of cereals and oil, and increasing the consumption of protein from meat and dairy products. The results of this scenario indicate an increased reliance on trade, not only to import animal products, but also cereals as feed for livestock. Although this scenario could potentially result in improvements in nutritional status, access to the improved diets could be constrained among the poor as a result of increased prices. The final scenario addresses price volatility by assuming the establishment of three-month or six-month strategic wheat stocks, which can be released into the domestic market during periods of global price hikes. According to the model, a global shock that would result in an increase in the price of wheat by 60 per cent could, to a large extent, be mitigated through the release of strategic wheat stocks. Although the feasibility of moving from business as usual to improvements in yields, diets or price stabilization was not considered in the projections, the results of these scenarios are indicative of potential scope for greater food security in the region.

Ways forward to enhance food security by 2030

Going forward, a principal question for each country will be to what extent they should focus

availability on domestic production versus food imports. Both domestic production and imports of food involve risks. An overreliance on local agriculture exposes populations to risks related to droughts and the unsustainable use of natural resources. An overreliance on imports exposes populations to risks related to volatility in world markets. Each country will need to find its own strategy to ensure stable food availability, based on its geoclimatic endowments, its comparative advantage in international trade, its political environment, and its ability to mitigate various types of risks.

Innovative approaches are available that can contribute to sustainable domestic production: many of these are already being used within the region, and many others can be adapted from the experiences of other regions. Appropriate approaches to sustainable domestic production generally differ between rain-fed and irrigated farming systems. For rain-fed farming systems, approaches are needed that would address the low income and weather-related risks faced by poor farmers. In particular, research and development, extension services and investments will be needed for crops that are resistant to drought and salinity, in addition to low-cost approaches to water harvesting, conservation and reuse.

For irrigated farming systems, reducing demand for water will be essential for sustainability. Cost-recovery policies will be needed to create appropriate incentives to maximize crop water productivity. Careful water management can encourage the expansion of the innovative technical approaches already being used in the region.

Despite potential increases in domestic production, none of the Arab countries are likely to achieve food self-sufficiency, and most are likely to continue to rely on trade. With the adoption of appropriate policies, trade can be used as a mechanism to support the stability of food security by reducing the risks associated with overreliance on domestic production. For some countries in the region, current trends reflect vulnerabilities. In particular, where food imports absorb a high and volatile share of foreign exchange earnings, stable food availability can be threatened by spikes in world food prices.

A range of instruments are available at the national, regional and global levels to manage vulnerabilities associated with heavy reliance on food imports. In addition to increasing domestic production, national governments have several other options, including smoothing prices over time by transferring price risk to trading partners through financial markets, or maintaining physical stocks of key commodities; obtaining the best price by diversifying trade partners; improving the infrastructure and management of import supply chains; and investing in production in other countries. Working together, Arab countries can respond to common challenges by expanding intraregional trade; coordinating market information; and coordinating physical stocks and food-related funds. Finally, Arab countries can usefully contribute to global actions, notably by expanding global trade agreements, including export policies, in order to avoid the magnification of shocks to local production; and broadening the donor base to allow for the expansion of international food assistance programmes.

In addition to domestic production and trade, a third aspect of food availability, namely food loss and waste, has been gaining increasing attention. Food loss and waste create a gap between the quantity of food potentially available from domestic production and

imports, and the quantity actually consumed by individuals. As with any emerging issue, major efforts are needed to raise awareness and improve the data. Equipped with better information, policymakers, the private sector and consumers can then mobilize efforts. The development of new and more efficient approaches to reducing food loss and waste is also needed. A wide range of innovative approaches already exists in the Arab region and beyond: the adoption and scaling-up of these technologies can go a long way towards supporting food security. Government and relevant private-sector entities involved in food logistics can usefully support food waste and loss reduction by addressing structural deficiencies, including bureaucratic red tape, taxes and regulations. At the retail level, food loss can be addressed through improved business techniques, such as inventory and production management. And at the consumption level, the reform of policies that lead to food loss, such as non-targeted subsidies, can also support food security.

As stable food security is central to human well-being, achieving it will require a wide range of actions. In addition to the opportunities to enhance food security through agriculture, trade and reducing food loss and waste, more attention is needed to address other aspects of food access and utilization. Efficient, targeted social protection programmes will continue to be essential for both the rural and urban poor. Education and incentives will be needed in order to shift to healthier lifestyles and diets, with the goal of reducing the region's malnutrition and obesity problems. Increased access to health care, water and sanitation will also be essential to improving nutritional status.

While remaining on a path of business as usual could lead to a dire future, there are opportunities to enhance food security throughout the Arab region. This publication has highlighted success stories in each dimension of food security. Each country will need to determine what strategy best fits its circumstances. But in all cases, lessons from other countries can serve as inspiration and provide a variety of options to be adapted and adopted.

Key messages and recommendations

In addition to the above summary of food security policy directions in the Arab region, key policy options highlighted throughout the report are recapitulated as follows:

On agricultural production and productivity, Arab countries need to consider the following:

- In trying to increase food self-sufficiency, countries need to conduct careful analyses in order to identify the right economic and social trade-offs and opportunities;
- Developing a more sustainable and resilient agricultural sector will require policies and practices that focus on the efficient use of water resources, while at the same time addressing soil quality and climate change. A holistic approach, including integrated land and water management that embraces institutional coordination between the water and agriculture sectors, is likely to be most effective;
- Improved agricultural techniques, selecting crop varieties for drought and heat tolerance, and improving the management of agricultural water use are likely to benefit yields. Technologies promoting water-use

efficiency are important, but need to be tailored to specific hydrological, environmental and institutional contexts;
- More attention has to be paid by governments and institutions to rain-fed farming systems. In addition to efforts to operationalize the concept of science-policy interface, further research and development, as well as the adaptation of appropriate technologies and innovative solutions, are needed in order to increase the yields of these farming systems;
- Focus should be on investments and incentives that promote market-oriented agriculture and maximum economic productivity for water consumed. This means that the emphasis will need to be on production that maximizes the value added per unit of water consumed, and on production systems and patterns that generate the highest incomes for farmers and/or save the most foreign exchange for the country;
- Policies and programmes should be implemented to protect poor and marginal producers and production systems. Small, poor agricultural and livestock producers in remote, marginal environments will be particularly vulnerable to climate change and extreme weather events. Support for the development of modern rangeland management systems and investment in infrastructure will be needed in order to increase productivity and sustainability. In the most marginal environments, households will need to be supported in their transition out of farming;
- Given the important role that women play in agricultural production in many countries in the region, adequate institutional, economic and legal supportive measures to ensure access to financial services and more secure land tenure and provide capacity-building programmes for women should be incorporated into national development plans.

On food trade, countries in the Arab region can mitigate the supply and price risks associated with an increasing reliance on food imports by:

- Increasing domestic agricultural production where economically feasible and environmentally sustainable. Along these criteria, and considering the national social, economic and political setting, this could entail encouraging the production of crops for which countries have natural comparative advantages, and discouraging the cultivation of low value-added, high water-intensive crops;
- Investing in other land-and-water-abundant countries to gain direct access to food supplies. Investment flows need to be regulated in order to maximize both economic and social benefits, while minimizing risks for both investing and recipient countries;
- Reducing the cost of food imports by investing in infrastructure to store and transport food, and to generally improve the management and logistics of the import chain. Some countries are struggling with bottlenecks at ports, while others have inefficient inland transportation systems;
- Reducing the impact of world food market shocks through a greater diversification of trading partners. Diversification in the sourcing of imported supplies is an effective approach for reducing vulnerability to supply risks. The price risk can also be transferred to exporting trading partners through long-term arrangements, including forward contracts or options for the delivery of a certain quantity of a particular commodity at a certain price.

Moreover, the price risk can be hedged through the use of financial market instruments, by paying a premium proportional to the degree of protection desired. A third approach to managing the price volatility of international food markets is by investing in physical stocks of food. These stocks can then be released during food price hikes. However, the economic feasibility of such an approach needs to be carefully assessed, due to the high financial and institutional costs associated with it;

- Expanding intraregional trade among Arab countries. Although some limited steps have been taken, including the removal of intraregional tariffs under the GAFTA agreement, and some investments in roads and telecommunications that reduce the cost of trade, there is enormous untapped potential, especially in reforming non-tariff measures and harmonizing regulatory frameworks, including, for instance, phytosanitary and technical regulations, testing and certification. Institutionalizing a regional Good Agricultural Practice (GAP) framework is seen as a step in that direction. Moreover, the WTO's new TFA, which entered into force in February 2017, can be utilized to expedite the movement, release and clearance of goods across borders. This could be achieved by streamlining and standardizing clearance procedures and practices, reducing fees and formalities connected with the import/export of goods, and introducing faster clearance procedures and enhanced conditions for freedom of transit for goods;
- Coordinating regionally on information and data collection, which could reduce the cost of importing food for all participating countries. Improving the information base would entail developing a regional early warning system, as a means to obtain more reliable estimates of regional stocks, domestic production and movement of food supplies, as well as a mechanism for coordinated policy responses;
- Activating the Arab food security fund proposed by various international and United Nations agencies and by the League of Arab States. Such a fund could provide relief during food shortages or emergencies, and ensure a rapid response. Moreover, coordination and cooperation on physical food stocks and food-related funds among countries in the region can potentially reduce investment costs for individual physical stocks of food. In addition to the benefits of economies of scale, regional coordination on food stocks would provide greater price stability, facilitate the movement of supplies across borders, and facilitate the coordination of market information.

On food loss and waste reduction, Arab countries need to consider policies that address the following issues:

- The development of new and more efficient methods to reduce food loss and waste is needed along the entire food supply chain, from both the private and public sectors;
- Appropriate technologies are also needed in the upstream stages of the food supply chain, including for agricultural production and harvest, post-harvest storage, and handling and processing. In this regard, an exchange of lessons learned and best practices among Arab countries, as well as with countries from outside the region, may well prove cost-saving and form the basis for enhanced coordination and cooperation;
- Government and relevant private sector entities involved in food logistics and food assistance programmes can effectively

support food waste and loss reduction by addressing structural deficiencies, including bureaucratic red tape, taxes, subsidies and regulations;

- Given the key role of women in the food supply chain, notably in food production, processing, retail and consumption, additional efforts need to be made to remove all barriers hindering their participation and contribution. They still lack adequate knowledge on good practices, and lack access to capital and resources that could enhance their contribution to food security in general, and help them reduce food loss and waste;
- On the behavioural front, greater education and training of stakeholders will be needed throughout the value chain, together with awareness campaigns such as on food labelling, purchase planning, in-home storage practices, portion sizes, better food preparation and so on. At the policy level, governments will need to use a combination of incentives (such as subsidies, financial support, and infrastructure) and disincentives (such as taxes and penalties) in order to decrease wasteful consumer behaviours.

While the above policy recommendations are generally applicable across the board to the entire Arab region, the geoclimatic, social and economic specificities of individual countries play a significant role in the application of those recommendations at the national level. While GCC countries, on the one hand, would not need to put much emphasis on agricultural production and productivity, trade-related recommendations are of high relevance to them. On the other hand, countries with agricultural potential, like Egypt, Iraq, Morocco, the Sudan and the Syrian Arab Republic, would need to consider adopting some of the highlighted recommendations for increasing the efficiency, productivity and sustainability of land and water resources. The report's analysis demonstrates that the LDCs of the Arab region, in particular, are most vulnerable, and as such, would need to consider most of the recommendations highlighted in the report if they are to improve their food security status. Given the complexity and cross-cutting nature of food security, the analysis and policy recommendations in this report can help countries in the Arab region move forward in their endeavours towards improving food security, in accordance with the 2030 Agenda for Sustainable Development and food security-related SDG targets.

References

Agricultural Market Information System (AMIS) (2015). Official Website. Available from http://www.amis-outlook.org/amis-about/en/. Accessed April 2017.

Arab Organization for Agricultural Development (AOAD) (2016). Conference on Reducing food loss in the Arab countries to achieve Arab food security. 27-28 September, Khartoum.

Arimond, Mary, and Marie T. Ruel (2002). Progress in developing an infant and child feeding index: an example using the Ethiopia Demographic and Health Survey 2000. Paper No. 143. Washington, D.C.: International Food Policy Research Institute. Available from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1.1732&rep=rep1&type=pdf.

_____ (2004). Dietary diversity, dietary quality and child nutritional status: evidence from eleven demographic and health surveys. Washington, D.C.: Food and Nutrition Technical Assistance Project. Available from http://pdf.usaid.gov/pdf_docs/Pnadd671.pdf.

Aw-Dahir, Mohamed (2015). Food Security and Sustainable Agriculture in the Arab Region. Issues Brief for the Arab Sustainable Development Report. Rome: FAO. Available from http://css.escwa.org.lb/SDPD/3572/Goal2.pdf.

Babcock, Bruce (2011). The impact of US biofuel policies on agricultural price levels and volatility. Issue Paper No. 35. Geneva: International Centre for Trade and Sustainable Development. Available from http://www20.iadb.org/intal/catalogo/PE/2011/08442.pdf.

Ballard, Terri J., Anne W. Kepple and Carlo Cafiero (2013). The Food Insecurity Experience Scale: Development of a Global Standard for Monitoring Hunger Worldwide. Technical Paper. Rome: FAO. Available from http://www.fao.org/fileadmin/templates/ess/voh/FIES_Technical_Paper_v1.1.pdf.

Breisinger, Clemens, and others (2010). Food Security and Economic Development in the Middle East and North Africa: Current State and Future Perspectives. International Food Policy Research Institute (IFPRI), Discussion Paper 00985 (May). Washington, D.C.: IFPRI. Available from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.224.7918&rep=rep1&type=pdf.

Burchi, Francesco, Jessica C. Fanzo and Emile Frison (2011). The role of food and nutrition system approaches in tackling hidden hunger. *International Journal of Environmental Research and Public Health*, vol. 8, No. 2, pp. 358-373. Available from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.291.5607&rep=rep1&type=pdf.

Christensen, Ida (2007). The Status of Rural Poverty in the Near East and North Africa. Rome: FAO and IFAD. Available from https://www.ifad.org/documents/10180/2d14b097-5569-4a54-9967-c970b5afdb32.

Cline, William R. (2007). *Global Warming and Agriculture: Impacts Estimates by Country*. Washington, D.C.: Center for Global Development (CGD) and the Peterson Institute for International Economics (PIIE).

Darwish, Talal, and Ali Fadel (2017). Prospects for improving food availability through combating desertification and restoring degraded lands and soils in the Arab countries. Background paper (August).

Demeke, Mulat, Guendalina Pangrazio and Materne Maetz (2009). Country Responses to the Food Security Crisis: Nature and Preliminary Implications of the Policies Pursued. Initiative on Soaring Food Prices. Rome: FAO. Available from http://www.fao.org/fileadmin/user_upload/ISFP/pdf_for_site_Country_Response_to_the_Food_Security.pdf.

Devereux, Stephen (2015). Social Protection and Safety Nets in the Middle East and North Africa. Research Report No. 80 (December). Brighton: Institute of Development Studies (IDS). Available from https://opendocs.ids.ac.uk/opendocs/bitstream/handle/123456789/8976/RR80.pdf?sequence=1.

Di Terlizzi, Biagio, and others (2016). Innovation for the reduction of food losses and waste. In *Mediterra 2016, Zero Waste in the Mediterranean: Natural Resources, Food and Knowledge*. Paris: International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM) and FAO. Available from https://www.ciheam.org/uploads/attachments/451/12_Mediterra2016_EN.pdf.

Dixon, John, Aidan Gulliver and David Gibbon (2001). Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World. Rome: FAO; Washington, D.C.: World Bank. Available from http://documents.worldbank.org/curated/en/126251468331211716/Farming-systems-and-poverty-improving-farmers-livelihoods-in-a-changing-world.

Economist Intelligence Unit (EIU) (2014). Global Food Security Index 2014 – Special report: food loss and its intersection with food security. London: EIU. Available from http://foodsecurityindex.eiu.com/Resources.

Egypt Network for Integrated Development (ENID) (2012). Subsidies and the Social Safety Net in Egypt. Policy Brief 012. Available from http://www.enid.org.eg/Uploads/PDF/PB12_subsidies_social_protection.pdf.

El-Kholy, Mohamed M. (2015). Technology of Medium Capacity Horizontal Silo Bags. Cairo: Agricultural Engineering Research Institute (AEnRI).

European Commission (2016). Reducing food waste: the EU's response to a global challenge. Fact Sheet, 28 November, Brussels: European Commission. Available from http://europa.eu/rapid/press-release_MEMO-16-3989_en.htm.

Favell, Andy (2015). How technology is helping deliver aid to Syrian refugees in the Middle East. ComputerWeekly.com. Available from http://www.computerweekly.com/feature/How-technology-is-helping-deliver-aid-to-Syrian-refugees-in-the-Middle-East.

Feidi, Izzat (2017). FAO Blue Growth Initiative to help boost fisheries and aquaculture in Arab countries. Available from http://www.fao.org/in-action/globefish/fishery-information/resource-detail/fr/c/379558/. Accessed 23 August 2017.

Food and Agriculture Organization of the United Nations (FAO) (1996). World Food Summit. Available from http://www.fao.org/WFS/.

_____ (2001) The State of Food Insecurity in the World 2001. Rome: FAO. Available from http://www.fao.org/docrep/003/y1500e/y1500e00.htm.

_____ (2006). World agriculture: towards 2030/2050. Interim report. Rome: FAO. Available from http://www.fao.org/fileadmin/user_upload/esag/docs/Interim_report_AT2050web.pdf.

_____ (2007). Digital Soil Map of the World (DSMW). Land and Water Division, 28 February. Rome: FAO. Available from http://www.fao.org/geonetwork/srv/en/metadata.show?id=14116.

_____ (2009). Draft Declaration of the World Summit on Food Security. World Summit on Food Security, Rome, 16-18 November. Available from http://www.fao.org/fileadmin/templates/wsfs/Summit/Docs/Declaration/WSFS09_Draft_Declaration.pdf.

_____ (2011). *The State of the World's Land and Water Resources for Food and Agriculture: Managing Systems at Risk*. Rome: FAO; London: Earthscan. Available from http://www.fao.org/docrep/017/i1688e/i1688e.pdf.

_____ (2012). AQUASTAT, FAO's global information system on water and agriculture. Available from http://www.fao.org/nr/water/aquastat/main/index.stm. Accessed 27 July 2017.

_____ (2013). The State of Food and Agriculture 2013: Food Systems for Better Nutrition. Rome: FAO. Available from http://www.fao.org/3/a-i3300e.pdf.

_____ (2015). Towards a Regional Collaborative Strategy on Sustainable Agricultural Water Management and Food Security in the Near East and North Africa Region. Cairo.

_____ (2017a). FAOSTAT Data, Suite of Food Security Indicators. Available from http://www.fao.org/faostat/en/#data/FS. Accessed April 2017.

_____ (2017b). Gender and Land Rights Database. Available from http://www.fao.org/gender-landrights-database/data-map/statistics/en/?sta_id=982. Accessed August 2017.

Food and Agriculture Organization of the United Nations (FAO) Committee on Agriculture (2007). Environment and Agriculture. Item 6 of the Provisional Agenda, 20th Session, Rome, 25-28 April. COAG/2007/6. Available from ftp://ftp.fao.org/docrep/fao/meeting/011/j9289e.pdf.

Food and Agriculture Organization of the United Nations (FAO) Global Information and Early Warning System (GIEWS) (2017a). Country Cereal Balance Sheet (CCBS) Data. Available from http://www.fao.org/giews/data-tools/en/. Accessed April 2017.

_____ (2017b). Saudi Arabia Country Brief. 22 June. Available from http://www.fao.org/giews/countrybrief/country.jsp?code=SAU.

Food and Agriculture Organization of the United Nations (FAO), International Fund for Agricultural Development (IFAD) and World Food Programme (WFP) (2013). The State of Food Insecurity in the World 2013: The Multiple Dimensions of Food Security. Rome: FAO. Available from http://www.fao.org/docrep/018/i3434e/i3434e.pdf.

_____ (2014). The State of Food Insecurity in the World 2014: Strengthening the Enabling Environment for Food Security and Nutrition. Rome: FAO. Available from http://www.fao.org/publications/sofi/2014/en/.

Food and Agriculture Organization of the United Nations (FAO), International Fund for Agricultural Development (IFAD), United Nations Conference on Trade and Development (UNCTAD) and World Bank (2010). Principles for responsible agricultural investment that respects rights, livelihoods and resources. Discussion Note, 25 January. Available from http://siteresources.worldbank.org/INTARD/214574-1111138388661/22453321/Principles_Extended.pdf.

Gammoh, Issa A., and Theib Y. Oweis (2011). Contour laser guiding for the mechanized "Vallerani" micro-catchment water harvesting systems. *Journal of Environmental Science and Engineering*, vol. 5, pp. 1309-1316. Available from http://www.vallerani.com/wp/wp-content/uploads/2015/06/art.-ICARDA-contu.pdf.

Garrett, James L., and Marie T. Ruel (1999). Food and Nutrition in an Urbanizing World. *Choices*, vol. 14, No. 4, Choices at the Millennium: A Special issue (fourth quarter), pp. 12-17.

Hallam, David (2011). International Investment in Developing Country Agriculture: Issues and Challenges. *Food Security*, vol. 3, sup. 1, pp. 91-98.

Intergovernmental Panel on Climate Change (IPCC) (2007). Fourth Assessment Report: Climate Change 2007. Available from https://www.ipcc.ch/report/ar4/.

Intergovernmental Technical Panel on Soils (ITPS) (2015). Status of the World's Soil Resources. Rome: FAO. Available from http://www.fao.org/3/a-i5199e.pdf.

International Center for Agricultural Research in the Dry Areas (ICARDA) (2017a). Official Website. Available from www.icarda.org.

International Center for Agricultural Research in the Dry Areas (ICARDA) (2017b). Zero-tillage seeders. Available from http://www.icarda.org/conservation-agriculture/zero-tillage-seeders.

International Fund for Agricultural Development (IFAD) (2010). Rural Poverty Report 2011- New Realities, New Challenges: New Opportunities for Tomorrow's Generation. Rome: IFAD. Available from https://www.ifad.org/documents/10180/c47f2607-3fb9-4736-8e6a-a7ccf3dc7c5b.

International Labour Organization (ILO) (2017). ILOSTAT Database. Central statistics database of the ILO. Available from http://www.ilo.org/ilostat.

Jaber, Lina S., Katharina Diehl and Shadi Hamadeh (2016). Livestock and food security in the Arab region: policy framework. *Food Security*, vol. 8, No. 5, pp. 899-908. Available from https://www.researchgate.net/publication/307952238_Livestock_and_food_security_in_the_Arab_region_policy_framework.

Jobbins, Guy, and Giles Henley (2015). Food in an Uncertain Future: The Impacts of Climate Change on Food Security and Nutrition in the Middle East and North Africa. London: Overseas Development Institute (ODI); Cairo: World Food Programme (WFP). Available from http://documents.wfp.org/stellent/groups/public/documents/communications/wfp279986.pdf.

Lampietti, Julian, and others (2011). A strategic framework for improving food security in Arab countries. *Food Security*, vol. 3, sup. 1, pp. 7-22. Available from https://doi.org/10.1007/s12571-010-0102-3.

LeanPath Food Waste Prevention (2017). Official Website. Available from www.leanpath.com.

Magnan, Nicholas, and others (2011). Modelling the limitations and implicit costs of cereal self-sufficiency: the case of Morocco. *Food Security*, vol. 3, sup. 1, pp. 49-60.

Marktanner, Marcus (2017). The Effects of Conflict on Food Security – The Cases of Syria, Yemen, and Lebanon. Background study for FAO Near East and North Africa Overview of Food Insecurity 2017, June 3.

Menon, Purnima, Marie T. Ruel and Saul S. Morris (2000). Socio-economic differentials in child stunting are consistently larger in urban than in rural areas. *Food and Nutrition Bulletin*, vol. 21, No. 3, pp. 282-289. Available from http://journals.sagepub.com/doi/pdf/10.1177/156482650002100305.

Molden, David (ed.) (2007). Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture. Colombo: International Water Management Institute (IWMI); London: Earthscan.

Musaiger, Abdulrahman O., and others (2012). Food-Based Dietary Guidelines for the Arab Gulf Countries. *Journal of Nutrition and Metabolism*, vol. 2012, Article ID 905303. Available from https://www.hindawi.com/journals/jnme/2012/905303/.

Nejdawi, Reem, and others (2015). Arab Sustainable Development Report, First Edition. Beirut, United Nations Economic and Social Commission for Western Asia (ESCWA) and United Nations Environment Programme (UNEP). E/ESCWA/SDPD/2015/3. Available from https://www.unescwa.org/publications/arab-sustainable-development-report-2015.

Ng, Tiffany (2013). South Korea's Waste Management Policies. Research Office Information Note. 26 March, Hong Kong: Legislative Council Secretariat. Available from http://www.legco.gov.hk/yr12-13/english/sec/library/1213inc04-e.pdf.

Organization for Economic Cooperation and Development (OECD) (2010). *Obesity and the Economics of Prevention: Fit not Fat*. Paris: OECD.

Organization for Economic Cooperation and Development (OECD) and Food and Agriculture Organization of the United Nations (FAO) (2012). OECD-FAO Agricultural Outlook 2012. Paris: OECD; Rome: FAO. Available from http://dx.doi.org/10.1787/agr_outlook-2012-en.

Plumer, Brad (2015). Map: Here's how much each country spends on food. *Vox*, 19 August. Available from https://www.vox.com/2014/7/6/5874499/map-heres-how-much-every-country-spends-on-food.

Randall, Debora (2015). Beyond yields – how can collaboration improve post-harvest profits within smallholder supply chains? Grow Africa Smallholder Working Group (SWG) Briefing Paper. Grow Africa Partnership and Alliance for a Green Revolution in Africa (AGRA). Available from https://www.growafrica.com/groups/briefing-paper-how-collaboration-can-improve-post-harvest-profits-within-smallholder-supply.

Regmi, Madhav, and Krishna P. Paudel (2017). Food security in a remittance based economy. *Food Security*, vol. 9, No. 4, pp. 831-848.

Ruel, Marie T. (2000). Urbanization in Latin America: Constraints and opportunities for child feeding and care. *Food and Nutrition Bulletin*, vol. 21, No. 1, pp. 12-24. Available from http://journals.sagepub.com/doi/pdf/10.1177/156482650002100103.

Sadler, Marc, and Nicholas Magnan (2011). Grain import dependency in the Middle East and North Africa Region: Risk management options. *Food Security*, vol. 3, sup. 1, pp. 77-89.

Silva, Joana, Victoria Levin and Matteo Morgandi (2013). Inclusion and Resilience: The Way Forward for Social Safety Nets in the Middle East and North Africa. Washington, D.C.: World Bank. Available from http://documents.worldbank.org/curated/en/455431468275110287/Inclusion-and-resilience-the-way-forward-for-social-safety-nets-in-the-Middle-East-and-North-Africa.

Suez Environnement (2015). As-Samra Wastewater Treatment Plant: A Major Asset for Jordan. Available from www.degremont.com.

United Nations (2015). World Population Prospects: The 2015 Revision – Key Findings and Advance Tables. Working Paper No. ESA/P/WP.241, Department of Economic and Social Affairs, Population Division, New York: United Nations. Available from https://esa.un.org/unpd/wpp/publications/files/key_findings_wpp_2015.pdf.

_____ (2016). Metadata on Goal 12: Ensure sustainable consumption and production patterns. Statistics Division, New York: United Nations. Available from https://unstats.un.org/sdgs/files/metadata-compilation/Metadata-Goal-12.pdf.

_____ (2017). World Population Prospects: The 2017 Revision – Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248, Department of Economic and Social Affairs, Population Division, New York: United Nations. Available from https://esa.un.org/unpd/wpp/Publications/Files/WPP2017_KeyFindings.pdf.

United Nations Children's Fund (UNICEF) (2013). UNICEF data: Monitoring the situation of women and children. Available from www.childinfo.org/malnutrition_weightbackground.php.

United Nations Conference on Trade and Development (UNCTAD) (2015). The Besieged Palestinian Agricultural Sector. New York and Geneva: United Nations. Available from http://unctad.org/en/PublicationsLibrary/gdsapp2015d1_en.pdf.

United Nations Development Programme (UNDP) (2006). Human Development Report 2006 – Beyond Scarcity: Power, Poverty and the Global Water Crisis. New York: UNDP. Available from http://hdr.undp.org/sites/default/files/reports/267/hdr06-complete.pdf.

United Nations Economic and Social Commission for Western Asia (ESCWA) (2016). Report of the sixteenth session of the Committee on Transport, Cairo, 23-24 November 2015. E/ESCWA/EDID/2015/IG.3/6/Report. Beirut, 15 February. Available from https://www.unescwa.org/sites/www.unescwa.org/files/events/files/report_of_the_sixteenth_session_of_the_committee_on_transport.pdf.

United Nations Economic and Social Commission for Western Asia (ESCWA) and others (2017). Arab Climate Change Assessment Report – Main Report. E/ESCWA/SDPD/2017/RICCAR/Report. Beirut. Available from https://www.unescwa.org/sites/www.unescwa.org/files/events/files/riccar_main_report_2017.pdf.

United Nations General Assembly (2015). Transforming our world: The 2030 Agenda for Sustainable Development. General Assembly resolution A/RES/70/1, 25 September. New York: United Nations. Available from http://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_RES_70_1_E.pdf.

United Nations Water (UN-Water) and Food and Agriculture Organization of the United Nations (FAO) (2007). Coping with water scarcity: Challenge of the twenty-first century. Available from http://www.fao.org/3/a-aq444e.pdf.

United States Department of Health and Human Services (HHS) and United States Department of Agriculture (USDA) (2015). Dietary Guidelines for Americans 2015-2020. 8th Edition, December. Available from http://health.gov/dietaryguidelines/2015/guidelines/.

Verner, Dorte (ed.) (2012). Adaptation to a Changing Climate in the Arab Countries: A Case for Adaptation Governance and Leadership in Building Climate Resilience. Washington, D.C.: World Bank. Available from http://documents.worldbank.org/curated/en/740351468299700935/Adaptation-to-a-changing-climate-in-the-Arab-countries-a-case-for-adaptation-governance-and-leadership-in-building-climate-resilience.

Vilariño, Maria V., Carol Franco and Caitlin Quarrington (2017). Food loss and waste reduction as an integral part of a circular economy. *Frontiers in Environmental Science*, vol. 5. Available from https://www.frontiersin.org/articles/10.3389/fenvs.2017.00021/full.

Wanner, Nathan, and others (2014). Refinements to the FAO methodology for estimating the prevalence of undernourishment indicator. FAO Statistics Division, ESS Working Paper No. 14-05, Rome: FAO. Available from http://www.fao.org/3/a-i4046e.pdf.

Ward, Christopher, and Sandra Ruckstuhl (2017). Water Scarcity, Climate Change and Conflict in the Middle East: Securing Livelihoods, Building Peace. New York: I.B. Tauris.

Welch, Ross M., and Robin D. Graham (2002). Breeding crops for enhanced micronutrient content. *Plant and Soil*, vol. 245, No. 1, pp. 205-214.

World Bank (2007). Middle East and North Africa Region (MENA): Regional Business Strategy to Address Climate Change. Washington, D.C.: World Bank.

_____ (2010a). Economic Integration in the GCC. Washington, D.C.: World Bank. Available from http://siteresources.worldbank.org/INTMENA/Resources/GCCStudyweb.pdf.

_____ (2010b). Economic Integration in the Maghreb. Washington, D.C.: World Bank. Available from http://documents.worldbank.org/curated/en/969341468278074872/Economic-integration-in-the-Maghreb.

_____ (2010c). Economic Integration in the Mashreq. Washington, D.C.: World Bank. Available from http://documents.worldbank.org/curated/en/929821468278677551/Economic-integration-in-the-Mashreq.

_____ (2013). Climate Change in the Middle East and North Africa. Available from http://www.worldbank.org/en/programs/mena-climate-change.

_____ (2014). World Development Indicators. Available from https://data.worldbank.org/data-catalog/world-development-indicators. Accessed June 2017.

_____ (2016). Logistics Performance Index (LPI) Global Rankings 2016. Available from https://lpi.worldbank.org/international/global.

_____ (2017). Transforming livelihoods through cash transfers to more than 1.5 million families in Egypt. 30 March. Available from http://www.worldbank.org/en/news/feature/2017/03/30/transforming-livelihoods-through-cash-transfers-to-more-than-15-million-families-in-egypt.

World Bank and Food and Agriculture Organization of the United Nations (FAO) (2012). The Grain Chain: Food Security and Managing Wheat Imports in Arab Countries. Washington, D.C.: World Bank. Available from http://documents.worldbank.org/curated/en/172941468299064537/The-grain-chain-food-security-and-managing-wheat-imports-in-Arab-countries.

World Food Programme (WFP) (2017a). Nutritional Activities in Yemen. June. Available from http://www1.wfp.org/countries/yemen.

_____ (2017b). WFP and the Retail Sector: Applying Business Solutions in Local Markets. April. Available from https://reliefweb.int/sites/reliefweb.int/files/resources/WFP-0000015259.pdf.

World Health Organization (WHO) (2010). Nutrition Landscape Information System (NLIS) Country Profile Indicators: Interpretation Guide. Geneva: WHO. Available from http://www.who.int/nutrition/nlis_interpretation_guide.pdf.

_____ (2011). Global Status Report on Noncommunicable Diseases 2010. Geneva: WHO. Available from http://www.who.int/nmh/publications/ncd_report_full_en.pdf.

_____ (2017a). Global Health Observatory (GHO) data repository: Density per 1000 – Data by country. Available from http://apps.who.int/gho/data/node.main.A1444.

_____ (2017b). Global Health Observatory (GHO) data repository: Prevalence of obesity among adults. Available from http://apps.who.int/gho/data/node.main.A900A?lang=en.

_____ (2017c). Media centre: Obesity and overweight. Fact sheet No. 311. Available from www.who.int/mediacentre/factsheets/fs311/en/.

World Health Organization (WHO) and Food and Agriculture Organization of the United Nations (FAO) (2002). Diet, Nutrition and the Prevention of Chronic Diseases. Report of a joint WHO/FAO expert consultation, 28 January-1 February, Geneva: WHO. Available from http://apps.who.int/iris/bitstream/10665/42665/1/WHO_TRS_916.pdf.

World Health Organization (WHO) and United Nations Children's Fund (UNICEF) (2017). Joint Monitoring Programme (JMP) database. Available from https://washdata.org/data. Accessed August 2017.

Zakaria, Sherouk (2017). Smart meters to help reduce food wastage in UAE hotels. *Khaleej Times*, 1 April. Available from http://www.khaleejtimes.com/lifestyle/food/smart-meters-to-help-reduce-food-wastage-in-uae-hotels.

Further readings

Abbott, Philip C., Christopher Hurt and Wallace E. Tyner (2008). What's Driving Food Prices? Farm Foundation Issue Report, Oak Brook, Illinois: Farm Foundation. Available from https://www1.eere.energy.gov/bioenergy/pdfs/farm_foundation_whats_driving_food_prices.pdf.

Abou-Hadid, Ayman (2010). Agricultural Water Management. In *Arab Environment – Water: Sustainable Management of a Scarce Resource*, 2010 Report of the Arab Forum for Environment and Development (AFED), Mohamed El-Ashry, Najib Saab and Bashar Zeitoon (eds.), Beirut: AFED. Available from http://www.afedonline.org/Report2010/pdf/En/Chapter4.pdf.

Addams, Lee, and others (2013). Charting Our Water Future: Economic Frameworks to Inform Decision-Making. Stockholm: 2030 Water Resources Group. Available from https://www.2030wrg.org/portfolio-item/charting-our-water-future/.

Afshin Ashkan, Laura A. Schmidt and others (2014). Dietary Policies to Reduce Non-Communicable Diseases. In *The Handbook of Global Health Policy*, Garrett W. Brown, Gavin Yamey and Sarah Wamala (eds). Hoboken, New Jersey: John Wiley & Sons, pp. 175-193.

Afshin, Ashkan, Saman Fahimi and others (2015). The impact of dietary habits and metabolic risk factors on cardiovascular and diabetes mortality in countries of the Middle East and North Africa in 2010: a comparative risk assessment analysis. *BMJ Open*, vol. 5, No. 5. Available from http://bmjopen.bmj.com/content/bmjopen/5/5/e006385.full.pdf.

Anon (2006). Electronic Conference on Salinization: Extent of Salinization and Strategies for Salt-Affected Land Prevention and Rehabilitation, 6 February-6 March. Organized and coordinated by the International Programme for Technology and Research in Irrigation and Drainage (IPTRID). Rome: FAO. Available from http://www.dgroups.org/groups/fao/salinization-conf/.

Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD) (2012). Arab Strategy for Water Security in the Arab Region. Cairo: Arab Ministerial Water Council (AMWC). Available from http://www.accwam.org/Files/Arab_Strategy_for_Water_Security_in_the_Arab_Region_to_meet_the_Challenges_and_Future_Needs_for_Sustainable_Development_-_2010-2030.pdf.

Arab Forum for Environment and Development (AFED) (2014). *Arab Environment: Food Security. Annual Report of the Arab Forum for Environment and Development*, A. Sadik, M. El-Solh and N. Saab, eds. Beirut. Available from http://www.afedonline.org/Report2014/E/Binder-eng.pdf.

Arab Organization for Agricultural Development (AOAD) (2009). Emergency Program for Arab Food Security. Khartoum: AOAD.

_____ (2010). Impact of Climate Change on Arab Countries. Khartoum. Available from http://www.aoad.org/Studies/Climate-change-effects.pdf. Accessed 9 January 2014.

_____ (2012). *Arab Agricultural Statistics Yearbook*, vol. 32. Khartoum: AOAD. Available from http://www.aoad.org/Agricultural_%20Statistical_Book_Vol32.pdf.

Arab Organization for Agricultural Development (AOAD) and League of Arab States (LAS) (2007). Strategy for Sustainable Arab Agricultural Development for the Upcoming Two Decades (2005-2025). Khartoum: AOAD; Cairo: League of Arab States. Available from http://www.aoad.org/strategy/straenglish.pdf.

Badgley, Catherine, and others (2007). Organic agriculture and the global food supply. *Renewable Agriculture and Food Systems*, vol. 22, No. 2, pp. 86-108. Available from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.521.5818&rep=rep1&type=pdf.

Baffes, John, and Allen Dennis (2013). Long-Term Drivers of Food Prices. Policy Research Working Paper 6455, Washington, D.C.: World Bank. Available from http://documents.worldbank.org/curated/en/832971468150565490/Long-term-drivers-of-food-prices.

Bailey, Rob, and Robin Willoughby (2013). Edible Oil: Food Security in the Gulf. Chatman House Briefing Paper, EER BP 2013/03. Available from https://www.chathamhouse.org/sites/files/chathamhouse/public/Research/Energy,%20Environment%20and%20Development/bp1113edibleoil.pdf.

Balcombe, Kelvin (2009). The Nature and Determinants of Volatility in Agricultural Prices: An Empirical Study from 1962-2008. Report to the Food and Agriculture Organization of the United Nations (FAO). Available from https://mpra.ub.uni-muenchen.de/24819/1/.

Barre, Mohamed (2015). Statistics of Food Loss. Presentation at the Food Security Information and Statistics Workshop, Amman, Jordan, 17-20 August.

Barrett, B. Christopher (2015). Benefits and Costs of the Food Security and Nutrition Targets for the Post-2015 Development Agenda: Post-2015 Consensus. Working Paper, Food Security and Nutrition Perspective Paper, Copenhagen: Copenhagen Consensus Center. Available from http://www.copenhagenconsensus.com/sites/default/files/food_security_nutrition_perspective_-_barrett.pdf.

Bashour, Issam, and others (2016). An overview of Conservation Agriculture in the dry Mediterranean environments with a special focus on Syria and Lebanon. *AIMS Agriculture and Food*, vol. 1, No. 1, pp. 67-84. Available from http://www.aimspress.com/article/10.3934/agrfood.2016.1.67/pdf.

Battersby, Jane (2012). Urban Food Security and the Urban Food Policy Gap. Paper presented at the "Towards Carnegie III" conference, University of Cape Town, September 3-7. Available from http://www.foresightfordevelopment.org/sobipro/55/1018-urban-food-security-and-the-urban-food-policy-gap.

Bhattacharya, Rina, and Hirut Wolde (2010). Constraints on Trade in the MENA Region. International Monetary Fund (IMF) Working Paper, Washington, D.C.: IMF. WP/10/31. Available from https://www.imf.org/external/pubs/ft/wp/2010/wp1031.pdf.

Bingham, Gail (2009). *International Water Resources*. Stockholm: CA & AC Publishing House.

Bingham, Gail, Aaron Wolf and Tim Wohlgenant (1994). Resolving Water Disputes: Conflict and Cooperation in the United States, the Near East, and Asia. United States Agency for International Development (USAID). Available from http://pdf.usaid.gov/pdf_docs/PNABT448.pdf.

BlueTech Research (2011). Turning Whey from Dairy Wastewater into Alcohol and Revenue. Available from https://www.bluetechresearch.com/latest-news/news/turning-whey-from-dairy-wastewater-into-alcohol-and-revenue/. Accessed 29 May 2017.

Boardman, John, Jean Poesen and Robert Evans (2003). Socio-economic factors in soil erosion and conservation. *Environmental Science & Policy*, vol. 6, No. 1, pp. 1-6.

Bonnal, Jean, Patricia Mejias-Moreno and Jean-Marc Faurès (2012a). Le Passage à l'Irrigation Localisée Collective: Les résultats d'une expérience dans le périmètre des Doukkala. Rome: FAO. Available from http://www.fao.org/3/a-i2861f.pdf.

Bou Kheir, Rania, Olivier Cerdan and Chadi Abdallah (2006). Regional soil erosion risk mapping in Lebanon. *Geomorphology*, vol. 82, Nos. 3-4, pp. 347-359.

Bray, George A., and Barry M. Popkin (1998). Dietary fat intake does affect obesity! *American Journal of Clinical Nutrition*, vol. 68, No. 6, pp. 1157-1173. Available from http://www.cpc.unc.edu/projects/nutrans/publications/Bray-Popkin-AJCN.pdf.

Breisinger, Clemens, and others (2013). Tackling Egypt's Rising Food Insecurity in a Time of Transition. Joint IFPRI-WFP Country Policy Note. Washington, D.C.: International Food Policy Research Institute (IFPRI); Cairo: World Food Programme (WFP). Available from www.ifpri.org/sites/default/files/publications/ifpriwfppn_egypt.pdf.

Bruinsma, Jelle (ed.) (2003). *World Agriculture Towards 2015/2030: An FAO Perspective*. Rome: FAO; London: Earthscan. Available from http://www.fao.org/3/a-y4252e.pdf.

Bullock, Andy (2013). Background Paper for the Regional Initiative on Water Scarcity in the Near East and North Africa. Cairo: FAO RNE.

Carius, Alexander (2007). Environmental Peacemaking: Conditions for Success. Environmental Change and Security Program (ECSP) Special Report, Issue 12, Washington, D.C.: Woodrow Wilson International Center for Scholars. Available from https://www.wilsoncenter.org/publication/environmental-peacemaking-conditions-for-success.

Cascao, Ana Elisa (2009). Institutional analysis of Nile Basin Initiative: What worked, what did not work and what are the emerging options? Nile Basin Focal Project Report. Colombo: International Water Management Institute (IWMI).

Cavatassi, Romina, and others (2011). Linking Smallholders to the New Agricultural Economy: the case of the Plataformas de Concertación in Ecuador. *Journal of Development Studies*, vol. 47, No. 10, pp. 1545-1573. Available from https://hal.archives-ouvertes.fr/hal-00721636/document.

Centre International de Hautes Etudes Agronomiques Méditerranéennes (CIHEAM) and Food and Agriculture Organization of the United Nations (FAO) (2013). Modernization of Irrigation System Management: A Synthesis of MASCOTTE Application in Seven Systems in the NENA Region. Bari: CIHEAM; Rome: FAO.

Charbel, Laurence, and others (2016). Preliminary Insights on Household Food Wastage in Lebanon. *Journal of Food Security*, vol. 4, No. 6, pp. 131-137. Available from http://pubs.sciepub.com/jfs/4/6/2/.

Clements, Rebecca, and others (2011). *Technologies for Climate Change Adaptation – Agriculture Sector*. Xianli Zhu (ed.), Roskilde: UNEP Risø Centre. Available from http://orbit.dtu.dk/files/5706575/Technologies_for_Climate_Change_Adaptation_Agriculture_sector.pdf.

Compton, Julia, Steve Wiggins and Sharada Keats (2010). Impact of the global food crisis on the poor: what is the evidence? London: Overseas Development Institute (ODI). Available from https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/6371.pdf.

Cotula, Lorenzo, and others (2011). Agricultural investment and international land deals: evidence from a multi-country study in Africa. *Food Security*, vol. 3, sup. 1, pp. 99-113.

Croppenstedt, André, Maurice Saade and Gamal Siam (2006). Food Security and Wheat Policy in Egypt. Roles of Agriculture Project Policy Brief No. 2, Rome: FAO.

Darghouth, Salah, and others (2008). Watershed Management Approaches, Policies and Operations: Lessons for Scaling Up. Water Sector Board Discussion Paper Series, Paper No. 11, Washington, D.C.: World Bank. Available from https://openknowledge.worldbank.org/handle/10986/17240.

Darnhofer, Ika, and others (2016). The resilience of family farms: towards a relational approach. *Journal of Rural Studies*, vol. 44, pp. 111-122.

Darwish, Talal, and others (2006). Nitrogen and water use efficiency of fertigated processing potato. *Agricultural Water Management*, vol. 85, Nos. 1-2, pp. 95-104.

Development Studies Association (DSA) (2012). Improving rangeland management and carpet production in Arsal. Development Studies Association (DSA) Project supported by UNDP and Hariri Foundation.

Doane, David P., and Lori E. Seward (2011). Measuring Skewness: A Forgotten Statistic? *Journal of Statistics Education*, vol. 19, No. 2. Available from www.amstat.org/publications/jse/v19n2/doane.pdf.

Dregne, Harold E., and Nan-Ting Chou (1992). Global Desertification Dimensions and Costs. In *Degradation and Restoration of Arid Lands*, International Center for Arid and Semi-Arid Land Studies (ICASALS), Lubbock: Texas Tech University. Available from http://www.ciesin.columbia.edu/docs/002-186/002-186.html.

Ecker, Olivier, Jean François Trinh Tan and Perrihan Al-Riffai (2014). Facing the Challenge: The Recent Reform of the Egyptian Food Subsidy System. Arab Food and Nutrition Security Blog, 19 December. Available from http://www.arabspatial.org/blog/blog/2014/12/19/facing-the-challenge-the-recent-reform-of-the-egyptian-food-subsidy-system/.

El Moujabber, Maroun, and others (2006). Etude de la Tolérance de la Fraise (Fragaria vivace) à la Salinité au Liban. *Lebanese Science Journal*, vol. 7, No. 2, pp. 33-44. Available from http://lsj.cnrs.edu.lb/wp-content/uploads/2015/12/moujabber.pdf.

Feltz, Nicolas, and Marnik Vanclooster (2013). Factors explaining on-site irrigation performance variability in Triffa's irrigated perimeter (East Morocco). *Procedia Environmental Sciences*, vol. 19, pp. 757-766.

Food and Agriculture Organization of the United Nations (FAO) (2002). Measurement and Assessment of Food Deprivation and Undernutrition. Summary of Proceedings of the International Scientific Symposium, Rome, 26-28 June. Available from http://www.fao.org/3/a-y4250e.pdf.

_____ (2003). Financing Normal Levels of Commercial Imports of Basic Foodstuffs: In the context of the Marrakesh Decision on Least-Developed and Net Food-Importing Developing Countries. Rome. Available from http://www.fao.org/3/a-y5109t.pdf.

_____ (2006). The New Generation of Watershed Management Programmes and Projects. FAO Forestry Paper 150. Rome. Available from ftp://ftp.fao.org/docrep/fao/009/a0644e/a0644e.pdf.

_____ (2007). Digital Soil Map of the World (DSMW). Land and Water Development Division, 28 February. Rome. Available from http://www.fao.org/geonetwork/srv/en/metadata.show?id=14116.

_____ (2008). The State of Food Insecurity in the World 2008: High Food Prices and Food Security –Threats and Opportunities. Rome. Available from http://www.fao.org/docrep/011/i0291e/i0291e00.htm.

_____ (2009). Feeding the World, Eradicating Hunger. Background Paper for the World Summit on Food Security (WSFS), Rome, 16-18 November. Available from http://www.fao.org/fileadmin/templates/wsfs/Summit/WSFS_Issues_papers/WSFS_Background_paper_Feeding_the_world.pdf.

_____ (2010). Forest and Climate Change in the Near East Region. Forest and Climate Change Working Paper 9, Rome. Available from http://www.fao.org/forestry/24646-0acdf8232cda6c92cb3e7b460f00fbea.pdf.

_____ (2012). Coping with Water Scarcity: An action framework for agriculture and food security. FAO Water Report 38, Rome. Available from http://www.fao.org/docrep/016/i3015e/i3015e.pdf.

_____ (2012). Irrigation Modernization in the NENA Region: Proceedings of the International Workshop, Bari September 2012. Rome.

_____ (2013). Agricultural Livelihoods and Food Security Impact Assessment and Response Plan for the Syria Crisis in the Neighbouring Countries of Egypt, Iraq, Jordan, Lebanon and Turkey. Available from http://www.fao.org/fileadmin/user_upload/emergencies/docs/FAO-Syria-Crisis-Assessment-Response%20Plan_Neighbouring%20Countries-en.pdf.

_____ (2013). Regional Initiative on Water Scarcity in the Near East and North Africa. Available from http://www.fao.org/fileadmin/user_upload/rne/docs/WSI-Pamphlet-en.pdf.

_____ (2014). Reducing food losses and waste in the Near East & North Africa region. Fact Sheet, 32nd Session of the FAO Regional Conference for the Near East, 24-28 February. Rome. Available from http://www.fao.org/docrep/019/as212e/as212e.pdf.

_____ (2015a). Global Initiative on Food Loss and Waste Reduction. Rome. Available from http://www.fao.org/3/a-i4068e.pdf.

_____ (2015b). Regional Overview of Food Insecurity – Near East and North Africa: Strengthening Regional Collaboration to Build Resilience for Food Security and Nutrition. Cairo. Available from http://www.fao.org/3/a-i4644e.pdf.

_____ (2016). International Symposium on Sustainable Food Systems for Healthy Diets and Improved Nutrition. 1-2 December. Available from http://www.fao.org/about/meetings/sustainable-food-systems-nutrition-symposium/en/.

Food and Agriculture Organization of the United Nations (FAO) Committee on World Food Security (CFS) (2012). Coming to Terms with Terminology. CFS 2012/39/4. Available from http://www.fao.org/docrep/meeting/026/MD776E.pdf.

Food and Agriculture Organization of the United Nations (FAO) Regional Office for the Near East and North Africa (RNE) (2014). FAO Statistical Yearbook 2014: Near East and North Africa Food and Agriculture. Cairo: FAO RNE. Available from http://www.fao.org/docrep/019/i3591e/i3591e.pdf.

Food and Agriculture Organization of the United Nations (FAO) and Intergovernmental Technical Panel on Soils (ITPS) (2015). Status of the World's Soil Resources (SWSR) – Main Report. Rome: FAO and ITPS. Available from http://www.fao.org/3/a-i5199e.pdf.

Food and Agriculture Organization of the United Nations (FAO), World Food Programme (WFP) and the Syrian Arab Republic (2012). Joint Rapid Food Security Needs Assessment. June 2012 Report. Available from https://www.wfp.org/content/syrian-arabic-republic-joint-rapid-food-security-needs-assessment-june-2012.

Frenken, Karen (2009). Irrigation in the Middle East Region in Figures: AQUASTAT Survey 2008. FAO Water Report 34. Rome: FAO. Available from http://www.fao.org/3/a-i0936e.pdf.

Gardi, Ciro, and others (2015). Land Take and Food Security: Assessment of Land Take on the Agricultural Production in Europe. *Journal of Environmental Planning and Management*, vol. 58, No. 5, pp. 898-912.

Garnett, Tara (2014). What is a sustainable healthy diet? Food Climate Research Network (FCRN). Available from http://www.fcrn.org.uk/sites/default/files/fcrn_what_is_a_sustainable_healthy_diet_final.pdf.

Gilbert, Christopher L. and C. Wyn Morgan (2010). Has food price volatility risen? Institute for Prospective Technological Studies (IPTS) workshop on Methods to Analyse Price Volatility, Seville, Spain, 28-29 January. Available from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.849.2535&rep=rep1&type=pdf.

Giorgio, D.De., and Montemurro, F. (2006). Nutritional status and nitrogen utilization efficiency of durum wheat in a semiarid Mediterranean environment. *Agricoltura Mediterranea*, vol. 160, pp. 91-101.

Global Footprint Network (2015). National Footprint Accounts. Available from http://www.footprintnetwork.org.

Griffiths, Cara A., and others (2016). Chemical intervention in plant sugar signalling increases yield and resilience. *Nature*, vol. 540, No. 7634, pp. 574-578. Available from https://doi.org/10.1038/nature20591.

Gustavsson, Jenny, and others (2011). Global Food Losses and Food Waste: Extent, Causes and Prevention. Study conducted for the International Congress 'Save Food!' at Interpack2011, Düsseldorf, Germany. Rome: FAO. Available from http://www.fao.org/docrep/014/mb060e/mb060e00.pdf.

Hamdallah, Ghassan (2007). Balanced Plant Nutrition: A Basis for Plant, Animal and Human Health. 13th Arab Fertilizer Association (AFA) International Annual Fertilizers Forum and Exhibition, Sharm El-Sheikh, Egypt, 6-8 February. Available from https://www.ipipotash.org/udocs/Hamdallah_IPI_AFA_IMPHOS_PROCEEDING.pdf.

Harrigan, Jane (2014). *The Political Economy of Arab Food Sovereignty*. Basingstoke, United Kingdom: Palgrave Macmillan.

Harrison, Paul (2002). World Agriculture Towards 2015/2030: Summary Report. Rome: FAO. Available from http://www.fao.org/3/a-y3557e.pdf.

Henao, Julio, and Carlos Baanante (2006). Agricultural Production and Soil Nutrient Mining in Africa: Implications for Resource Conservation and Policy Development. IFDC Technical Bulletin, Muscle Shoals, Alabama: International Fertilizer Development Center (IFDC). Available from https://vtechworks.lib.vt.edu/bitstream/handle/10919/68832/4566_Henao2006_Ag_production_nutrient_mining_.pdf?sequence=1.

Heng, L.K., and others (2007). Optimizing wheat productivity in two rain-fed environments of the West Asia-North Africa region using a simulation model. *European Journal of Agronomy*, vol. 26, No. 2, pp. 121-129.

High Level Panel of Experts (HLPE) (2011). Price Volatility and Food Security: A Report by the High Level Panel of Experts on Food Security. HLPE Report 1, Rome: FAO. Available from http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/HLPE-price-volatility-and-food-security-report-July-2011.pdf.

_____ (2014). Food Losses and Waste in the Context of Sustainable Food Systems: A Report by the High Level Panel of Experts on Food Security and Nutrition. HLPE Report 8, Rome: FAO. Available from http://www.fao.org/3/a-i3901e.pdf.

Hoornweg, Daniel, and Perinaz Bhada-Tata (2012). What a Waste: A Global Review of Solid Waste Management. Urban Development Series Knowledge Papers, No. 15, Washington, D.C.: World Bank. Available from https://openknowledge.worldbank.org/handle/10986/17388.

Horton, Susan, and Jay Ross (2003). The economics of iron deficiency. *Food Policy*, vol. 28, No. 1, pp. 51-75.

Huchet-Bourdon, Marilyne (2011). Agricultural Commodity Price Volatility: An Overview. OECD Food, Agriculture and Fisheries Working Papers, No. 52, Paris: OECD Publishing. Available from dx.doi.org/10.1787/5kg0t00nrthc-en.

Husain, Arif, Jean-Martin Bauer and Susanna Sandström (2014). Economic Impact Study: Direct and Indirect Impact of the WFP Food Voucher Programme in Jordan. Rome: WFP. Available from https://www.wfp.org/content/jordan-economic-impact-study-wfp-food-voucher-programme-april-2014.

Immerzeel, Walter, and others (2011). Middle East and Northern Africa Water Outlook. Washington, D.C.: World Bank. Available from http://siteresources.worldbank.org/INTMNAREGTOPWATRES/Resources/MNAWaterOutlook_to_2050.pdf.

Integrated Regional Information Networks (IRIN) (2005). Food incentives for girl education. 11 September. Available from www.irinnews.org/report.aspx?reportid=25459.

International Center for Agricultural Research in the Dry Areas (ICARDA) (2007). Building Bridges of Confidence Through Technical Dialogue. Final Report on the MENA Regional Initiative for Dryland Management. Aleppo: ICARDA; Rome: FAO; Washington, D.C.: World Bank. Available from http://www.fao.org/3/a-a1231e/a1231e01.pdf.

_____ (2009). Annual Report 2008. Aleppo: ICARDA. Available from https://www.icarda.org/publications-resources/annual-report.

International Center for Biosaline Agriculture (ICBA) (2014). ICBA Annual Report 2014: Innovation—Impact—Partnership. Dubai: ICBA. Available from http://www.biosaline.org/sites/default/files/ar2014-eng.pdf.

International Monetary Fund (IMF) (2004). Review of the Compensatory Financing Facility. IMF Policy Development and Review Department, Washington, D.C.: IMF. Available from www.imf.org/external/np/pdr/ccff/eng/2004/021804.htm.

Jobbins, Guy, and Giles Henley (2015). Food in an Uncertain Future: The Impacts of Climate Change on Food Security and Nutrition in the Middle East and North Africa. London: Overseas Development Institute (ODI); Cairo: World Food Programme (WFP). Available from http://documents.wfp.org/stellent/groups/public/documents/communications/wfp279986.pdf.

Keats, Sharada, and Steve Wiggins (2014). Future Diets: Implications for Agriculture and Food Prices. London: ODI. Available from https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/8776.pdf.

Konandreas, Panos (2010). Promoting agricultural inputs under the Food Aid Convention to increase food production in emergency-prone developing countries. Paper prepared for the FAO Emergency Operations and Rehabilitation Division. Rome: FAO. Available from www.fao.org/fileadmin/templates/tc/tce/pdf/Promoting_agricultural_inputs_under_the_FAC_P_Konandreas.pdf.

Konandreas, Panos (2012). Trade Policy Responses to Food Price Volatility in Poor Net Food-Importing Countries. International Centre for Trade and Sustainable Development (ICTSD) Programme on Agricultural Trade and Sustainable Development, Issue Paper No. 42, Geneva: ICTSD and FAO. Available from www.ictsd.org/downloads/2012/06/trade-policy-responses-to-food-price-volatility-in-poor-net-food-importing-countries.pdf.

Konandreas, Panos, Barbara Huddleston and Virabongsa Ramangkura (1978). Food Security: An Insurance Approach. International Food Policy Research Institute (IFPRI) Research Report No. 4, Washington, D.C.: IFPRI. Available from http://www.ifpri.org/publication/food-security.

Lampietti, Julian, and others (2009). Improving Food Security in Arab Countries. World Bank, FAO and IFAD Joint Working Paper, Washington, D.C.: World Bank; Rome: FAO and IFAD. Available from http://documents.worldbank.org/curated/en/195841468046455493/Improving-food-security-in-Arab-countries.

Langdale, G.W., and others (1992). Restoration of eroded soil with conservation tillage. *Soil Technology*, vol. 5, No. 1, pp. 81-90.

Liou, Yuei-An, and Sanjib Kumar Kar (2014). Evapotranspiration Estimation with Remote Sensing and Various Surface Energy Balance Algorithms – A Review. *Energies*, vol. 7, No. 5, pp. 2821-2849. Available from http://www.mdpi.com/1996-1073/7/5/2821.

Lipinski, Brian, and others (2013). Reducing Food Loss and Waste. Working Paper, Instalment 2 of 'Creating a Sustainable Food Future', Washington, D.C.: World Resources Institute (WRI). Available from http://www.wri.org/publication/reducing-food-loss-and-waste.

Maystadt, Jean-François, Jean-François Trinh Tan and Clemens Breisinger (2014). Does food security matter for transition in Arab countries? *Food Policy*, vol. 46, pp. 106-115.

Mazid, Ahmed, Aden Aw-Hassan and Hisham Salahieh (2007). Farmers' Performance Criteria for New Barley Varieties and their Diffusion through Farmer-to-Farmer Seed Distribution. Aleppo: ICARDA.

McCalla, Alex F. (2009). World Food Prices: Causes and Consequences. *Canadian Journal of Agricultural Economics*, vol. 57, No. 1, pp. 23-34. Available from http://onlinelibrary.wiley.com/wol1/doi/10.1111/j.1744-7976.2008.01136.x/full.

McDonnell, Rachael, and Shoaib Ismail (2011). Climate Change is a Threat to Food Security and Rural Livelihoods in the Arab Region. Dubai: ICBA.

Minot, Nicholas, and others (2010). Trade Liberalization and Poverty in the Middle East and North Africa. IFPRI Research Monograph, Washington, D.C.: IFPRI. Available from http://www.ifpri.org/publication/trade-liberalization-and-poverty-middle-east-and-north-africa.

Mirata, Murat, and Tareq Emtairah (2014). Water Efficiency in Agriculture. In *Water Efficiency Handbook*, Arab Forum for Environment and Development (AFED), Beirut: AFED. Available from http://www.afedonline.org/WEH2014/eng/WATER-Efficiency-Handbook-ENGLISH.pdf.

Mirkin, Barry (2010). Population Levels, Trends and Policies in the Arab region: Challenges and Opportunities. Arab Human Development Report Research Paper Series, New York: UNDP. Available from http://mait.camins.cat/ET2050_library/docs/med/arab_population.pdf.

Montanarella, Luca, and others (2016). World's soils are under threat. *SOIL*, vol. 2, No. 1, pp. 79-82. Available from https://www.soil-journal.net/2/79/2016/.

Montgomery, David R. (2007). Is agriculture eroding civilization's foundation? *GSA Today*, vol. 17, No. 10, pp. 4-9. Available from https://doi.org/10.1130/GSAT01710A.1.

Mozaffarian, Dariush (2016). Foods, obesity, and diabetes – are all calories created equal? *Nutrition Reviews*, vol. 75, sup. 1, pp. 19-31.

Mozaffarian, Dariush, David Hemenway and David S. Ludwig (2013). Curbing Gun Violence: Lessons from Public Health Successes. *Journal of the American Medical Association (JAMA)*, vol. 309, No. 6, pp. 551-552. Available from https://jamanetwork.com/journals/jama/fullarticle/1556167.

Mozaffarian, Dariush, Ashkan Afshin and others (2012). Population Approaches to Improve Diet, Physical Activity, and Smoking Habits: A Scientific Statement from the America Heart Association. *Circulation*, vol. 126, No. 12, pp. 1514-1563. Available from http://circ.ahajournals.org/content/126/12/1514.long.

Mozaffarian, Dariush, Tao Hao and others (2011). Changes in Diet and Lifestyle and Long-Term Weight Gain in Women and Men. *New England Journal of Medicine*, vol. 364, No. 25, pp. 2392-2404. Available from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.370.2295&rep=rep1&type=pdf.

Nicolai, Susan, and others (2015). Projecting Progress: Reaching the SDGs by 2030. Overseas Development Institute (ODI) Flagship Report, London: ODI. Available from https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9839.pdf.

Organisation for Economic Co-operation and Development (OECD) (2011). Managing Risk in Agriculture: Policy Assessment and Design. Paris: OECD. Available from dx.doi.org/10.1787/9789264116146-en.

_____ (2012). Obesity Update 2012. Paris: OECD. Available from www.oecd.org/health/49716427.pdf.

Organisation for Economic Co-operation and Development (OECD) and Food and Agriculture Organization of the United Nations (FAO) (2008). OECD-FAO Agricultural Outlook 2008-2017. Paris: OECD; Rome: FAO. Available from http://www.oecd.org/trade/agricultural-trade/40715381.pdf.

_____ (2010). OECD-FAO Agricultural Output 2010-2019. Paris: OECD; Rome: FAO.

_____ (2013). OECD-FAO Agricultural Outlook 2013-2022. Paris: OECD; Rome: FAO. Available from https://www.oecd.org/tad/agricultural-policies/OECD-FAO_Outlook_2013-2022.pdf.

Oweis, Theib (1997). Supplemental Irrigation: A Highly Efficient Water-Use Practice. Aleppo: ICARDA. Available from https://www.researchgate.net/publication/267138098_Supplemental_Irrigation_A_Highly_Efficient_Water-Use_Practice.

Oweis, Theib, and Awni Taimeh (1996). Evaluation of a small basin water harvesting system in the arid region of Jordan. *Water Resources Management*, vol. 10, No. 1, pp. 21-34. Oweis, Theib, and Ahmed Hachum (2009). Supplemental irrigation for improved rainfed agriculture in WANA region. In *Rainfed Agriculture: Unlocking the Potential*, Suhas P. Wani, Johan Rockström and Theib Oweis (eds.), Comprehensive Assessment of Water Management in Agriculture Series, vol. 7, London: Centre for Agriculture and Bioscience International (CABI). Available from http://www.iwmi.cgiar.org/Publications/CABI_Publications/CA_CABI_Series/Rainfed_Agriculture/Protected/Rainfed_Agriculture_Unlocking_the_Potential.pdf.

Pagiola, Stefano (2002). Paying for Water Services in Central America: Learning from Costa Rica. In *Selling Forest Environmental Services: Market-based Mechanisms for Conservation and Development*, Stefano Pagiola, Joshua Bishop and Natasha Landell-Mills (eds.), London: Earthscan.

Pagiola, Stefano, and Gunars Platais (2006). Payments for environmental services: From theory to practice. Washington, D.C.: World Bank.

Popkin, Barry M. (2003) The Nutrition Transition in the Developing World. *Development Policy Review*, vol. 21, Nos. 5-6, pp. 581-597. Available from www.cpc.unc.edu/projects/nutrans/publications/Popkin-Devl-Pol-iRev-300.pdf.

Popkin, Barry M., Linda S. Adair and Shu Wen Ng (2012). The Global Nutrition Transition: The Pandemic of Obesity in Developing Countries. *Nutrition Reviews*, vol. 70, No. 1, pp. 3-21. Available from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3257829/.

Prakash, Adam (ed.) (2011). *Safeguarding Food Security in Volatile Global Markets*. Rome: FAO. Available from http://www.fao.org/docrep/013/i2107e/i2107e.pdf.

Rahimizadeh, Majid, and others (2010). Nitrogen use efficiency of wheat as affected by preceding crop, application rate of nitrogen and crop residues. *Australian Journal of Crop Science (AJCS)*, vol. 4, No. 5, pp. 363-368. Available from http://www.cropj.com/rahimzadeh_3_5_2010_363_368.pdf.

Reutlinger, Shlomo (1977). Food Insecurity: Magnitude and Remedies. Staff Working Paper, no. SWP 267, Washington, D.C.: World Bank. Available from http://documents.worldbank.org/curated/en/209791467993231695/Food-insecurity-magnitude-and-remedies.

Rosegrant, Mark W., and others (2015). Returns to Investment in Reducing Postharvest Food Losses and Increasing Agricultural Productivity Growth: Post-2015 Consensus. Working Paper, Benefits and Costs of the Food Security and Nutrition Targets for the Post-2015 Development Agenda, Food Security and Nutrition Assessment Paper, Copenhagen: Copenhagen Consensus Center. Available from http://www.copenhagenconsensus.com/sites/default/files/food_security_nutrition_assessment_-_rosegrant_0.pdf.

Ruckstuhl, Sandra (2009). Renewable Natural Resources: Practical Lessons for Conflict-Sensitive Development. Conflict, Crime & Violence Issue Note, Social Development Department, Washington, D.C.: World Bank. Available from http://siteresources.worldbank.org/EXTSOCIALDEVELOPMENT/Resources/244362-1164107274725/RNR_PRS.pdf.

_____ (2010). Red Sea-Dead Sea Conveyance Case Study: Working paper for the report Water and Conflict in the Middle East and North Africa. Washington, D.C.: World Bank.

Ruel, Marie T., and others (1998). Urban challenges to food and nutrition security: a review of food security, health, and caregiving in the cities. Food Consumption and Nutrition Division (FCND) Discussion Paper No. 51, Washington, D.C.: IFPRI. Available from http://www.ifpri.org/publication/urban-challenges-food-and-nutrition-security.

Saab, Najib (2009). Arab Public Opinion and Climate Change. In *Arab Environment: Climate Change – Impact of Climate Change on Arab Countries*, Mostafa K. Tolba and Najib Saab (eds.), Beirut: Arab Forum for Environment and Development (AFED). Available from http://www.preventionweb.net/files/12741_FullEnglishReport1.pdf.

Sarraf, Maria, Bjorn Larsen and Marwan Owaygen (2004). Cost of Environmental Degradation – The Case of Lebanon and Tunisia. Environmental Economics Series, Paper No. 97, World Bank Environment Department. Available from http://documents.worldbank.org/curated/en/445831468760782622/Cost-of-environmental-degradation-the-case-of-Lebanon-and-Tunisia.

Scandizzo, Pasquale, and Adriana Paolantonio (2010). Climate Change, Risk and Adaptation in Yemeni Agriculture. Washington, D.C.: World Bank.

Scherr, Sara J. (1999). Soil Degradation: A Threat to Developing-Country Food Security by 2020? Food, Agriculture, and the Environment Discussion Paper 27, Washington, D.C.: IFPRI. Available from https://ageconsearch.umn.edu/bitstream/42277/2/dp27.pdf.

Schertz, David L., and others (1989). Effect of past soil erosion on crop productivity in Indiana. *Journal of Soil and Water Conservation*, vol. 44, No. 6, pp. 604-608.

Schmidhuber, Josef (2007). Biofuels: an emerging threat to Europe's food security? Impact of an increased biomass use on agricultural markets, prices and food security: A longer-term perspective. Notre Europe, Policy Paper 27. Available from http://www.institutdelors.eu/media/policypaper-schmidhuber-en.pdf?pdf=ok.

Schuster, Monica, and Máximo Torero (2016). Toward a Sustainable Food System: Reducing Food Loss and Waste. In *2016 Global Food Policy Report*, Washington, D.C.: IFPRI. Available from http://www.ifpri.org/publication/2016-global-food-policy-report.

Sdralevich, Carlo, and others (2014). Subsidy Reform in the Middle East and North Africa: Recent Progress and Challenges Ahead. Washington, D.C.: IMF. Available from https://www.imf.org/external/pubs/ft/dp/2014/1403mcd.pdf.

Sharma, Ramesh (2011). Food Export Restrictions: Review of the 2007-2010 Experience and Considerations for Disciplining Restrictive Measures. FAO Commodity and Trade Policy Research Working Paper No. 32, Rome: FAO. Available from www.fao.org/fileadmin/templates/est/PUBLICATIONS/Comm_Working_Papers/EST-WP32.pdf.

Sharma, Ramesh, and Panos Konandreas (2008). WTO provisions in the context of responding to soaring food prices. FAO Commodity and Trade Policy Research Working Paper No. 25, Rome: FAO.

Shatanawi, Muhammad, and others (2005). Irrigation systems performance in Jordan. In *Irrigation Systems Performance*, Nicola Lamaddalena and others (eds), Bari: Centre International de Hautes Etudes Agronomiques Méditerranéennes, pp. 123-131.

Shideed, Kamel (2008). The food crisis and its socioeconomic impact: towards reducing the food gap in the Arab countries. *Arab Agriculture Investment Journal*, vol. 6, pp. 31-35.

Solh, Mahmoud, and Maarten Van Ginkel (2014). Drought preparedness and drought mitigation in the developing world's drylands. *Weather and Climate Extremes*, vol. 3, pp. 62-66. Available from http://www.sciencedirect.com/science/article/pii/S221209471400019X.

Solomon, Susan, and others (eds.) (2007). Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press. Available from http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html.

Spaargaren, Otto, and Vincent Van Engelen (1999). Land Resources Information Systems – A Source of Information and Basic Tool for Modelling and Monitoring Land-use and Land-cover Changes. International Soil Reference and Information Centre (ISRIC), the Netherlands. Available from http://www-basin.nies.go.jp/project/lugec/Proceedings/10)Otto%20Spaargaren.pdf.

Sumner, Daniel A. (2009). Recent Commodity Price Movements in Historical Perspective. *American Journal of Agricultural Economics*, vol. 91, No. 5, pp. 1250-1256.

Tacoli, Cecilia, Budoor Bukhari and Susannah Fisher (2013). Urban Poverty, Food Security and Climate Change. Human Settlements Working Paper No. 37, London: International Institute of Environment and Development (IIED).

Taha, Faisal, and Shoaib Ismail (2010). Potential of marginal land and water resources: Challenges and opportunities. Proceedings of the International Conference on Soils and Groundwater Salinization in Arid Countries, Muscat: Sultan Qaboos University, pp. 99-104.

Taha, Faisal, Shoaib Ismail and Abdullah Dakheel (2005). Biosaline Agriculture: An International Perspective within a Regional Context of the Middle East and North Africa (MENA). Keynote Paper on "Food Security and Use of Non-Conventional Water Resources", International Conference on Water, Land and Food Security in Arid and Semi-Arid Regions, Bari, Italy, 6-11 September, Bari: CIHEAM, pp. 255-278.Tanyeri-Abur, Ayşen, and Nasredin Hag Elamin (2011). International Investments in Agriculture in Arab Countries: An Overview and Implications for Policy. *Food Security*, vol. 3, sup. 1, pp. 115-127.

The Lancet (2013). Maternal and Child Nutrition Series. Available from www.thelancet.com/series/maternal-and-child-nutrition.

Theron, Marian, and others (2006). Inadequate dietary intake is not the cause of stunting amongst young children living in an informal settlement in Gauteng and rural Limpopo Province in South Africa: the NutriGro study. *Public Health Nutrition*, vol. 10, No. 4, pp. 379-389. Available from https://www.cambridge.org/core/journals/public-health-nutrition/article/div-classtitleinadequate-dietary-intake-is-not-the-cause-of-stunting-amongst-young-children-living-in-an-informal-settlement-in-gauteng-and-rural-limpopo-province-in-south-africa-the-nutrigro-studydiv/94D94B628D1BD1353792FDA40F75B380.

Tinbergen, Jan (1962). Shaping the World Economy: Suggestions for an International Economic Policy. New York: Twentieth Century Fund.

Turral, Hugh, Jacob Burke and Jean-Marc Faurès (2011). Climate Change, Water and Food Security. FAO Water Report 36, Rome: FAO. Available from http://www.fao.org/docrep/014/i2096e/i2096e.pdf.

Turton, Anthony R., and Gerhard Lichtenthaler (2002). Natural Resource Reconstruction and Traditional Value Systems: A Case Study from Yemen. Occasional Paper 14, SOAS Water Issues Study Group, London: School of Oriental and African Studies (SOAS) University of London.

United Nations (2013). World Population Prospects: The 2012 Revision, Highlights and Advance Tables. Working Paper No. ESA/P/WP.228, Department of Economic and Social Affairs, Population Division, New York: United Nations. Available from https://esa.un.org/unpd/wpp/publications/Files/WPP2012_HIGHLIGHTS.pdf.

_____ (2015). Sustainable Development Goals (SDGs) – Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture. Available from http://www.un.org/sustainabledevelopment/hunger/.

_____ (2015). World Urbanization Prospects: The 2014 Revision. ST/ESA/SER.A/366, Department of Economic and Social Affairs, Population Division, New York: United Nations. Available from https://esa.un.org/unpd/wup/publications/files/wup2014-report.pdf.

United Nations and League of Arab States (LAS) (2013). The Arab Millennium Development Goals Report: Facing Challenges and Looking Beyond 2015. Beirut: ESCWA. Available from http://www.undp.org/content/dam/rbas/doc/MDGS%20publications/Arab_MDGR_2013_English.pdf.

United Nations Development Programme (UNDP) (2009). Arab Human Development Report 2009: Challenges to Human Security in the Arab Countries. New York: UNDP. Available from http://www.undp.org/content/undp/en/home/librarypage/hdr/arab_human_developmentreport2009.html.

_____ (2011). Arab Development Challenges Report 2011: Towards the Developmental State in the Arab Region. Cairo: UNDP. Available from http://www.undp.org/content/dam/undp/library/corporate/HDR/UNDP-ADCR_En-2012.pdf.

United Nations Economic and Social Commission for Western Asia (ESCWA) (2010). Food security and conflict in the ESCWA region. E/ESCWA/ECRI/2010/1. Available from https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/e_escwa_ecri_10_1_e.pdf.

_____ (2015). Arab Development Outlook: Vision 2030. E/ESCWA/EDID/2015/3. Available from https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/arab-development-outlook-vision-2030-english.pdf.

_____ (2015). Pathways toward Food Security in the Arab Region: An Assessment of Wheat Availability. E/ESCWA/SDPD/2015/1. Available from https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/e_escwa_sdpd_15_1_e.pdf.

_____ (2015). Regional Coordination Mechanism (RCM) Issues Brief for the Arab Sustainable Development Report. Available from http://shaamsplatform.org/library/regional-coordination-mechanisms-rcm-issues-brief-for-the-arab-sustainable-development-report/.

United Nations General Assembly (2016). Resolution adopted by the General Assembly on 1 April 2016. A/RES/70/259. Available from http://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/70/259.

Van Steenbergen, Frank (2002). Local Groundwater Regulation. Water Praxis Document No. 14, Land and Water Product Management Group, Arnhem: Arcadis Euroconsult. Available from http://www.groundwatermanagement.org/documents/14locgrounwregulationpraxis.pdf.

Verheijen, Frank G.A., and others (2009). Tolerable versus actual soil erosion rates in Europe. *Earth-Science Reviews*, vol. 94, Nos. 1-4, pp. 23-38.

Verner, Dorte (2013). Introduction. In *Economics of Climate Change in the Arab World: Case Studies from the Syrian Arab Republic, Tunisia, and the Republic of Yemen*, Dorte Verner and Clemens Breisinger (eds.), Washington, D.C.: World Bank. Available from https://openknowledge.worldbank.org/handle/10986/13124.

Verner, Dorte, and Clemens Breisinger (eds.) (2013). *Economics of Climate Change in the Arab World: Case Studies from the Syrian Arab Republic, Tunisia, and the Republic of Yemen*. Washington, D.C.: World Bank. Available from https://openknowledge.worldbank.org/handle/10986/13124.

Ward, Christopher (2009). Water Conflict in Yemen: The Case for Strengthening Local Resolution Mechanisms. In *Water in the Arab World: Management Perspectives and Innovations*, N. Vijay Jagannathan, Ahmed Shawky Mohamed and Alexander Kremer (eds.), Washington, D.C.: World Bank. Available from https://siteresources.worldbank.org/INTMENA/Resources/Water_Arab_World_full.pdf.

_____ (2010). Euphrates Case Study. Working paper for the report 'Water and Conflict in the Middle East and North Africa', Washington, D.C.: World Bank.

_____ (2010). Nile Case Study. Working paper for the report 'Water and Conflict in the Middle East and North Africa', Washington, D.C.: World Bank.

_____ (2014). The Water Crisis in Yemen: Managing Extreme Water Scarcity in the Middle East. London: IB Tauris.

Ward, Christopher, and Anwar Al-Aulaqi (2008). Yemen: Issues in Decentralized Water Management. A Wadi MENA Research Study, Cairo: Wadi MENA.

Ward, Christopher, Khaled Hariri and others (2007). Yemen's Water Sector Reform Program – A Poverty and Social Impact Analysis (PSIA). World Bank, GTZ and the Government of Yemen. Available from http://documents.worldbank.org/curated/en/503681468335429999/Main-report.

Ward, Christopher, Taha Taher and others (2009). Equity and Efficiency in Yemen's Urban Water Reform – A Sector Study and Poverty and Social Impact Analysis. World Bank, GTZ and the Government of Yemen. Available from https://www.researchgate.net/profile/Taha_Taher2/publication/306914354_Equity_and_Efficiency_in_Yemen%27s_Urban_Water_Reform_-_A_Sector_Study_and_Poverty_and_Social_Impact_Analysis/links/57c00e8c08aeda1ec386cdb3/Equity-and-Efficiency-in-Yemens-Urban-Water-Reform-A-Sector-Study-and-Poverty-and-Social-Impact-Analysis.pdf.

Water Watch (2011). Land and Water Productivity in the Doukkala Irrigation Scheme, Morocco. Wageningen: Waterwatch.

Whittington, Dale, Xun Wu and Claudia Sadoff (2005). Water resources management in the Nile Basin: the economic value of cooperation. *Water Policy*, vol. 7, pp. 227-252. Available from http://www.transboundarywaters.orst.edu/publications/publications/Whittington%20et%20al,%20Nile%20%202005.pdf.

Woertz, Eckart (2013). *Oil for Food: the Global Food Crisis and the Middle East*. Oxford: Oxford University Press.World Bank (2002). Reaching the Rural Poor in the Middle East and North Africa Region. Washington, D.C.: World Bank. Available from http://documents.worldbank.org/curated/en/266601468760218081/Reaching-the-rural-poor-in-the-Middle-East-and-North-Africa-Region.

_____ (2005). Shaping the Future of Water for Agriculture: A Sourcebook for Investment in Agricultural Water Management. Washington, D.C.: World Bank. Available from https://openknowledge.worldbank.org/handle/10986/7298.

_____ (2006). Iraq – Country Water Resources Assistance Strategy: Addressing Major Threats to People's Livelihoods. Water, Environment, Social and Rural Development Department, Middle East and North Africa Region, Washington, D.C.: World Bank. Available from https://openknowledge.worldbank.org/handle/10986/19449.

_____ (2006). Reengaging in Agricultural Water Management: Challenges and Options. Directions in Development, Washington, D.C.: World Bank. Available from https://openknowledge.worldbank.org/handle/10986/6957.

_____ (2006). Repositioning Nutrition as Central to Development: A Strategy for Large-Scale Action. Directions in Development, Washington, D.C.: World Bank. Available from https://openknowledge.worldbank.org/handle/10986/7409.

_____ (2007). Making the Most of Scarcity: Accountability for Better Water Management in the Middle East and North Africa. MENA Development Report, Washington, D.C.: World Bank. Available from https://openknowledge.worldbank.org/handle/10986/6845.

_____ (2007). World Development Report 2008: Agriculture for Development. Washington, D.C.: World Bank. Available from https://openknowledge.worldbank.org/handle/10986/5990.

_____ (2008). The Political Economy of Policy Reform: Issues and Implications for Policy Dialogue and Development Operations. Report No. 44288-GLB, Social Development Department, Washington, D.C.: World Bank. Available from https://openknowledge.worldbank.org/handle/10986/7782.

_____ (2009). Global Economic Prospects 2009: Commodities at the Crossroads. Washington, D.C.: World Bank. Available from https://openknowledge.worldbank.org/handle/10986/2581.

_____ (2009). West Bank and Gaza -— Assessment of Restrictions on Palestinian Water Sector Development. Washington, D.C.: World Bank. Available from https://openknowledge.worldbank.org/handle/10986/3056.

_____ (2011). Nutrition at a Glance: Morocco. Washington, D.C.: World Bank. Available from http://documents.worldbank.org/curated/en/687741468060262373/Morocco-Nutrition-at-a-glance.

World Food Programme (WFP) (2014). Seasonal Livelihoods Programming: Adapting the WFP Seasonal Livelihood Programming Consultation to Urban Contexts — Draft Concept. Rome: WFP.

Yau, Sui-Kwong, Musa Nimah and Mohamad Farran (2011). Early sowing and irrigation to increase barley yields and water use efficiency in Mediterranean conditions. *Agricultural Water Management*, vol. 98, No. 12, pp. 1776-1781.

Yu, Winston (2008). Benefit Sharing in International Rivers: Findings from the Senegal River Basin, the Columbia River Basin, and the Lesotho Highlands Water Project. Africa Region Water Resources Unit Working Paper 1, Sustainable Development Department, Washington, D.C.: World Bank. Available from http://documents.worldbank.org/curated/en/159191468193140438/Benefit-sharing-in-international-rivers-findings-from-the-Senegal-river-basin-the-Columbia-river-basin-and-the-Lesotho-highlands-water-project.

Zeitoon, Bashar M. (2012). Population, Consumption, and Sustainability Options: The Case of the GCC Countries. In *Survival Options: Ecological Footprint of Arab Countries*, Najib Saab (ed.), 2012 Report of the Arab Forum for Environment and Development (AFED), Arab Environment 5, Beirut: AFED. Available from http://www.afedonline.org/report2012/PDF/English/6.pdf.

Zeitoun, Mark (2009). The Political Economy of Water Demand Management in Yemen and Jordan: A Synthesis of Findings. Water Demand Management (WDM) Research Series, Working Paper No. 5, Cairo: International Development Research Centre (IDRC). Available from http://www.yemenwater.org/wp-content/uploads/2013/03/Zeitoun-PE-of-WDM-in-Yemen-and-Jordan-2009.pdf.

Zhou, Qin, and others (2015). Changes in carbon and nitrogen allocation, growth and grain yield induced by arbuscular mycorrhizal fungi in wheat (Triticum aestivum L.) subjected to a period of water deficit. *Plant Growth Regulation*, vol. 75, No. 3, pp. 751-760.

Zurayk, Rami, Jad Chaaban and Alia Sabra (2011). Ensuring that potential Gulf farmland investments in developing countries are pro-poor and sustainable. *Food Security*, vol. 3, sup. 1, pp. 129-137.

Endnotes

1. The social dimension of access was added to the definition in 2001. FAO, 2001.
2. Within the context of this report, the Arab region comprises all member countries of the League of Arab States. These are: Algeria, Bahrain, the Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, State of Palestine, Qatar, Saudi Arabia, Somalia, the Sudan, Syrian Arab Republic, Tunisia, United Arab Emirates and Yemen.
3. Prolonged exposure to heat increases risks of dehydration, strokes and heart disease. Dehydration affects the metabolism of food. High temperatures also increase the incidence of salmonellosis and other types of food poisoning. See Jobbins and Henley, 2015.
4. Throughout this report, cereals are used as the primary example because of their dietary importance and because of the availability of data. This emphasis is not intended to suggest that other food commodities, such as vegetables, are less important.
5. Sodicity refers to the amount of sodium in soil.
6. FAO, 1996; FAO, 2009.
7. Given the integrated nature of the SDGs, some targets address, directly or indirectly, more than one dimension of food security, as shown in table I.1.
8. Some of the data presented in this report may differ from that available nationally or regionally, for instance from the Arab Organization for Agricultural Development (AOAD).
9. The average dietary energy supply adequacy is defined as the ratio of the dietary energy supply to the average dietary energy requirement, where the dietary energy supply is the average calories per capita per day derived from all food supplies over a specified period of time, and the average dietary energy requirement is a normative reference measure for adequate calorie intake of the average individual in a country for a healthy life and a normal level of activity.
10. This includes migration from rural areas.
11. Darwish and Fadel, 2017.
12. FAO, 2007.
13. Comparable data is not available for some other important food categories, such as vegetables.
14. Self-sufficiency ratios are calculated as 100*domestic production/(domestic production – exports + imports).
15. More details on the methodology for estimating skewness can be found in Annex 2 of FAO, IFAD and WFP, 2013; Wanner and others, 2014.
16. Devereux, 2015.
17. Numbers are for 2008. Plumer, 2015.
18. World Bank, 2014.
19. FAO, 2017b.
20. Jobbins and Henley, 2015.
21. Ibid.
22. Crop yield in Palestine is reported to be only half that of Jordan, and only 43 per cent of the yield in Israel. UNCTAD, 2015.
23. UNCTAD, 2015.
24. Demeke, Pangrazio and Maetz, 2009.

25. WFP, 2017b.
26. Devereux, 2015.
27. Silva, Levin and Morgandi, 2013.
28. ENID, 2012.
29. World Bank, 2017.
30. WFP, 2017a.
31. The term 'malnutrition' is a more comprehensive concept that includes not only situations of inadequate calorie supply, but also the quality of the diet, especially the lack of micronutrients essential for a healthy life. Malnutrition also includes situations of excessive intake of food leading to overweight and obesity.
32. The prevalence of undernourishment (PoU) indicator has its limitations. Inter alia, it does not identify the food insecure and the seasonality of food insecurity (for the definition of PoU and its associated methodology, see Wanner and others, 2014). It also requires large amounts of household data, which limits comprehensive and regular assessment. Recognizing these limitations, the FAO Voices of the Hungry project developed an experience-based food insecurity scale module called the Food Insecurity Experience Scale (FIES). The FIES is used as a common metric for measuring food insecurity at several levels of severity, across different geographic areas and cultures. The FIES survey module consists of eight short questions that refer to the experiences of the individual respondent, or of the respondent's household as a whole. The questions focus on self-reported food-related behaviours and experiences associated with increasing difficulties in accessing food due to resource constraints. See Ballard, Kepple and Cafiero, 2013. FIES provides estimates of the proportion of the population facing difficulties in accessing food, at different levels of severity, based on data collected through direct interviews; PoU is an estimate of the adequacy of dietary energy intake in a population, based on national-level estimates of food availability, food consumption and energy needs.
33. The calculation entails multiplying the depth of the food deficit (kcal/capita/day) by the population of each country and by 365 days, and then dividing by the number of kcal contained in a kg of cereals (about 4,000 kcal/kg).
34. WHO, 2010.
35. Across the world, two billion people suffer from one or more micronutrient deficiencies. See Burchi, Fanzo and Frison, 2011.
36. On average, the prevalence of underweight children was higher in rural areas than in urban areas in 82 out of 95 developing countries for which data was available. See UNICEF, 2013. For a detailed discussion of these and other assessments, see also FAO, 2013.
37. Ruel, 2000; Arimond and Ruel, 2002.
38. Arimond and Ruel, 2004. Yet, there seem to be exceptions to this, as for example in Egypt, where urban child stunting has been increasing and is now as high as in rural areas. One reason is the often chaotic growth of urban slums and "migration into poverty" of rural populations.
39. Garrett and Ruel, 1999; Menon, Ruel and Morris, 2000.
40. Nejdawi and others, 2015.
41. Other regions with high levels of obesity include the Pacific Islands, Central and South America, North America and Southern Africa.
42. OECD, 2010.
43. WHO, 2011.
44. OECD, 2010.
45. Verner, 2012; Dixon, Gulliver and Gibbon, 2001, p. 84; IFAD, 2010; Christensen, 2007, pp. 67 and 73.
46. World Bank, 2014.
47. Jaber, Diehl and Hamadeh, 2016.
48. FAO has launched major initiatives to support artisanal fisheries and aquaculture through its Blue Growth Initiative, which is ongoing in Algeria, Mauritania and Morocco, with others in the pipeline. Feidi, 2017.

49. The increase in quantity produced between two time periods can be deconstructed into effects attributed to yield increase, effects attributed to area increase, and the combination of these two factors. The relevant formula is as follows: Q2-Q1 = A2*Y2 – A1*Y1 = A1*(Y2-Y1) + Y1*(A2-A1) + (Y2-Y1) * (A2-A1) = Yield effect + Area effect + Interaction effect. Where: Q, Y and A are quantity produced, yield realized and area harvested, respectively, and subscripts 1 and 2 correspond to the averages of periods 1990-1996 and 2010-2016, respectively. When the area harvested remains unchanged, the area effect is zero and the yield effect is ±100 per cent. When yields remain unchanged, the yield effect is zero and the area effect is ±100 per cent. The reality is always somewhere in between, with both area and yield varying (but not necessarily increasing) between the two periods, which results in a positive interaction term (if changes in area and yield are of the same sign) or a negative one (if of the opposite sign). In the case of the developed region in the graph, had the area harvested remained the same between the two periods, output would have increased by over 170 per cent on account of yield increases alone. The contribution of area to the total output increase in the developed region was actually negative, with area harvested declining by some 55 per cent between the two periods.
50. The increase in the total number of hectares farmed in the Arab region was paralleled by a faster increase in population size. As a result, the quantity of farmed land per person has fallen by 6 per cent in the last 50 years.
51. The water scarcity line is defined by the United Nations in UNDP, 2006, and in UN-Water and FAO, 2007.
52. Darwish and Fadel, 2017.
53. Sodicity 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.
54. ITPS, 2015.
55. IPCC, 2007.
56. Cline, 2007. Some farming systems may benefit from warmer temperatures, which will extend the growing season or increase productivity of winter crops. In Yemen, for example, where rain falls in the summer months, an increase in average temperatures of 2ºC could be expected to extend the growing season by about six weeks. See Verner, 2012. Some areas are expected to receive more rainfall, with a higher frequency of floods. This trend has already been observed in Oman, Saudi Arabia and Yemen.
57. Verner, 2012; FAO, 2015; Ward and Ruckstuhl, 2017.
58. See review of literature in Jobbins and Henley, 2015.
59. ESCWA and others, 2017.
60. Verner, 2012.
61. Dixon, Gulliver and Gibbon, 2001; IFAD, 2010; Christensen, 2007.
62. In addition to increasing the amount of water in the soil profile, the water harvesting project was found to reduce wind and water erosion of topsoil by almost 70 per cent.
63. Based on FAO, 2017a.
64. World Bank, 2013.
65. In 2014, Egypt held a share of about 13 per cent of the region's cereal cultivation area and produced about 35 per cent of its total cereal output, which means that its productivity per hectare was three times the regional average.
66. FAO GIEWS, 2017b.
67. Aw-Dahir, 2015.
68. Ibid.; Ward and Ruckstuhl, 2017.
69. ICARDA, 2017a.
70. Molden, 2007; Aw-Dahir, 2015.
71. Suez Environnement, 2015; Gammoh and Oweis, 2011.
72. Egypt's experience helps define four features that characterize successful programmes for drainage water reuse: (a) drainage water reuse has to be assessed at the level of overall basin efficiency and socioeconomic benefit; (b) a legal and regulatory framework is needed to control drainage water reuse; (c) programmes should be developed in

association with users and should be extended explicit water entitlements in the same way as fresh canal water; and (d) trade-offs should be well managed.

73. Magnan and others, 2011; Lampietti and others, 2011.
74. Ibid. Findings from Nepal suggest that international remittance money is crucial to improving the food security situation of rural populations in the low and marginal food security categories. Regmi and Paudel, 2017.
75. Findings from Nepal suggest that international remittance money is crucial to improving the food security situation of rural populations in the low and marginal food security categories. Regmi and Paudel, 2017.
76. Potentially, there can also be a third type of risk (counterparty performance risk), which refers to situations when, despite, for instance, grain being available at an acceptable price, the party who contracts to deliver the grain defaults on the contract. Sadler and Magnan, 2011.
77. FAO, 2006; FAO Committee on Agriculture, 2007.
78. Climate change is also associated with greater variability in precipitation and temperatures, increasing the frequency and intensity of droughts and floods, which will significantly magnify the impact of climate shocks on agriculture. Developing regions including Africa will be negatively affected by these developments. Cline, 2007.
79. While oil prices have dropped considerably from their peak in 2008, there is broad agreement that, over the longer term, prices for fossil fuels will be higher than past average prices. This will lead to higher agricultural production costs than in the past (through pressure on the cost of machinery, fuel and other energy-dependent inputs such as fertilizer). Beyond the farm, the costs of inputs and long-distance food distribution will also be affected by higher transport and refrigeration costs.
80. Babcock, 2011.
81. FAO, the International Fund for Agricultural Development (IFAD), the World Bank and the United Nations Conference on Trade and Development (UNCTAD) are developing a minimum set of principles for responsible agricultural investment that respects rights, livelihoods and resources to address these and other issues, based on detailed research on the nature, extent and impacts of foreign investment and best practices in law and policy. FAO and others, 2010; Hallam, 2011.
82. World Bank and FAO, 2012.
83. World Bank, 2010a; 2010b; 2010c.
84. Recently, the sixteenth session of the Committee on Transport of ESCWA considered trade and transport facilitation in the Arab region, inter alia, by amending the Agreement on International Railways, the Agreement on International Roads and the Memorandum of Understanding on Maritime Transport Cooperation in the Arab Mashreq. See ESCWA, 2016.
85. The Agricultural Market Information System (AMIS) is an inter-agency platform to enhance food market transparency and policy response for food security. It was launched in 2011 by the G20 ministers of agriculture following the global food price hikes of 2007/2008 and 2010. Bringing together the principal trading countries of agricultural commodities, AMIS assesses global food supplies (focusing on wheat, maize, rice and soybeans) and provides a platform to coordinate policy action in times of market uncertainty. See AMIS, 2015.
86. United Nations General Assembly, 2015.
87. EIU, 2014.
88. United Nations, 2016.
89. FAO, IFAD and WFP, 2014.
90. EIU, 2014.
91. Vilariño, Franco and Quarrington, 2017.
92. Di Terlizzi and others, 2016.
93. Statistically, average yields for the Arab region have declined, but this was mostly due to the discontinuation of wheat production in Saudi Arabia, which was far above the regional average.

94. The OECD-FAO Agricultural Outlook 2012-2021 provided several model scenarios which simulated the impacts of partially closing realizable crop yield gaps on local and global commodity markets. The basis for the scenarios was that every agricultural zone has a realizable and sustainable economic potential yield given available technology, soil type and normal weather conditions. Accordingly, investments could be made to close gaps between actual and potential yield, generating higher output, lower food prices, and hence improved food security. OECD and FAO, 2012.
95. By commodity, yields exempted from the scenario were as follows: wheat – Egypt, Saudi Arabia; maize and other coarse grains – Bahrain, Jordan, Kuwait, Oman, Qatar, Syrian Arab Republic and United Arab Emirates.
96. FAO, 2017a.
97. Musaiger and others, 2012.
98. HHS and USDA, 2015.
99. Ibid.
100. WHO and FAO, 2002.
101. The waste factor accounts for food loss and food waste at the following five stages of the food supply chain: agricultural production, post-harvest handling and storage, processing, distribution and consumption.
102. OECD and FAO, 2012.

This publication aims to inform the debate on the status of food security in Arab countries, and provide policy options for enhancing food security in the future, in line with the overarching directions of the 2030 Agenda for Sustainable Development. Given the heterogeneity of the Arab region, both in terms of natural endowment, particularly in water resources, and economic capabilities, the report's analysis divides it into four subregions, each consisting of a more homogeneous group of countries.

This report provides a broad overview of food security in the Arab region, including the availability, access and utilization of food. Elements of stability come into play in discussing all three of these dimensions. The report also includes in-depth analysis of selected thematic issues, namely agriculture, international food trade, and food loss and waste. Using the Aglink-Cosimo model, a section is devoted to discussing likely future projections, if the region continues on its present course, and the potential impacts of actions to increase crop yields, shift to healthier consumption patterns, or establish and maintain strategic food stocks. On the basis of the report's analysis, a set of key findings, as well as general and specific policy recommendations, are highlighted in the final section.

17-00626