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Food Security and Economic Development in the Middle East and North Africa

Current State and Future Perspectives

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Contents

List of Tables

List of Boxes

List of Figures

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ABSTRACT

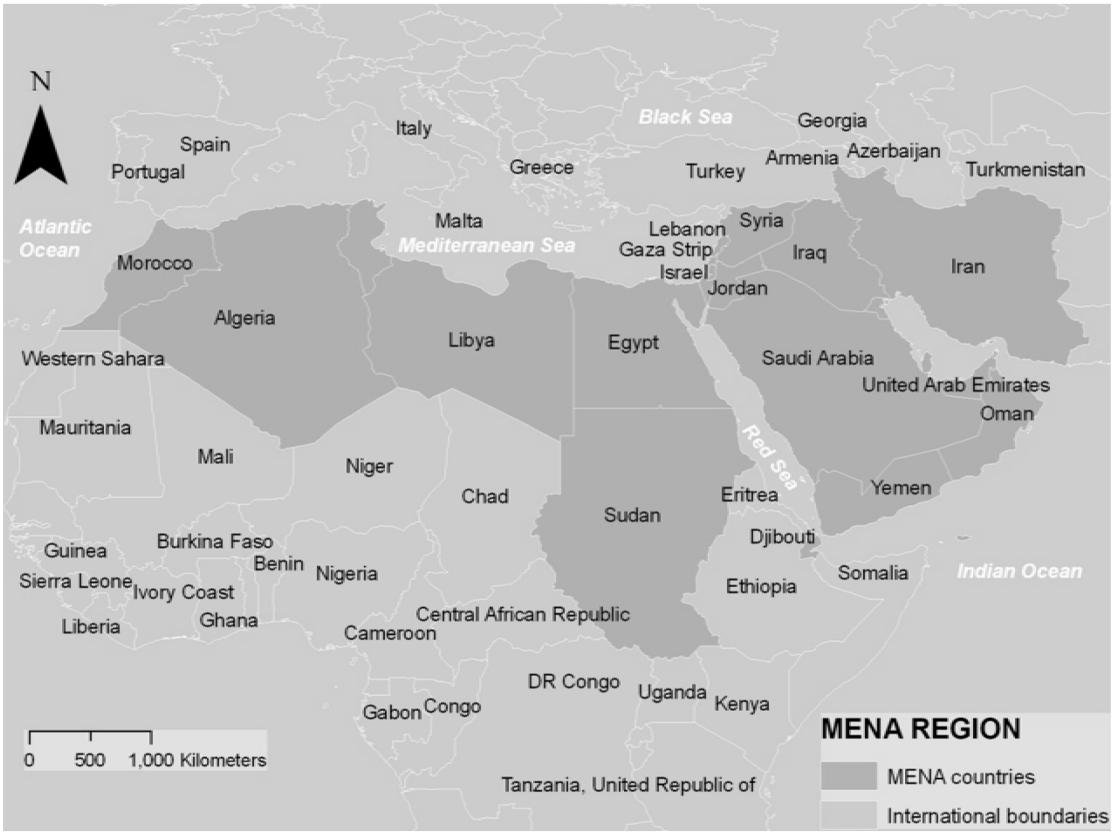
A rapidly changing world combined with mounting domestic challenges is prompting many Middle East and North African (MENA) countries to rethink their development models and to initiate economic and social reforms. Taking this new momentum as a starting point, this paper uses the concept of Food Security to identify the region's challenges along four major themes: economic growth and incomes, trade and infrastructure, agriculture and water, and health and education. Results show that many of the region's longstanding challenges persist; yet taking immediate action is more urgent in light of the recent, global food, fuel, and financial crisis and projected severe impacts of climate change. Fostering development and achieving food security will require economic growth and diversification that generates jobs for the majority of people, breaking the strong vulnerability to international oil and food price volatility, managing depleting water resources and climate change adaptation effectively, transforming social policies to target the poor, and empowering women to play a more active role in the economy and society. Designing policies and investments for achieving progress in this direction are most likely to be successful if based on lessons from the past, successful countries' experiences and research-based strategic analysis. The paper therefore concludes with a list of priority research areas to identify key actions to be taken on regional, national and sub-national levels to foster development and food security.

Keywords: economic development, growth, food security, agriculture, water, trade, health, policy reform, Middle East, North Africa (MENA)

ABBREVIATIONS AND ACRONYMS

AEZ	Agroecological Zone
AMU	Arab Maghreb Union
CCSM	Community Climate System Model
CCT	Conditional Cash Transfer
COMESA	Common Market for Eastern and Southern Africa
CSIRO	Commonwealth Scientific and Industrial Research Organization
DEA	Data Envelopment Analysis
DSSAT	Decision Support System for Agrotechnology Transfer
EMAA	Euro-Mediterranean Association Agreement
E.U.	European Union
FAO	Food and Agriculture Organization of the United Nations
FDI	Foreign Direct Investment
FS	Food-Secure
FSC	Food Security Challenges
FSHI	Food-Secure High-Income
FTA	Free Trade Agreement
GAFTA	Greater Arab Free Trade Area
GCC	Gulf Cooperation Council
GCM	General Circulation Model
GDP	Gross Domestic Product
GHI	Global Hunger Index
HadCM	Hadley Centre's Coupled Model
HADCO	Hail Agricultural Development Corporation
IFC	International Finance Cooperation
IFPRI	International Food Policy Research Institute
IMF	International Monetary Fund
IMPACT	International Model for Policy Analysis of Agricultural Commodities and Trade
IPCC	International Panel on Climate Change
LDC	Least-Developed Country
MENA	Middle East and North Africa(n)
NCAR	National Center for Atmospheric Research
NoCC	No-Climate-Change Scenario
OECD	Organization for International Cooperation and Development
PROGRESA	Programa de Educación, Salud y Alimentación
SPP	Social Protection Program
TFP	Total Factor Productivity
UAE	United Arab Emirates
UNDP	United Nations Development Programme
URAA	Uruguay Round Agreement Act
WTO	World Trade Organization

Middle East and North Africa Region



Source: Funes, 2010.

Note: IFPRI includes the following countries in the Middle East and North Africa Region (MENA): Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Malta, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, United Arab Emirates, West Bank and Gaza, and Yemen.

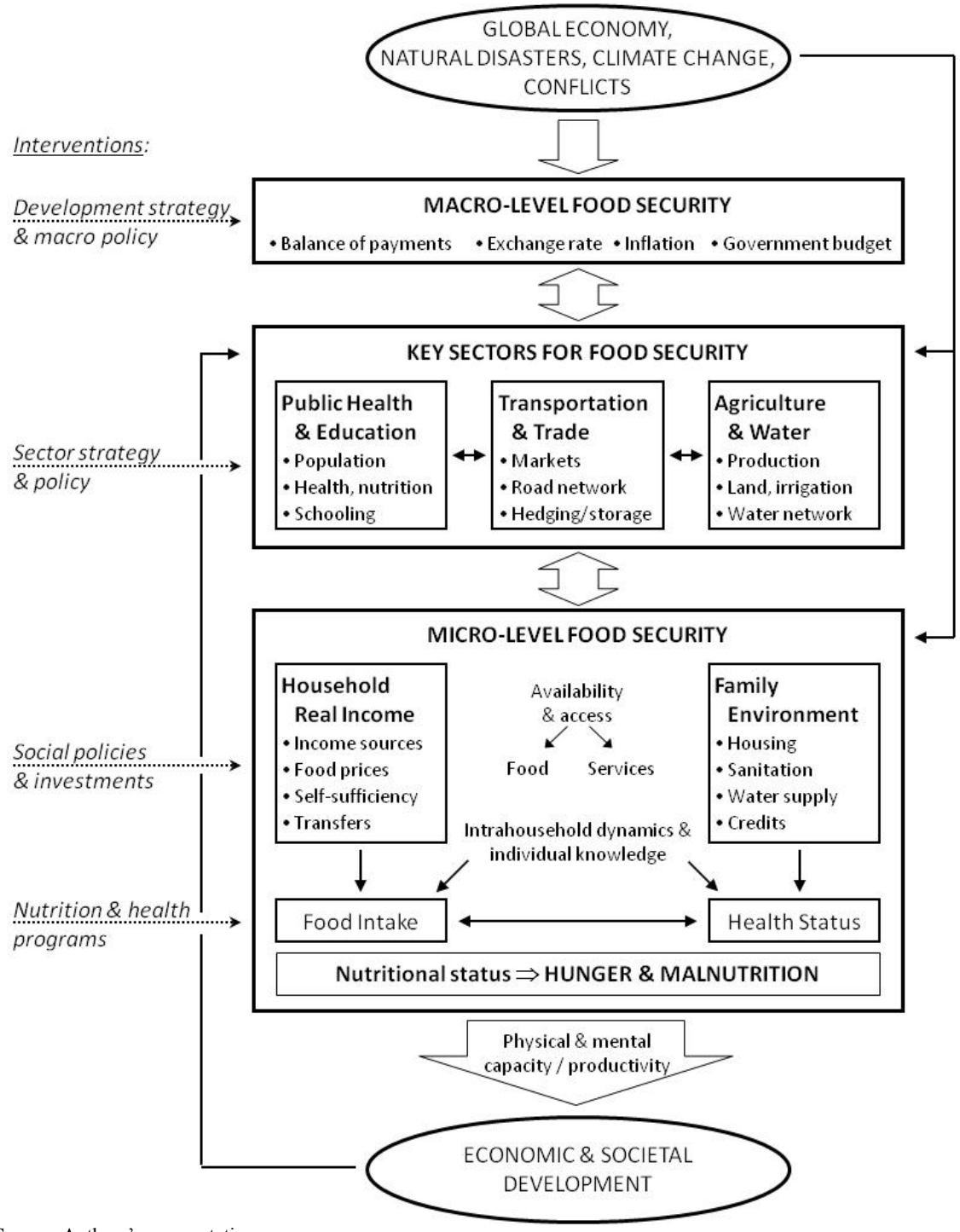
1. INTRODUCTION AND CONCEPTUAL FRAMEWORK

A rapidly changing global environment and mounting domestic challenges are pushing many Middle East and North African (MENA) countries to rethink their development models. The conventional model has been based on oil wealth, a preference of state over markets, import substitution industrialization, and often untargeted redistribution mechanisms (World Bank 2004a). It is widely acknowledged that economic diversification, a stronger role of the private sector, and a stronger focus on pro-poor growth are urgently needed for MENA countries to prosper in the 21st century (Loefgren and Richards 2003; World Bank 2004a; UNDP 2009). These development challenges are complicated by global and regional issues such as the triple global crisis, ongoing conflicts, and climate change. The global food price shock in 2007–2008 in particular has spurred governments to refocus on policies and investments to improve food security and better link food security to national development strategies and plans.

The objective of this paper is to analyze and structure MENA's major development challenges related to food security. In addition, we propose a new MENA country typology and identify a policy research agenda for the region. We use the universally accepted definition of food security: "a situation when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO 2009b). After giving a general definition, we consider food security as an integrated, multidimensional, and cross-sector concept (Figure 1). This conceptual framework differentiates food security on the national level (referred to as macro-level food security) and food security on the household and individual levels (referred to as micro-level food security) and emphasizes that improving food security is a multisector challenge. The main sector groups involved in improving food security are transportation/trade, public health/education, and agriculture/water, in addition to groups involved in working toward the general goal of accelerating economic growth that benefits the poor and food-insecure households.

Section 2 of this paper analyzes the state of food security in MENA at both the macro and household levels and presents a new typology that classifies countries based on their mineral resources and food security status. Section 3 identifies opportunities and challenges for development in general and for improving food security in MENA countries more specifically. Section 4 concludes the discussion and lays out a comprehensive research agenda on policies and investment options to help governments address the development challenges of the 21st century.

Figure 1. Food security: Conceptual framework



Source: Authors' representation.

2. FOOD SECURITY IN MENA: A COUNTRY TYPOLOGY

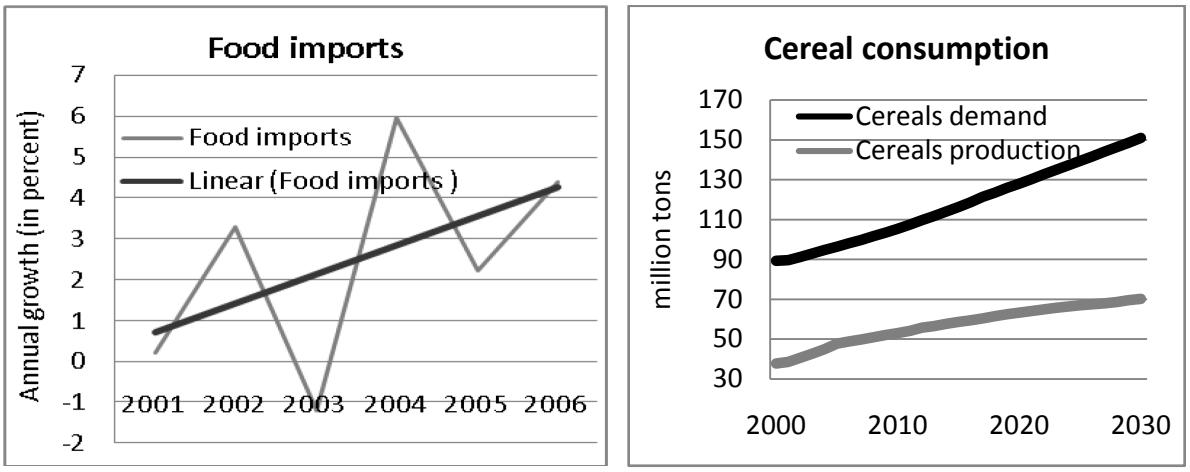
Macro-Level Food Security

The MENA region is the most food import–dependent region in the world, and net food imports are projected to rise even further in the future. In 2000–2002, net food imports accounted for 25–50 percent of national consumption (Figure 2). This high reliance on imported food can be attributed to both demand- and supply-side factors. Demand-side factors include rising population and changing consumption patterns due to higher income, whereas supply-side factors include limited natural resources such as land and water. The food and oil price spikes of 2007–2009 were a stark reminder of the potential fragility of the food security situation in the region. The MENA population tripled from 100 million in 1960 to more than 300 million people in 2006 and is projected to continue to grow at an annual rate of 1.7 percent. Shifting demand patterns from staples to higher-value food products, combined with limited potential for land expansion, will further increase the region's food trade deficit (for cereals, see Figure 3). Managing future food security at the national level therefore must include strategic choices about securing access to food through a mix of domestic investments (agriculture and food stocks) and international market arrangements (trade agreements and hedging) or potential innovative mechanisms (such as virtual reserves).

Figure 2. Net global trade in food

Source: FAO 2009a.

Figure 3. Food imports and demand balance (history and projections, 2001–2030)



Source: Authors' calculations based on World Bank 2009 and IFPRI 2009.

Food security thus does not equal self-sufficiency. Domestic per capita food production can be a useful indicator, but food security goes beyond this narrow concept. A country can be food secure if it exports enough goods and services to finance food imports. A commonly used indicator to measure food security at the macro level is the ratio of total exports to food imports (Diaz Bonilla et al. 2002; Yu, You, and Fan 2009). This ratio reflects the relative cost of access to food in each country. This indicator has the advantage of capturing both the demand for imports and the capacity of a country to export; that is; it captures the fact that as long as a country generates enough foreign exchange from exports to finance food imports, it is considered food secure.[1] Thus, macro-level food security is not equal to food self-sufficiency—a fact of particular relevance for the MENA region.

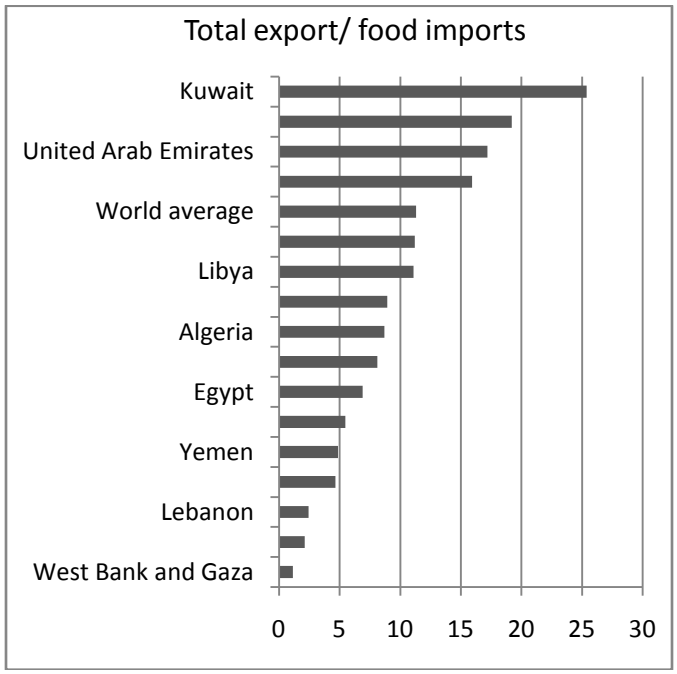
Many MENA countries face food security challenges based on this measure. A higher ratio of total exports to food imports indicates a higher level of food security in a country. The average total export/food import ratio for 178 countries in the world is 11.3, suggesting that on average, about 8.8 percent of the export revenue is used for food imports.[2] MENA countries, however, use 11.5 percent of exports for importing food, a figure higher than the world average. Significant country variations are observed (Figure 4). Out of 16 MENA countries, only 3 outperform the world average in food trade security: Kuwait, United Arab Emirates, and Iran. However, the value of this indicator falls below the MENA average in 10 countries, underscoring the vulnerability to changes in food prices and international food availability of these countries.

[1] The ratio of total exports to food imports is an indicator of the ability of a country to finance its food imports out of total export revenues (that is, a measure of access to the world food supply by an individual country). This indicator is more relevant for food security analysis than the net food trade position (that is, food exports minus food imports). This last indicator reflects only the fact that a country is a net food importer or exporter, not the relative cost for access to food in that particular country and therefore how vulnerable it may be to changes in food prices and international food availability. A country that is a net food exporter but for which the total food bill takes a larger percentage of total exports (for example, Bangladesh, which has a food bill of about 20 percent of total exports) is likely to be more vulnerable than a country that is a substantial net food importer but whose food bill takes only a small percentage of its total exports (for example, Venezuela, a country that spends about 5.7 percent of total exports, which include substantial oil sales, on imported food).

The ratio of the food import bill over total exports presents a broader and more adequate picture of the role of trade, and the possible impact of trade policies, on food security. Focusing only on the value of the food import bill (gross or net) does not take into account the broader contribution of trade to food security, which involves not only the availability of food in world markets but also the generation of export income to finance those imports. A country whose food import bill goes up may still be less vulnerable if at the same time its total exports have gone up by a larger amount. Conversely, even a country with declining food import bills may be more vulnerable if export receipts have dropped even more. Therefore, in the context of trade policies, the important issue is whether total exports have grown faster than the food import bill as a result of those policies.

[2] We use the export/food import ratio to ensure that a lower value is associated with higher vulnerability of a country to secure food imports. However, to derive the share of total foreign exchange used to import foods, the inverse of the ratio must be used; it can be derived as 1/ratio x 100.

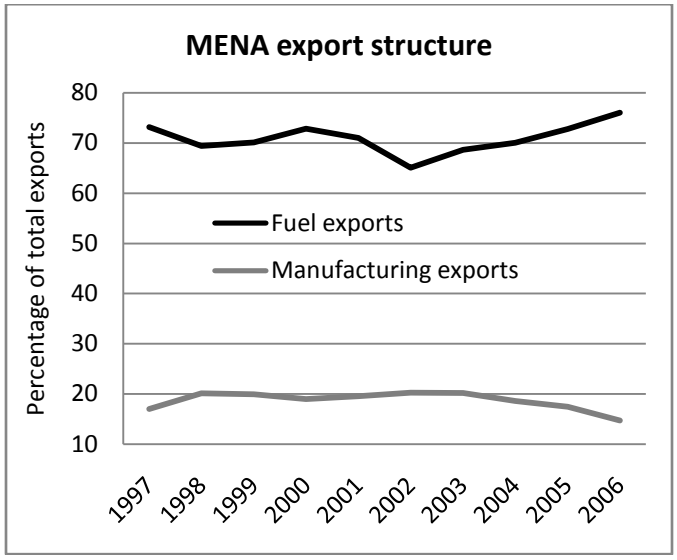
Figure 4. Macro-level food security



Source: Authors' calculation based on FAO 2009a and World Bank 2008.

In addition to low total export/food import ratios, the current structure of exports makes the region highly vulnerable to external shocks. The fact that around 70 percent of the region's export earnings come from oil exposes the region to food security risks related to oil price fluctuations (Figure 5). At the same time, manufacturing exports—a main driver of successful transformation and job creation in Asia—have been declining as a share of total exports. The current export structure thus not only makes the region dependent on oil prices but also poses larger development questions about economic transformation and diversification.

Figure 5. Oil and food trade in MENA



Source: Authors' calculations based on World Bank 2009.

Household-Level Food Security

The MENA region faces moderate hunger, but the number of food-insecure people has been increasing between 1990 and 2005, according to the Global Hunger Index (GHI).[3] Similar to the 2009 Global GHI, the 2009 GHI for the MENA region showed improvement over the 1990 GHI, from 7.7 to 5.2 (Table 1). Among all world regions, MENA was the only region that showed an increase in the proportion of undernourished people over the past decade (see Table 1). Even though the other regions reflected a decline, a rise in the proportion of the population with calorie deficiency, from 3.8 to 4.6 percent, was observed in MENA. This increase may be underestimated, because Iraq, which is suffering from severe hunger, was not included in the GHI calculation because of insufficient data. Also, the 2009 GHI does not fully reflect the impact of recent increases in food and energy prices or of the global financial crisis of 2008–2009.

Table 1. Data underlying the calculation of the 1990 and 2009 Global Hunger Indexes

Region	Proportion of undernourished		Prevalence of underweight in children		Under-five mortality rate		GHI	
	1990–1992	2003–2005	1988–1992	2002–2007	1990	2007	1990	2009
Sub-Saharan Africa	31	28.5	27.4	23.4	17.7	14.3	25.4	22.1
South Asia	25	21.7	55.2	40.4	12	7	30.7	23.0
Southeast Asia	17.5	11.4	20.5	12	5.5	2.7	14.5	8.7
Near East and North Africa	**3.8**	**4.6**	**12.2**	**7.9**	**7**	**3**	**7.7**	**5.2**
Latin America and Caribbean	11.8	8.3	9	4.3	5.4	2.6	8.7	5.1
World	**19.7**	**16.1**	**30.4**	**22.7**	**9.8**	**6.8**	**20.0**	**15.2**

Source: von Grebmer et al. 2009.

The proportion of undernourished in the MENA region may now even be higher because of the recent food crisis and ongoing global recession; 132 million people may have fallen back into poverty because of high global food and fuel prices (Ivanic and Martin 2008). Chen and Ravallion (2009) estimate that 64 million people will fall into poverty as a consequence of the financial crisis in 2009 (using the US$2 at PPT /day threshold). The U.K. Department of International Development estimates that 90 million additional people will be poor by the end of 2010 (using the US$ 1.25 at PPT/day poverty line) (McCord and Vandemoortele 2009). Breisinger et al. (2010) estimate that the poverty in Yemen has increased from 34.8 percent in 2005/06 to 42.8 percent in 2009. During the same period, the severity of food insecurity has increased to 32.1 percent (Ecker et al. 2010).

[3]The GHI is a multidimensional approach to measuring hunger. It combines three equally weighted indicators: (1) the proportion of undernourished as a percentage of the population (reflecting the share of the population with insufficient dietary energy intake), (2) the prevalence of underweight in children younger than five (indicating the proportion of children suffering from weight loss), and (3) the mortality rate of children younger than five (partially reflecting the fatal synergy between inadequate dietary intake and unhealthy environments). This multidimensional approach to calculating the GHI offers several advantages. It captures various aspects of hunger in one index number, thereby presenting a quick overview of a complex issue. It takes account of the nutrition situation of not only the population as a whole but also a physiologically vulnerable group—children—for whom a lack of nutrients creates a high risk of illness, poor physical and cognitive growth, and death. In addition, by combining independently measured indicators, the GHI reduces the effects of random measurement errors. The index ranks countries on a 100-point scale, with 0 being the best score (no hunger) and 100 being the worst, though neither of these extremes is achieved in practice. Values less than 4.9 reflect low hunger, values between 5.0 and 9.9 reflect moderate hunger, values between 10.0 and 19.9 indicate a serious problem, values between 20.0 and 29.9 are alarming, and values of 30.0 or higher are extremely alarming. Data for the 2009 GHI are from 2002 to 2007. Specifically, the data on the proportion of undernourished are for 2003–2005; data on child mortality are for 2007; and data on child malnutrition are for the latest year in the period 2002–2007 for which data are available. For more information, see von Grebmer et al. (2009).

A New Food Security Typology for MENA Countries

Despite these common food security challenges, MENA countries are diverse, and policy options on how to improve food security may differ. The most commonly used typology for MENA countries is based on mineral resource wealth (mainly oil and gas). We extend this typology and use several food security–related indicators to help guide broad strategic choices related to food security and development. The main indicators to assess a country's food security status include the food trade balance (ratio of total exports to food imports), the agricultural potential (food production per capita), and the International Food Policy Research Institute's (IFPRI's) GHI (Table 2). We thus capture both the macroeconomic and household-level dimensions of food security. Countries are defined as food secure (green) if (1) all the values of the four chosen food security indicators are above the international average of this indicator and/or (2) the countries are classified as high-income countries according to the World Bank's definition—a gross national income (GNI) of more than US$11,906 per capita.

Food security as measured by the trade indicator is low in MENA countries, and most MENA countries are classified as highly food import dependent (see Figure 4). Results show that all of these countries use 11.5 percent or more (international average) of their export earnings to import food, indicating a high vulnerability of the balance of payments to external shocks. Countries with food security challenges that are mineral resource rich and thus depend on oil and gas for their exports (Algeria, Iraq, Libya, Sudan, Syria, and Yemen) face additional vulnerability on the export side of the external balance.

The level of agricultural production per capita is low in MENA countries; only Iran, Lebanon, and Syria have high self-sufficiency levels. Per capita food production is the lowest in Djibouti and Yemen, which also are among the countries with the lowest per capita incomes. Section 3 of this paper will explore agricultural potentials and major constraints and challenges for agricultural production, water scarcity, and climate change.

Food security as measured by nutrition outcomes (captured by GHI) confirms the household-level pattern of food security distribution in MENA countries. Although the region as a whole has moderate hunger, 2009 GHI values reflect that Yemen and Djibouti have alarming levels of hunger, and Sudan has a serious hunger problem.

While most MENA countries are low– or lower-middle–income countries, Bahrain, Kuwait, Qatar, and Saudi Arabia are considered higher-income countries according to the World Bank's definition. Despite their generally low agricultural production and sometimes high dependency on oil exports, we classify them as food secure because of the higher income levels.

According to these criteria, we classify Bahrain, Iran, Kuwait, Qatar, Saudi Arabia, and United Arab Emirates as *food-secure (FS) countries.* Following this logic, we classify Algeria, Djibouti, Egypt, Iraq, Jordan, Lebanon, Libya, Morocco, Sudan, Syria, Tunisia, West Bank and Gaza, and Yemen as countries with *food security challenges (FSC)* (see Table 2).

Table 2. Classification of MENA countries according to food security levels and mineral wealth

	Total exports/ food imports	Food production per capita	Global Hunger Index	GNI per capita
Food security challenge countries				
Mineral resource rich				
Algeria	8.7	111	<5	2,720
Iraq	n/a	n/a	n/a	*800
Libya	11.1	133	<5	5,860
Sudan	5.5	148	19.6	640
Syria	8.9	237	5.2	1,430
Yemen	4.9	44	27	650
Mineral resource poor				
Djibouti	2.1	54	22.9	1,000
Egypt	6.9	199	<5	1,270
Jordan	4.7	120	<5	2,490
Lebanon	2.4	258	<5	5,520
Morocco	8.1	163	5.8	1,990
Tunisia	11.2	220	<5	2,880
West Bank and Gaza	1.1	135	n/a	1,230
Food secure countries				
Mineral resource rich				
Iran	15.9	246	<5	2,580
Bahrain	n/a	n/a	n/a	*24,733
Kuwait	25.4	55	<5	30,630
Saudi Arabia	19.2	104	<5	12,540
United Arab Emirates	17.2	114	n/a	22,583
Qatar	n/a	n/a	n/a	*76,000
Oman	n/a	n/a	n/a	*24,674
MENA average	**9.6**	**146**	**5.2**	**6,001**
MENA - Food security challenge	**6.3**	**152**	n/a	**2,307**
MENA - Food secure	**19.4**	**130**	n/a	**17,083**
World average	**11.3**	**233**	**15.2**	

Source: Authors' calculations based on Yu, You, and Fan 2009.
Note: Countries are defined as food secure (green) if the value of the food security indicator is above the respective international average of this indicator. Gross national income (GNI) is for 2005 based on World Development Indicators 2008. MENA = Middle East and North Africa.
*International Monetary Fund gross domestic product estimate for 2007.

3. FOOD SECURITY AND DEVELOPMENT IN MENA: OPPORTUNITIES AND CHALLENGES

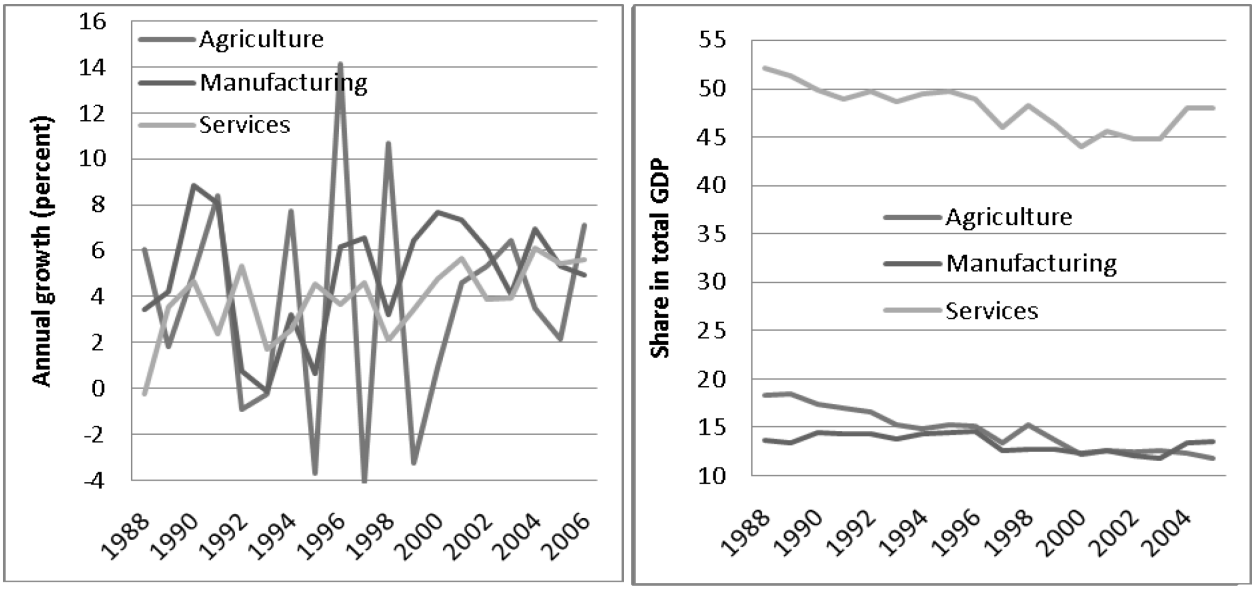
Economic Growth and Incomes

Growth Story and Structural Change

Economic growth that raises people's incomes is the single most important driver of food security. Rapid economic growth and transformation of rural and urban sectors will thus be key for future prosperity and food security. On the aggregate, annual growth rates in the MENA region averaged 5 percent over the past years, yet much of this growth has been driven by oil and related government services (World Bank 2009). Therefore, growth has often not translated into structural transformation, and many MENA countries still rely on the "old social contract," where oil revenues are used for the maintenance of a large public sector and for redistribution mechanisms, often through subsidy schemes (World Bank 2004a). Experiences from other world regions indicate that export–led growth [in manufacturing, services, and agriculture (in countries with potential) will have to play an important role in MENA's future growth and the creation of jobs (Breisinger and Diao 2008).

In the MENA region as a whole, however, manufacturing's share in the gross domestic product (GDP) remains relatively low, at 13.4 percent, and the service sectors are dominated by domestic activities and public services rather than knowledge-intensive and export-oriented products (Figure 6). At the same time, agricultural growth, which has played an important role in the transformation and poverty reduction process of other world regions, has been modest and highly volatile because of the high dependency of yields on rainfall and limited water resources. Yet growth in rural areas, in farm and nonfarm activities, will have to play an important role, given that about 40 percent of the MENA population still lives in rural areas and that the absolute number of rural inhabitants keeps growing. Given that the majority of the population in MENA is younger than 30 and oil is a limited source of income, the key challenge will be to find the right mix of policies to accelerate job-creating growth and transform rural and urban sectors to achieve higher living standards and food security.

Figure 6. Sector growth and structural change in the MENA region, 1988–2006



Source: Authors' calculation based on World Development Indicators 2008. MENA is defined according to the World Bank classification.

In MENA countries with food security challenges, especially resource-rich countries, manufacturing growth has also been slow This phenomenon is especially notable in mineral-rich countries—the well-known Dutch disease effect, where revenues from minerals hamper the competitiveness of nonmineral export sectors by appreciating the exchange rate and inflating the cost of domestic factors. In addition, countries in conflict, such as Iraq, have seen dramatically shrinking manufacturing output, which pulls down the overall average. However, Syria is among the more successful countries within this group, with average annual growth rates of the manufacturing sectors of 6.3 percent between 2000 and 2006. The role of manufacturing in nonmineral-rich countries is generally higher, both in FSC and FS countries. The sector is biggest in Egypt and Tunisia (18 percent of GDP), followed by Jordan and Morocco with 15 percent (Table 3). The only country where manufacturing has become a bigger share of the economy over time is Tunisia, up from 8.1 percent in 1965; the sector's importance in the economy in most other countries has remained at levels of the 1960s and 1970s. In all cases, international experiences suggest that growth rates in manufacturing of between 7 and 10 percent will be needed for economywide growth acceleration, job creation, and poverty reduction (Breisinger and Diao 2008).

The Role of Agriculture and the Rural Economy

Despite severe natural resource constraints in many MENA countries, agricultural growth has been more rapid than manufacturing growth in many countries. The sector grew at an annual rate of 3.2 percent in FSC countries, thus making a contribution to improving food security through incomes, domestic provision of food, and export earnings. However, in many countries, agricultural growth has not been sustainable and has led to falling groundwater tables (see discussion below). The agricultural sector makes up 15 percent of the mineral resource–rich economies, and a much higher share in Sudan and Syria, with shares of 25 and 40 percent, respectively. In mineral resource–poor FSC countries, agriculture plays the most important role in Egypt, Tunisia, Morocco, and Jordan. In Jordan and Morocco, agriculture has grown most rapidly during the analyzed period, whereas output has been below population growth in Yemen, Lebanon, Iraq, and Tunisia (Table 3). However, given the continued high population growth rates and water constraints, maintaining per capita agricultural output will be a challenge for many MENA countries.

Table 3. Economic growth and structure in MENA

	Economic structure (share in GDP)*		**GDP growth (per capita)***			**Population**
	Agric.	Manuf.	Agric.	Manuf.	Growth†	Rural (%)
Food security challenge countries	**14**	**12**	**3.2**	**1.7**	**1.9**	**52**
Mineral resource rich	15	6	2.6	1.4	2.2	58
Algeria	9	7	7.5	0.7	1.5	36
Iraq	7	1	–6.7	–15.9	3.1	33
Libya	n/a	n/a	n/a	n/a	2.1	15
Sudan	40	8	1.6	2.8	2.0	58
Syria	25	7	1.7	6.3	2.7	49
Yemen	10	5	–2.7	0.0	3.0	72

Table 3. Continued

	Economic structure (share in GDP)*		GDP growth (per capita)*			Population
	Agric.	Manuf.	Agric.	Manuf.	Growth†	Rural (%)
Mineral resource poor	13	17	3.8	2.0	1.7	47
Djibouti	3	2	1.0	1.1	2.0	14
Egypt, Arab Rep.	16	18	1.6	0.9	1.8	57
Jordan	2	15	11.3	8.4	2.5	17
Lebanon	6	12	–1.0	4.3	1.3	13
Morocco	15	15	12.8	3.5	1.2	41
Tunisia	11	18	–0.4	2.1	0.9	34
West Bank and Gaza	n/a	n/a	n/a	n/a	4.3	28
Food-secure countries	**6**	**11**	**1.7**	**4.9**	**1.9**	**28**
Bahrain	n/a	n/a	n/a	n/a	2.2	3
Iran, Islamic Rep.	13	14	4.3	9.4	1.6	33
Kuwait	0	2	12.2	–0.4	2.9	2
Oman	2	6	0.6	11.9	0.8	28
Qatar	n/a	n/a	n/a	n/a	5.6	5
Saudi Arabia	5	10	–1.3	2.6	2.2	19
United Arab Emirates	3	13	–5.3	-1.0	5.0	23
Total MENA	**9**	**11**	**2.6**	**3.4**	**1.9**	**45**

Source: Authors' calculation based on World Development Indicators (WDI) 2008 (World Bank 2009).
Notes: GDP = gross domestic product.
*Average 2000–2004. More recent GDP numbers are not available for many countries from WDI 2008. †Growth from 2000 to 2006.

About half of all people in FSC countries live in rural areas. The share of rural population is highest in Yemen, Sudan, and Egypt, whereas among food-challenged countries, urbanization is most advanced in Libya, Djibouti, and Lebanon. As expected, FS (and mostly high-income) countries are more urbanized. Yet 28 percent remain rural, with the highest average rural population shares in Iran and Oman. Population growth remains high, at 1.9 percent, in both FSC and FS countries. Population growth in FSC countries is driven by high birth rates, especially in Yemen, Iraq, and West Bank and Gaza, whereas high growth rates in Qatar and the United Arab Emirates are explained by immigration. Given the limited natural resources and slow overall growth, bringing down population growth will have to be an integral part of the food security strategy in many countries. Countries in the region with low population growth rates, such as Tunisia, Morocco, and Iran, might provide useful lessons (see section on public health).

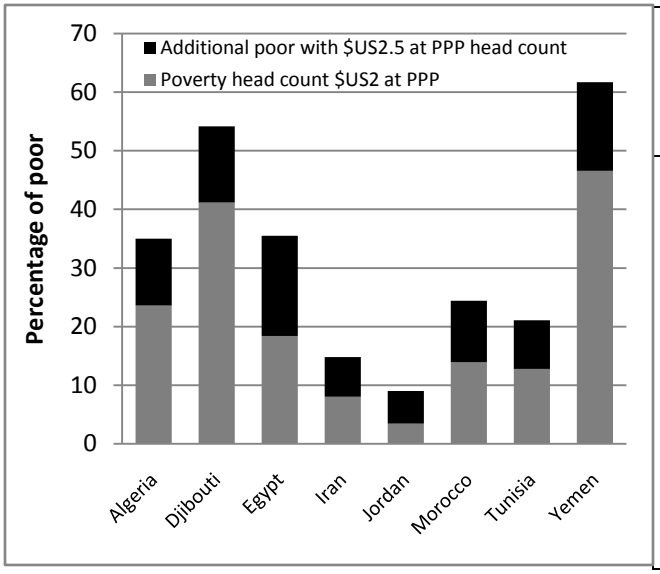
Poverty Reduction and Job Creation

Growth in the MENA region has generally been poverty reducing, yet poverty levels remain high in many countries, and people are often vulnerable to falling back into poverty. Twenty percent of the people in the MENA region live below US$2 a day, and poverty levels have been declining in most of these countries, especially in Jordan, Tunisia, Iran, and Egypt (before the triple global crisis hit).[4] However, reduction in relative poverty has been slow in Algeria and Morocco and has increased in Yemen and

[4]Only limited information is available on other MENA countries with potentially significant levels of poverty, such as Libya, Syria, Lebanon, and West Bank and Gaza.

Djibouti. Because of high population growth, the absolute number of poor has increased in many countries. At the same time, many people in MENA countries remain vulnerable to external shocks such as the 2007–2008 food crisis and the global recession. People in Egypt, Morocco, and Jordan are particularly vulnerable to external shocks; poverty in Egypt almost doubles if per capita income decreases by US$0.50 at PPT per day (Figure 7). Although no recent poverty estimate is available for the MENA region, global and country-level experience suggests that the triple global crisis has increased the number of people living in poverty (Chen and Ravallion 2009; McCord and Vandemoortele 2009; Ivanic and Martin 2008; Breisinger et al. 2010).

Figure 7. Changes in poverty levels in selected MENA countries



	Survey year	Poverty head count	Survey year	Poverty head count	% annual change
Algeria	1988	23.8	1995	23.6	-0.1
Djibouti	1996	15.1	2002	41.2	18.2
Egypt	1991	27.6	2005	18.4	-2.8
Iran	1990	13.1	2005	8.0	-3.2
Jordan	1992	14.9	2006	3.5	-9.9
Morocco	1991	15.9	2007	14.0	-0.8
Tunisia	1990	19.0	2000	12.8	-3.9
Yemen	1992	15.4	2005	46.6	8.9

Source: Calculations based on POVNET 2009.

With these poverty challenges, job-creating growth will become even more important, given the high share of young population and continued high population growth. The challenge is to change the traditional growth pattern to growth that is broader based and job creating. Unemployment levels are high, and informal sector employment makes up high shares of nonagricultural employment in many countries. In 2010 the labor force is estimated at 146 million and is expected to reach 185 million by 2020 (World Bank 2004a). In Yemen, for example, about 50 percent of the population is younger than 15. Yemen's unemployment rate increased by 5 percentage points within five years, to a rate of 16 percent in 2004. More recent estimates vary but consistently put this number much higher. Unemployment is higher in urban areas, affecting 19 percent of the urban population, compared with 10 percent of the rural population (GOY, World Bank, United Nations Development Program 2007). In addition, many more are underemployed.

Trade and Trade Policies

International and Intraregional Trade

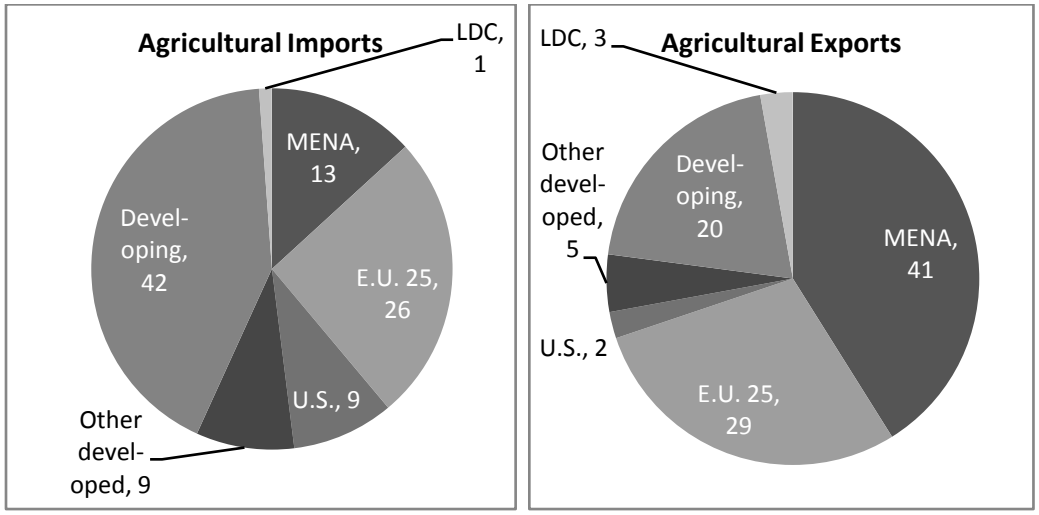
Macro-level food security can be improved through trade by either increasing the export of goods and services, thus giving countries a comparative advantage, or by improving existing trade regimes to foster

competitiveness. [5] The following section will focus on the second strategy, more specifically revisiting the MENA region's current trading partners and options to reform trade and agricultural policies.

The E.U. 25 is the single most important trading partner for agricultural products, especially exports. Intraregional trade in MENA with respect to agriculture is dominant in exports, representing 41 percent of the region's total agricultural exports. Outside the region, the E.U. 25 and the group of developing countries absorb 29 and 20 percent of MENA agricultural exports, respectively. Among single-country destinations, the United States is the destination of 2 percent of MENA exports. Imports present a different structure; intraregional trade represents only 13 percent of agricultural imports, and developing countries and the E.U. 25 are the main sources for MENA imports— 42 and 26 percent, respectively. The United States plays a larger role in the region's imports than exports, contributing 9 percent of the region's total agricultural imports (Figure 8).

Developing countries as a group also play a dominant role in MENA trade, especially for imports: Imports are much more concentrated and dominated by large exporters of agriculture in Latin America, such as Argentina and Brazil, which together contribute 15 percent of MENA agricultural imports. China and India are also active sources of agricultural imports for the MENA region. Among single MENA countries, the direction of trade varies: North African countries such as Morocco and Tunisia are more likely to trade with northern countries such as the E.U. 25, whereas Middle Eastern countries favor south–south trade within the MENA region, with shares of exports ranging between 39 percent for Egypt and 82 percent for Jordan. In imports, all countries mostly import from the E.U. 25; Syria, which seems to favor imports from developing countries, is the exception.

Figure 8. Composition of agricultural trading patterns for the MENA region



Source: Minot et al. 2010, based on MAcMap-HS6 database 2004.
Note: LDC = least-developed countries.

Trade protection remains high in MENA. Among the MENA countries, overall protection is highest in Tunisia, followed by Morocco, Syria, and Egypt. Bouët (2006) ranks Egypt, Morocco, and Tunisia among the 11 most protectionist countries among countries in the MAcMap-HS6 database for 2001 (CEPII 2008). For these countries, the results are consistent with earlier tariff rankings generated by various international organizations between 1988 and 1998, including the United Nations Conference on Trade and Development, the Organization for Economic Cooperation and Development (OECD), the World Bank, and the International Monetary Fund (IMF), summarized in Oliva 2000. The organizations rank Egypt, Morocco, and Tunisia as more often restrictive than not, but the rankings differ among the

[5] This section is based on Minot et al. 2010.

studies.[6] There is less consistency on Jordan and Syria, which appear restrictive in some studies (such as the ranking of the IMF and Oliva's own index in the case of Syria) and open in others (the ranking according to the United Nations Conference on Trade and Development). Zarrouk and Zallio (2000) argue that industrial strategies founded on import substitution and a large public sector have led to high protection in MENA countries and that governments have ended up relying on import duties as a main source of revenues. In contrast, Jordan and Lebanon are relatively more open, with levels of protection in agriculture that are comparable to the developed countries' average.

MENA countries have high levels of protection in agriculture. Table 4 identifies countries as protectors of agriculture if the ratio of the level of agricultural protection to industrial protection is at least 1.4. On average, countries protect agriculture more than industry—a phenomenon that is particularly notable for developed countries, which have low levels of industrial protection combined with high protection rates of agriculture (Japan and Switzerland are the most illustrative). MENA countries are protectors of agriculture on average: The level of protection in agriculture is more than twice the industrial rate. Since the structural adjustment programs and accession to the World Trade Organization (WTO), which curtailed industrial protection, the average global tariff has decreased (WTO 2002); agriculture protection, however, has been reduced at a much slower pace. The exceptions are Djibouti, Egypt, and Syria, which have higher protection in industry than agriculture.[7] Morocco and Tunisia have very high levels of agricultural protection; these levels are matched only by Switzerland among the OECD countries and by India among developing countries, and they more than double the MENA region average. These results testify to the shift in protection by developing countries since the findings in Schiff and Valdes 1992 that illustrate the bias against agriculture emanating from agricultural sector policies (direct effects) and from industrial protection and macroeconomic policies (indirect effects) in 18 developing countries. Considering only the direct effects, the study estimated that taxation on agriculture was 25 percent in Egypt over the period 1964–1984 and 15 percent in Morocco over the same period.[8]

Table 4. Applied levels of protection by region, 2004

Region	Country	Level of protection				Agriculture is more
		Overall (1) (%)	Agriculture (2) (%)	Industry (3) (%)	Ratio (2)/(3)	protected (Ratio > 1.4)
MENA	Djibouti	30	14	32	0.4	no
	Egypt	15	8	15	0.5	no
	Jordan	8	11	8	1.3	no
	Lebanon	4	9	3	2.7	yes
	Morocco	19	44	17	2.6	yes
	Syria	16	13	16	0.8	no
	Tunisia	20	50	17	2.9	yes
	West Bank and Gaza	n/a	n/a	n/a	n/a	n/a
	Rest of MENA	8	14	8	1.7	yes
	MENA average	**11**	**14**	**10**	**2.5**	**yes**
	Developed-country average	**2**	**13**	**2**	**6.5**	**yes**
	Developing-country average	**8**	**18**	**7**	**2.4**	**yes**

Source: Minot et al. 2010.

[6]These assessments do not take into account the substantial liberalization of trade policy in Egypt in 2004, as discussed below.

[7]In this aggregation, the beverages and tobacco sector is not included in agriculture. This classification matters in the case of Egypt, which has an ad valorem equivalent (AVE) tariff of 818 percent for beverages and tobacco.

[8]To maintain consistency in comparing the results of Schiff and Valdes (1992) and the MAcMap-HS6 database, we do not include the indirect effect part of the tax on agriculture from the former study.

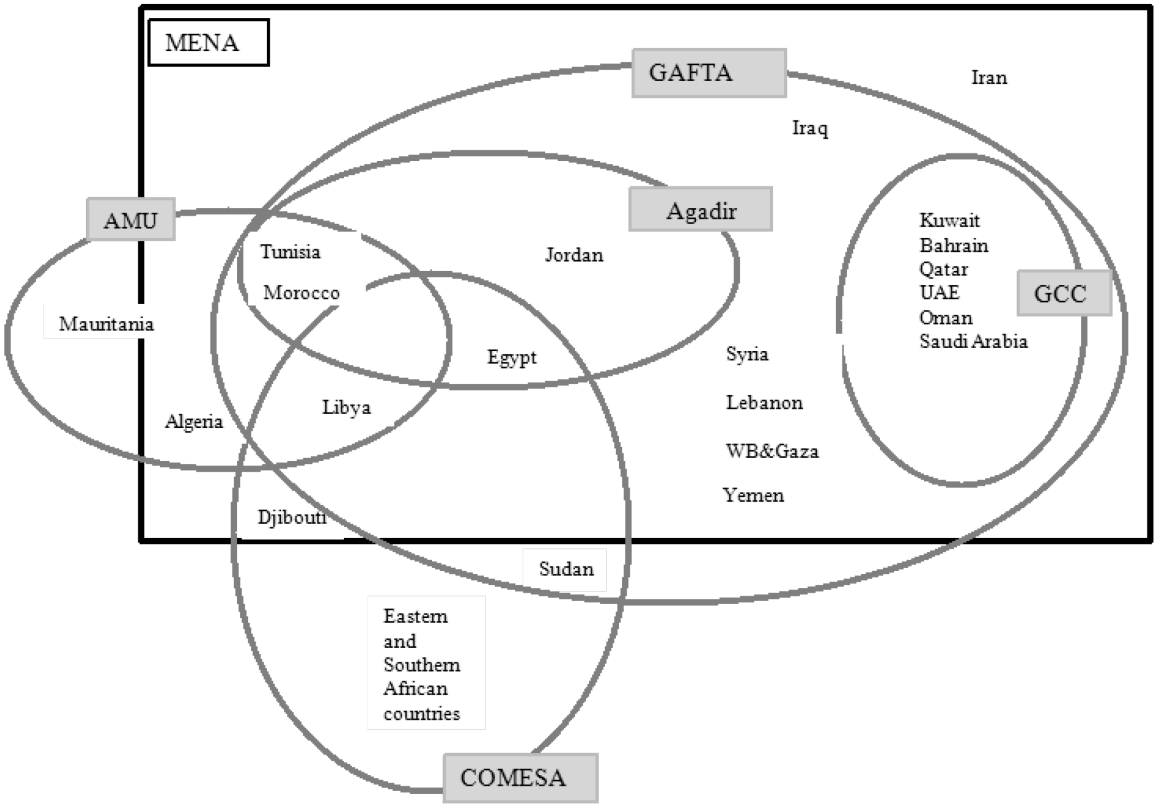
The MENA countries have signed a series of multilateral, regional, and bilateral trade agreements. The Uruguay Round Agreement Act (URAA) imposes some commitments on member countries, including the conversion of quantitative restrictions into tariffs or tariff rate quotas, the binding of tariff rates, a reduction in bound tariff rates by an average of 36 percent, and a reduction in trade-distorting measures of support to agriculture by 20 percent, on average. Developing countries have been given more modest targets for tariff rate reductions and more time to comply, and the least-developed countries (LDCs) are effectively exempted from most commitments under the URAA. The direct impact of these commitments on the MENA countries has been modest. Syria and West Bank and Gaza are not WTO members, and Djibouti and Yemen, as LDCs, are exempt from most URAA commitments. For the remaining MENA countries, the bound rates are often far above the applied tariff rates, particularly for agricultural products. Thus, commitments to reduce the bound rates have had little effect on the actual level of agricultural protection.

The European Union has signed Euro-Mediterranean Association Agreements (EMAAs) with five MENA countries as part of the European Mediterranean Partnership, and three others are in the process of ratification. These EMAAs commit both parties to phase out almost all tariffs on manufactured goods, though the MENA countries have a longer period during which to comply. Until recently, plans to incorporate agriculture had not been supported by firm targets or schedules for agricultural liberalization. The agricultural roadmap initiated in 2005 can be seen as renewed incentives from all concerned to accelerate and intensify the EMAA agenda. In 2001, the European Union launched the Everything But Arms initiative, under which the LDCs have duty-free access to E.U. markets for almost all goods. Within the MENA region, Djibouti and Yemen can take advantage of the initiative's provisions. Bananas, rice, and sugar were temporarily exempted, and duty-free access was delayed until January 2006, July 2009, and September 2009, respectively.

As part of the U.S.–Middle East Free Trade Initiative, the United States has signed bilateral free trade agreements (FTAs) with Bahrain, Jordan, Morocco and Oman and intermediate agreements with four other MENA countries. The effect of the U.S.–Jordan FTA will be small, because Jordan's level of protection is already low and because U.S.–Jordan trade is small. The effect of the U.S.–Morocco FTA will be larger, because Moroccan trade barriers are higher. It is of particular importance that Morocco's wheat tariffs will be phased out over 10 years. Under the U.S. African Growth and Opportunity Act, Sub-Saharan African countries that meet certain criteria in human rights, reducing corruption, and combating terrorism will have free access to U.S. markets. Djibouti qualifies, but its exports to the United States are negligible.

A number of bilateral and regional agreements within the MENA region have been signed (see Figure 9 for an overview), but their effectiveness has been limited by the structural similarities of the MENA economies and the granting of exceptions for sensitive products. Nonetheless, a number of MENA countries, most notably Egypt and Tunisia, have reduced tariff barriers unilaterally in recent years. In other words, trade liberalization does occur outside the context of global, regional, and bilateral trade agreements.

Figure 9. Regional (trade) agreements for MENA countries



Source: Minot et al. 2010.
Note: Agadir = Agadir Agreement for the Establishment of a Free Trade Zone between the Arabic Mediterranean Nations; AMU = Arab Maghreb Union; COMESA = Common Market for Eastern and Southern Africa; GAFTA = Greater Arab Free Trade Area; GCC = Gulf Cooperation Council; UAE = United Arab Emirates; WB&G = West Bank and Gaza.

Impact of Agricultural Trade Liberalization

Economic theory suggests that trade liberalization leads to the most efficient use of resources. However, policymakers often argue that sustaining agriculture and the welfare of farmers is a more important goal that supersedes economic rationale. To shed some light on this debate, we summarize the results of several studies on the issue. Several dozen studies have been undertaken to examine the macroeconomic impact of various types of trade liberalization in the MENA region. Most of these studies use computable general equilibrium (CGE) models to simulate the effect of alternative trade policies. The results of these studies may be summarized as follows.

Trade liberalization is good for growth, yet domestic reform might be more important than changes in trade policies. Multilateral trade liberalization generally results in net gains to countries in the region, with real GDP expansion of 1–3 percent (Bouët 2008; Diao, Somwaru, and Roe 2001; Dessus, Fukasaku, and Safadi 1999). However, the benefits of trade liberalization to a country depend largely on the degree of domestic liberalization carried out by the country. Most of the gains from agricultural trade liberalization are associated with domestic reform rather than changes in trade policy in other countries, which confirms the well-known concept in studies of trade liberalization: What you do determines what you get. The following are examples:

- The benefits of multilateral trade liberalization are generally greater than the benefits of bilateral trade liberalization with the European Union or the United States.

- The benefits of multilateral trade liberalization are generally greater than the benefits of regional trade agreements within MENA.
- Trade liberalization usually results in lower production and more imports of wheat, but higher production and more exports of fruits and vegetables.

Another argument revolves around the concept that import barriers on agricultural products reduce poverty among poor agricultural producers. However, as shown in the following examples, higher agricultural prices resulting from multilateral trade liberalization have mixed effects on the poor:

- In Egypt, simulations reveal that higher wheat prices reduce poverty while higher rice and horticultural prices increase poverty, but that the effects are quite small (Minot et al. 2010).
- In Syria, the removal of wheat subsidies (lowering the producer price, but raising the consumer price) adversely affects poor households, but again the effect is very small (Chemingui and Fetini 2006).
- In Tunisia, removing import barriers reduces some agricultural prices, but also reduces rural poverty (Chemingui and Thabet 2008).
- In Morocco, removing agricultural protection lowers agricultural prices, which adversely affects the poor (Thomas et al. 2008).

There are several reasons for these small and mixed effects:

- Higher agricultural prices benefit some poor households (farmers with net sales), but they hurt other poor households (the urban poor and net buyers in rural areas).
- The percentage of households that are net sellers of agricultural goods is relatively small because, in most MENA countries, less than half the population is in farming and a significant share of farmers are net buyers.
- Farmers who are net sellers tend to be richer than the average farmer, so higher farm incomes do not always translate into lower poverty.
- Even farmers who are both poor and net sellers rely on nonagricultural activities for a significant share of their incomes.

Complementary Policies

Agricultural protection is thus a costly and imprecise tool with which to address the problem of rural poverty. Several studies have indicated that the size of the gains from trade liberalization depends on the existence of complementary policies and programs. The gains are smallest (or the losses largest) when consumers and producers are limited in their ability to respond to new opportunities and new prices. Studies of trade liberalization in Morocco and Tunisia show that if factor markets are flexible, the benefits of trade liberalization are three to five times greater than when factor markets are rigid (Dennis 2006).

Flexible factor markets allow factors of production (such as land, labor, and capital) to be reallocated from formerly protected sectors to newly profitable sectors. Examples of rigidities in MENA factor markets include the following:

- Regulations limiting the use of temporary workers and expatriates; remittances!
- The complicated bureaucratic procedures involved in dismissing workers
- Large severance allowances
- Delays in the application for and issuance of land and construction permits
- Significant capital requirements in starting a new business
- Difficulties in closing a business

Although these bureaucratic problems are common in many countries, business climate surveys suggest that they are more severe in the MENA countries than they are in most developing countries. In a

ranking among countries based on the ease of doing business, only three MENA countries are in the top half (Jordan, Tunisia, and Lebanon are ranked in the 45th to 49th percentile range), and several are in the bottom 15 percent (Egypt, Djibouti, and Sudan) (IFC 2009).

In agriculture, flexibility is more likely to be enhanced by effective agricultural services such as extension and market information systems that provide farmers with useful information about the agronomic and economic aspects of shifting into new commodities. It is sometimes claimed that farmers are not able to substitute into new crops because of agroclimatic limitations. This view is contradicted by numerous studies showing that farmers respond to incentives in the form of input and output prices, as well as new technology.

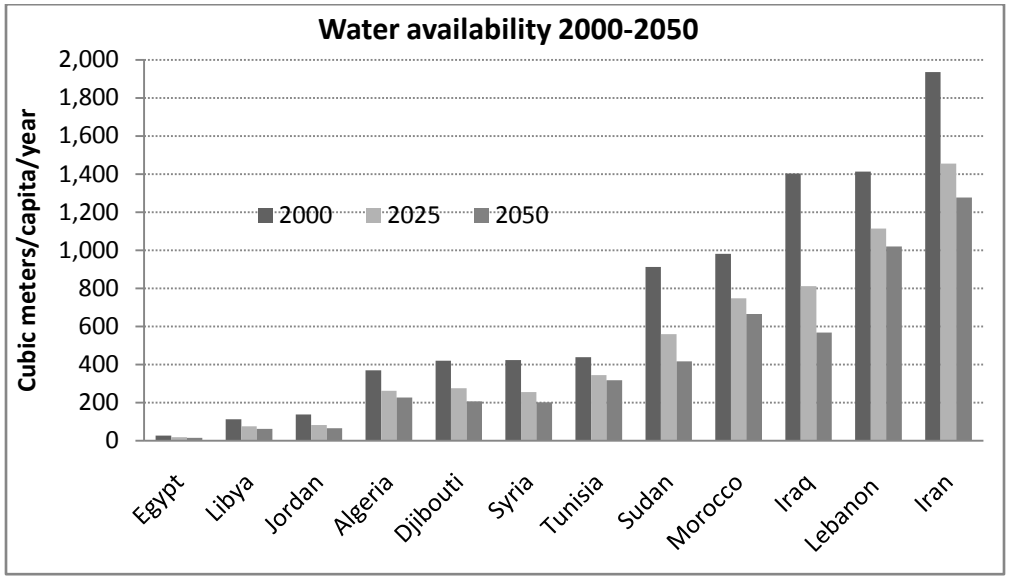
Another type of complementary policy that enhances the economic effect of trade liberalization is trade facilitation. This category includes measures to reduce the transaction costs related to international trade, including excessive documentation requirements, authorizations from multiple agencies, unclear or subjective criteria for the application of duties, and delays and uncertainties related to customs clearance.

Water and Agriculture

Water Availability and Agricultural Growth Potential

For most countries in the MENA region, sustaining per capita water availability will be an impossibly huge challenge. Instead, water scarcity will remain a defining characteristic in the region in the years to come. MENA is the most water-constrained region in the world, and climate change is very likely to further reduce the availability of, and access to, water (see also "Impact of Climate Change"). Per capita water availability globally, at 7,130 cubic meters, is almost 10 times the availability in the MENA region, which is 757 cubic meters. As a result of population growth alone, water availability in the region is projected to decline to 400 cubic meters per capita by 2050. Figure 10 presents water availability per capita over time for key countries in the MENA region. In 2000, only Iran had water availability in excess of 1,700 cubic meters per capita, a number generally considered the threshold between water abundance and water stress. Over time, Iraq is expected to see the largest drop in water availability, at 60 percent, but Djibouti, Jordan, Sudan, and Syria are also projected to experience declines in availability in excess of 50 percent.

Figure 10. Per capita internal renewable water availability for key countries in the MENA region, 2000 and projected 2025 and 2050



Source: IFPRI IMPACT model results.

As water availability decreases, competition between water use in agriculture and other sectors continues to increase. Agriculture contributes 12 percent to the MENA economy, yet it uses 89 percent of the water, as compared with 4 percent for industry (Table 5). Despite that situation, MENA is the region with the largest share of net food imports in total food production, chiefly due to land and water scarcity. Industrialization and service sector expansion, including tourism expansion, are likely to increase competition for scarce water resources. Rapid population growth and urbanization will further add to the demand for water. Thus, growing pressures on limited water resources pose important questions for the future allocation of this scarce resource among agricultural, industrial, residential, and environmental demands.

Innovation and new technologies that focus on drought stress and salinity tolerance—including desalination, wastewater recycling, and products of agricultural research—will play an important role in the future water supply. Several countries in the region, particularly the Gulf States, have started to invest in such advanced water technologies. Moreover, policies that encourage wasteful use of limited water supplies, such as fuel subsidies for groundwater pumping, and poor institutions and management of groundwater in much of the region should be eliminated as the cost of wasting increasingly scarce resources rapidly grows.

Table 5. Water use by sector

	Agriculture	Domestic	Industrial	Total (cubic kilometers)	As % of internal water resources
Food security challenges countries					
Mineral resource rich					
Algeria	65	22	13	6	54
Iraq	92	3	5	43	121
Libya	83	14	3	4	711
Sudan	97	3	1	37	124
Syria	95	3	2	20	285
Yemen	95	4	1	7	162
Mineral resource poor					
Djibouti	16	84	0	0	6
Egypt	86	8	6	68	3,794
Jordan	75	21	4	1	149
Lebanon	67	33	1	1	29
Morocco	87	10	3	13	43
Tunisia	82	14	4	3	63
West Bank and Gaza					n.a.
Food-secure countries					
Bahrain	57	40	3	0	7,500
Iran	91	7	2	73	57
Kuwait	52	45	2	0	
Oman	90	7	2	1	138
Qatar	72	24	3	0	569
Saudi Arabia	89	10	1	17	722
United Arab Emirates	68	23	9	2	1,533

Source: Authors' calculations based on FAO 2009a.

Innovation and the adoption of new technologies are important, yet improving water management and institutions are necessary for better food security. Given the extreme water scarcity in the region, most MENA countries with irrigated areas have some governance structures in place for managing irrigation water. Table 6 shows a selection of countries that have a water policy in place, and most of these countries also have irrigation strategies and irrigation action plans. Some countries have invested in highly efficient irrigation technologies, whereas others continue to rely on flood irrigation. All countries, however, have room for improvement in water resource management, particularly regarding economic incentives for conserving agricultural water sources and decentralized institutions for managing water at a lower level. The often short and ephemeral rivers in the region and the significant dependence on groundwater probably contribute to the relatively low share of river basin organizations in MENA reflected in Table 6.

Table 6. Institutional framework indicators

Country	Water policy?*	Specialized agency for basin-level management?	Dedicated irrigation infrastructure development entity?	Empowerment of water user associations?	Irrigation strategy?*	Irrigation action plan?*
Algeria	Yes	No	Yes	No	Yes	No
Djibouti	Yes	No	Yes	No	No	Yes
Egypt*	Yes	Yes	Yes	Early stage	Yes	Yes
Libya*	Yes	No	No	No	Yes	Yes
Morocco	Yes	Yes	Yes	Yes	Yes	Yes
Sudan*	Yes	No	No	Yes	Yes	Yes
Tunisia	Yes	No	Yes	Yes	Yes	Yes

Source: Adopted from Svendsen et al. 2009.
Note: The country responses for each of the questions and countries marked with an asterisk (*) are from the unpublished report of a workshop organized by World Bank Water and Food Group in Ouagadougou, Burkina Faso, March 2007. All other answers are interpreted from country profiles in FAO 2005.

There have been several broad institutional approaches to improving water use efficiency and productivity. These approaches include making the public sector more efficient, devolving more responsibility to farmer groups, and instituting greater involvement of the private sector. Institutional reform of public irrigation agencies holds some promise for long-term improvements in system performance. Possible reforms include shifting from a line department to a semi-independent or public utility mode; applying financial viability criteria to irrigation agencies; franchising rights to operate publicly constructed irrigation facilities; and strengthening accountability mechanisms, such as providing for farmer oversight of operating agencies (Rosegrant and Svendsen 1993). Farmers' participation in irrigation management at the tertiary and secondary levels has been widely promoted by governments to improve local management. The success depends on the degree of farmer cooperation and the incentives for farmers to take on an expanded role (Vermillion and Sagardoy 1999). Private sector irrigation development has generally been limited to groundwater development, and groundwater governance has proved to be highly complex.

Water rights are key to establishing incentives for irrigation management, and the MENA region is no exception. Although some system of water rights is found to operate in virtually any setting where water is scarce, systems that are not firmly grounded in formal or statutory law are likely to be more vulnerable to expropriation. In several MENA countries, components of Islamic water law form part of water legislation and customary practices. Islamic (water) law attempts to balance private incentives with social optimality. Key principles include the right to quench thirst, the principle of not harming water

sources, and the understanding of public benefit from open-access water accessible to all, while resources stored in privately owned wells can be traded and sold for fair compensation (see also Faruqui, Biswas, and Bino 2001). If well-defined rights are established, the water user can benefit from investing in water-saving technology. However, the establishment of formal water rights is not likely to be effective if it ignores existing customary arrangements (Bruns and Meinzen-Dick 2000, 2005).

Virtual water trade has long been suggested as a solution for the MENA region. Virtual water is defined as the volume of water used to produce a good or service, including agricultural commodities, where it can be measured in crop water depletion or in irrigation water depletion (Allan 1998; Hoekstra and Hung 2003). Countries in which water is particularly scarce might benefit by importing water-intensive agricultural goods. That is, by substituting cereal and other food imports for irrigated agricultural production (so-called imports of virtual water), countries can effectively reduce their agricultural water use. Importing countries benefit from this trade because water originally intended for agriculture can be allocated to other uses. Global water savings take place when agricultural exporters are more water efficient than importers, and global irrigation water savings occur when exporters produce agricultural products under rain-fed conditions while importers would have used irrigation water to produce the same agricultural commodities. Based on simulation modeling, Rosegrant, Cai, and Cline (2002) estimate an increase in cereal trade from water-abundant to water-deficit areas from 23 percent in 1995 to 38 percent by 2025, because food demand growth outstrips food production growth in water-deficit areas. However, although water scarcity is undoubtedly a major factor in MENA's trade policies and trade protection and domestic support for agricultural production distort the virtual water movement overall, water scarcity continues to play a modest role in global trade patterns (Ramirez-Vallejo and Rogers 2010).

Incentives that encourage excess water use for irrigation, such as price support, subsidized credit, and energy subsidies, are still widespread (Table 7). Economic incentives for agricultural water use, such as water-pricing policies, can improve efficiency and sustainability when combined with appropriate supporting policies (Gardner 1983). However, there are significant barriers to using direct pricing of water, and not only in the MENA region. Water pricing may conflict with the idea that the provision of water services is a basic right to all individuals if water prices rise to a level that low-income households cannot afford. The high costs of measuring and monitoring water use where infrastructure and institutions are weak can also be a major constraint to implementation of water pricing. Pricing reform is also difficult because long-standing practice and cultural and religious beliefs have treated water as a free good, and entrenched interests benefit from the existing system of subsidies and administered allocations of water (Rosegrant and Cline 2002). An alternative system to implement incentives in water allocation would be to pay farmers to use less water, based on the charge–subsidy approach suggested by Pezzey 1992 for pollution control (Rosegrant, Ringler, and Rodgers 2005; Ringler, Huy, and Msangi 2006). Such payments can create incentives for irrigation system managers to increase conveyance and distribution efficiencies and for farmers to increase on-farm water application efficiencies through advanced irrigation technologies. However, although the potential is considerable—simply because agriculture uses the largest volumes of water—enhancing water use efficiency is a highly complex task, because much of the apparent losses at the system level are reused elsewhere in the hydrologic basin.

Table 7. Incentives for excess irrigation

Countries	Barriers to imports	Domestic price support	Subsidized credit	Energy subsidies
Algeria	✓	✓	✓	✓
Bahrain	×	×	✓	✓
Djibouti	✓	-	-	-
Egypt	✓	✓	✓	✓
Iran	✓	✓	✓	✓
Iraq	×	✓	✓	✓
Jordan	✓	✓	✓	✓
Kuwait	×	×	✓	✓
Lebanon	✓	✓	×	✓
Libya	✓	✓	✓	✓
Morocco	✓	✓	×	×
Oman	×	✓	✓	✓
Qatar	×	×	✓	✓
Saudi Arabia	✓	✓	✓	✓
Syria	✓	✓	✓	✓
Tunisia	✓	✓	✓	×
United Arab Emirates	×	✓	✓	×
West Bank and Gaza	✓	×	×	×
Yemen	✓	✓	✓	✓

Source: Table adopted from World Bank 2007a.

More sustainable development of existing groundwater resources and halting of severe overexploitation also offer significant opportunities for many countries in the MENA region. Groundwater irrigation is more flexible than surface water irrigation and thus has generally much higher efficiencies in application; to achieve these efficiencies, building capacity and enforcing sustainable groundwater management are crucial.

Even though new investments are increasingly expensive, some of the increasing demand for water in MENA must be met from the carefully selected, economically efficient development of new water sources. Nontraditional sources include treated wastewater and desalinized saltwater. Continued technological development of desalinization processes, including through solar power, is needed.

Investments in agricultural research, by both the Consultative Group of International Agricultural Research and the National Agricultural Research System in the MENA region, need to be increasingly dedicated to reducing water use at the plant level through increasing several water use ratios. These ratios include the consumptive efficiency ratio, which indicates how much water is not taken up by plant roots; the transpiration efficiency ratio, which describes the ratio of the mass of carbon dioxide taken up by plant photosynthesis to the amount of water transpired; and the biomass efficiency ratio, which relates crop biomass to carbon dioxide assimilated by photosynthesis. Also, the yield efficiency or harvest index relates harvested yield to the crop biomass produced (Hsiao, Steduto, and Fereres 2007).

The above overview shows that the amount of water available for agriculture is likely to fall dramatically. Water is thus the major constraint for agricultural growth in MENA, and the potential for irrigation from existing sources is limited and is concentrated in few countries (Table 8). Given that most freshwater in MENA is used for irrigation, with large volumes applied to fields in Egypt, Sudan, and much of northern Africa, increased water productivity will be a key measure to ensure that sufficient water will be available for future food production. In addition, management practices that improve the effective use of rainfall, such as water harvesting or reduced tillage, can also provide broader

environmental benefits through reduced soil erosion, especially in arid and semiarid regions. Advanced tillage practices, contour plowing (typically a soil-preserving technique), and precision leveling are examples of practices that can improve infiltration and evapotranspiration, thus increasing the share of rainfall that can be used effectively for crop growth while minimizing soil erosion. Moreover, reducing the amount of soil tillage can reduce emissions of carbon stored in the soil, providing a potential strategy for greenhouse gas mitigation.

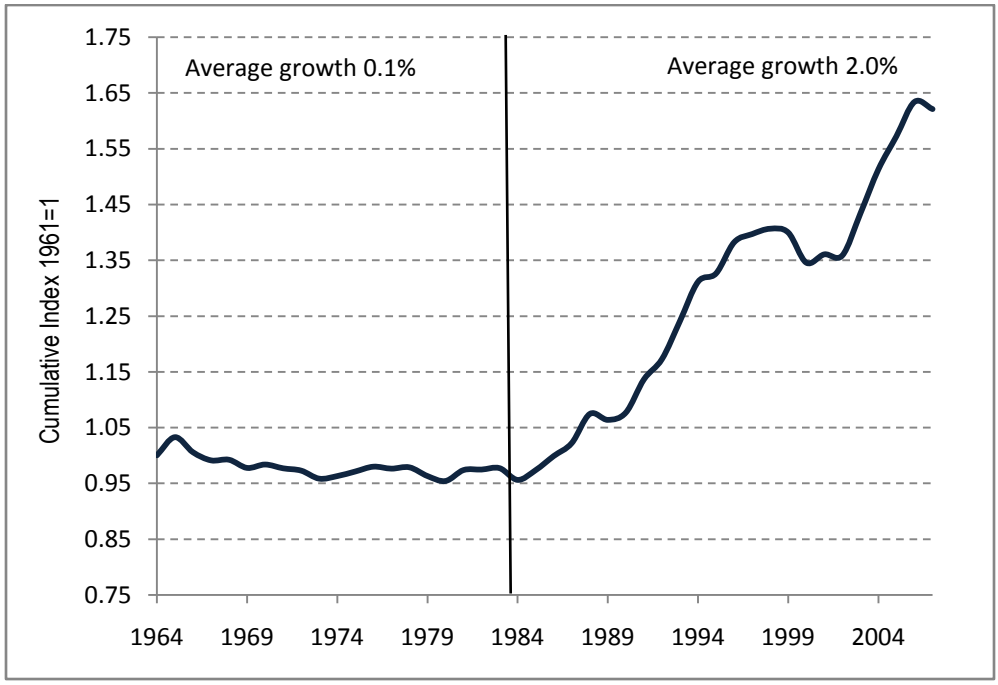
Table 8. Irrigation potential

	Cultivated area* (1,000 hectares)	Irrigation potential (share of cultivated land)	Irrigated area (share of cultivated land)	Remaining irrigation potential (in 1,000, hectares)
Food security challenges countries	**60,683**	**28**	**14**	**8,456**
Mineral resource rich	*42,744*	*24*	*8*	*6,634*
Algeria	8,390	6	5	57
Iraq	5,450	102	36	3,619
Libya	2,050	2	15	–276
Sudan	19,546	14	4	1,984
Syria	5,683	22	n/a	1,250
Yemen	1,625	n/a	n/a	n/a
Mineral resource poor	*17,939*	*39*	*28*	*1,822*
Djibouti	1	185	30	2
Egypt	3,538	125	92	1,174
Jordan	221	38	n/a	85
Lebanon	287	62	n/a	178
Morocco	8,960	19	16	216
Tunisia	4,931	11	8	167
West Bank and Gaza	n/a	n/a	n/a	n/a
Food-secure countries	**22,602**	**67**	**38**	**6,559**
Bahrain	n/a	n/a	n/a	n/a
Iran	18,549	81	39	7,736
Kuwait	18	139	39	18
Oman	99	0	62	-62
Qatar	21	248	30	46
Saudi Arabia	3,625	0	33	–1,191
United Arab Emirates	290	23	19	12
Total MENA	**83,285**	**39**	**21**	**15,015**

Source: Authors' calculations based on FAO AQUASTAT.
Note: *Total cultivated area included irrigated and nonirrigated land (arable land and permanent crops).

Despite the severe water constraints, an analysis of past agricultural growth experiences in the region suggests that there may be scope for productivity-led growth to offset some of the losses of reduced water availability. To assess this potential, we first look into the history of productivity growth in the region. Annual growth for the period 1961–2006 in MENA countries averaged 1.2 percent, although this average hides different growth patterns during the period. We distinguish two different periods of total factor productivity (TFP) growth: a first period of slow productivity growth between 1965 and 1984, when average growth was close to zero (only 0.09 percent), and a second period of improved performance and accelerated growth between 1985 and 2006, when the average growth rate was 2.0 percent (Figure 11).

Figure 11. Cumulative agricultural total factor productivity growth for the MENA region (index 1961 = 1)



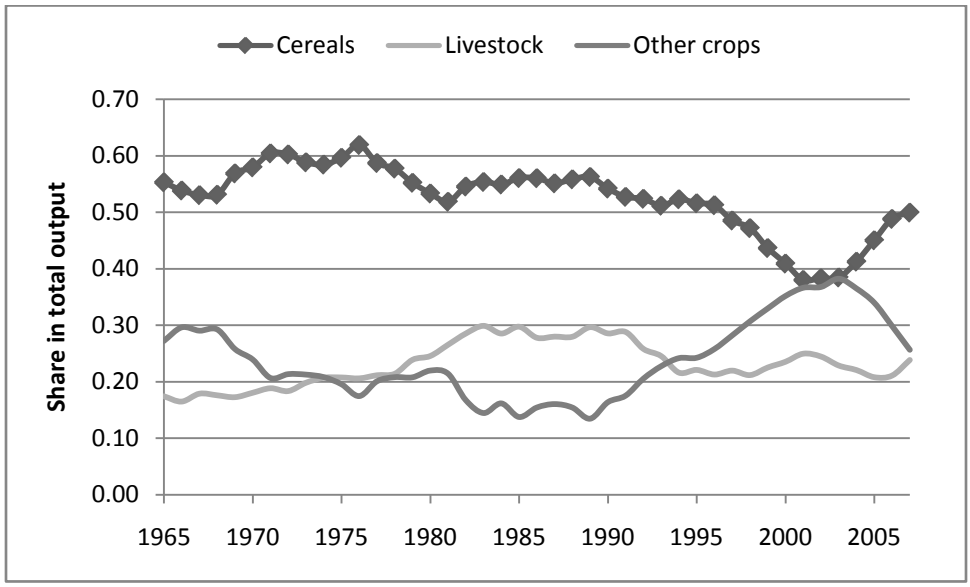
Source. Authors' calculation.

Agricultural policy reforms in the 1980s have spurred TFP growth. Regional trends in TFP correspond roughly with policy changes initiated in the region in the mid-1980s. Before the reforms, MENA countries provided high levels of output support to farmers and agrifood processors, as well as subsidized various inputs (water, fertilizers, seeds, and machinery). Governments also financed and purchased substantial amounts of various commodities, such as cereals, vegetable oil, and sugar. One of the main policy goals before the reforms in many MENA countries was to achieve food self-sufficiency, mainly in the production of cereals. For example, profitability of cereals (for example, wheat) was supported with attractive output prices and affordable input prices. In the crop sector, seeds and chemical inputs were often subsidized. Governments use a variety of measures to subsidize input use. One of the main policies across the region was the feed subsidization program, and in many countries feed subsidies represented one of the most important items in the budget of most ministries of agriculture. Trade policy was also one of the major instruments used to achieve sectoral goals in agriculture; the region made extensive use of tariffs and nontariff barriers, which imposed substantial costs on consumers, led to distorted patterns of production and trade, and reduced economic efficiency.

After a deep recession in the region in the 1980s, it became evident that large budgetary outlays for the agricultural sector and urban consumers were not sustainable. These difficulties triggered a wide range of economic reforms that started in agriculture in the mid-1980s and resulted in a significant boost to growth. These reforms are ongoing, and their extent and speed vary. The goal of these reforms in MENA, as in other developing countries at that time, was to liberalize output and input prices and to move the state away from marketing both outputs and inputs, establishing market infrastructure, ensuring proper use of norms and standards in trade, providing support to the national agricultural research system, and establishing a legal framework for the implementation of a market-based economy. New trade policy strategies were designed to facilitate agricultural growth and competitiveness. However, most countries instituted direct protection instruments to shield domestic production against cheaper imports of a number of "strategic commodities" (for example, soft or durum wheat in most MENA countries; milk and olive oil in Tunisia; cotton, sugar beets, and tobacco in Syria; and sugar beets and tobacco in Lebanon) and the volatility of international markets. As a result of these policies, MENA countries tend to have higher tariff rates than Gulf Cooperation Council countries and lag substantially behind other regions in their pace toward liberalization. According to Chaherli 2002, protection is still too high to allow any new real opportunity for increased agricultural imports. Nonetheless, as a result of foreign trade liberalization, international markets have started having an important influence on MENA domestic markets.

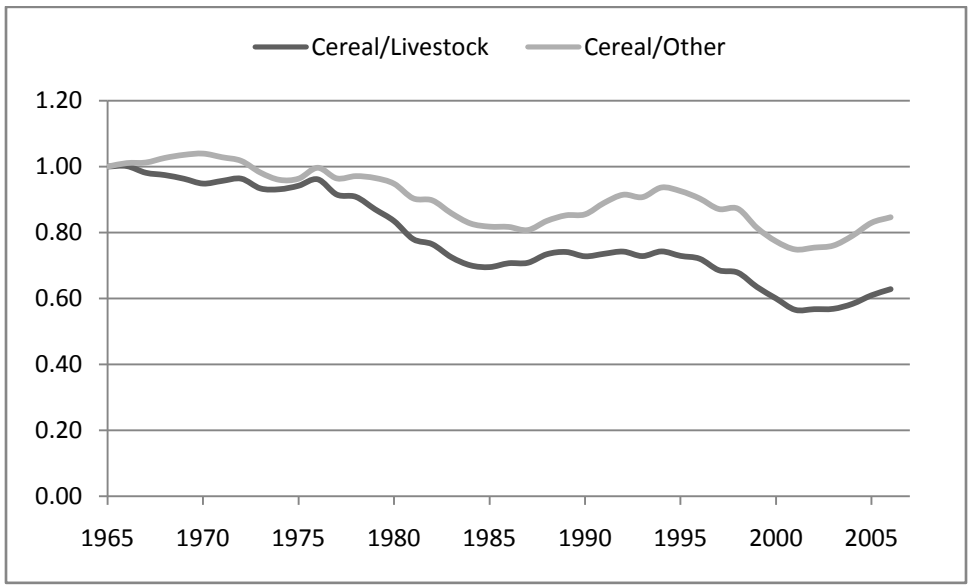
Increased TFP growth resulted from more efficient use of resources accumulated in the previous period (1965–1984). Even though the share of cereals in total output has been declining since the early 1960s (Figure 12), estimated cereal shadow prices using data envelopment analysis (DEA) remained high until the mid-1980s (Figure 13). Thus, the economic environment of the 1960s and 1970s favored a resource combination and resource availability that resulted in a relatively high shadow price for this commodity. Following policy changes after the mid-1980s and early 1990s, our results show a steep increase in the shadow price of other crops in the DEA TFP estimation, together with a sharp decline in cereals' share, signaling that during this period, the better possibilities for TFP expansion were given by growth in other crops. This balance favoring other crops appears to change by the end of the period (2000s). In recent years, a boost in productivity has resulted again from an acceleration of growth in cereal production and a recovery in the shadow price of cereals. On the input side, the period of poor performance corresponds with the fast expansion in the use of fertilizer and tractors (Figure 14). The area of arable land under irrigation started increasing in the early 1980s. After policy changes, the use of fertilizer appears to have reached a plateau oscillating around 140 kilograms per hectare on average for the region. Something similar happened with the percentage of arable land being irrigated and the number of tractors per hectare and worker.

Figure 12. Output shadow shares obtained from data envelope analysis (DEA) estimates of distance functions



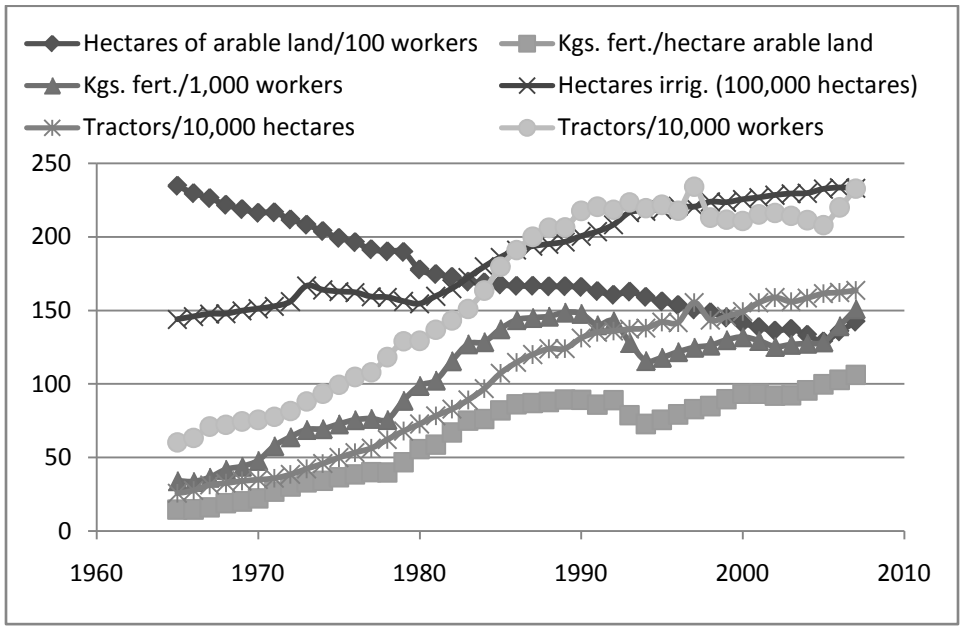
Source: Authors' calculations.

Figure 13. Ratio of cereal production with respect to production of livestock and other crops in the MENA region (1965 = 1)



Source: Authors' calculations.

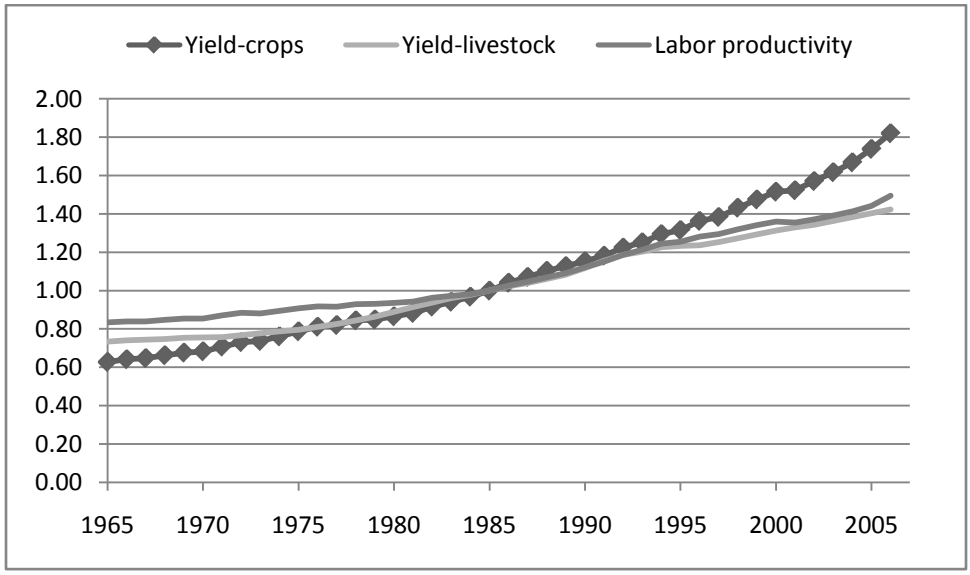
Figure 14. Input relationships in the MENA region (1965–2007)



Source: Authors' calculations.
Note: Kgs. = kilograms; fert. = fertilizer; irrig. = irrigation

Despite investment and fast growth in the use of inputs during 1965–1984, yields increased faster after 1985 (Figure 15). For instance, output per hectare of arable land increased at an annual growth rate of 2.76 percent between 1985 and 2007, but the rate was 2.24 percent between 1965 and 1984. Livestock output per head of animal stock increased at an annual rate of 1.62 percent, compared with 1.42 percent in the first half of the analyzed period. The most important difference was in labor productivity, which grew at 1.84 percent after 1985, compared with only 0.87 percent before 1985.

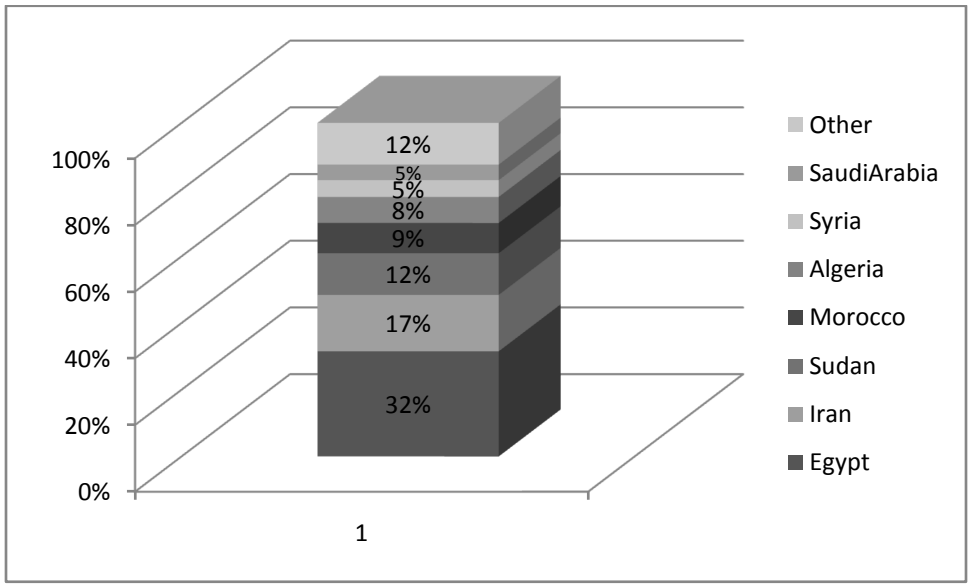
Figure 15. Trends in different measures of partial factor productivity (PFP) in the MENA region (index 1985 = 1)



Source: Authors' calculations.

The more than 60 percent of total TFP growth between 1985 and 2007 in MENA is explained by only three countries: Egypt, Iran, and Sudan. These countries, together with Morocco, Algeria, Syria, and Saudi Arabia, explain 88 percent of the total TFP growth (Figure 16). Egypt, Iran, Sudan, Morocco, Algeria, Syria, and Saudi Arabia explain most of the TFP growth in MENA during the period of improved performance (1985–2007), shown in Figure 11. More than 30 percent of total TFP growth is explained by Egypt alone. This country is the best-performing country in terms of TFP growth and is the second largest contributor to total agricultural output in the region. Some of the countries that explain growth, such as Iran, Sudan, and Morocco, are not among the best-performing countries, but because of the size of their share in MENA's agricultural output, their contribution is still relevant. Some of the best-performing countries between 1985 and 2007 include Egypt, Lebanon, Saudi Arabia, and Libya.

Figure 16. Contribution of different countries to total agricultural total factor productivity (TFP) growth in the MENA region, 1985–2007



Source: Authors' calculations.

Best-performing countries differ from other countries in that they show higher labor productivity, a reduction in the number of workers per hectare, and higher growth in the use of fertilizer and tractors per worker. Best-performing countries show significant growth in both labor and land productivity, but labor productivity increased faster than land productivity (4.24 and 2.40 percent growth in labor and land productivity, respectively, between 1985 and 2007). The rest of the countries show the opposite pattern: higher growth in land than in labor productivity (3.09 and 1.19 percent, respectively). High labor productivity in best-performing countries results from reduced intensity in the use of labor. This relationship is reflected in a lower growth in the number of hectares per worker and increased use of fertilizer and tractors per worker. Underperforming countries, in contrast, show a reduction in the number of hectares per worker, higher growth in the use of fertilizer and tractors per hectare, and more intensive use of labor relative to capital (negative growth in the use of fertilizer and tractors per worker). Both groups of countries have increased the irrigated area; however, best-performing countries show higher growth during the whole period (1965–2007). More detailed information on the methodology can be found in Nin Pratt, A. and B. Yu. (2008) and Nin-Pratt, A. and B. Yu (2010).

Impact of Climate Change

Climate change will affect food security in MENA through a variety of channels. It will have direct impacts on agricultural production and the availability of water. Indirect impacts will include higher prices received for imported foodstuffs and, depending on the climate policies implemented, changes in the cost of energy and agricultural inputs.

The majority of global climate models predict that the MENA region will experience a reduction of rainfall in this century (Christensen et al. 2007). In North Africa, runoff may decrease. The number of people who will experience water stress is likely to increase even further as a result (see also Cruz et al. 2007, 469–506). Climate change could decrease mixed rainfed and semiarid systems, particularly the length of the growing period on the margins of the Sahel (Boko et al. 2007, 433–467).

Agriculture will be hard hit by climate change, through both reduced crop area and reduced yields. Agriculture is extremely vulnerable to climate change. Higher temperatures eventually reduce yields of desirable crops while encouraging weed and insect pest proliferation. Changes in precipitation patterns increase the likelihood of short-run crop failure and long-run production declines. Although there will be gains in some crops in some regions of the world, the overall impacts on agriculture are expected to be negative, threatening global food security. Even though the MENA region is already quite warm today, global warming is expected to add another 2 degrees Celsius to annual average temperatures by 2050.

Although climate change impacts in the form of crop yield declines are less severe in MENA than in Asia, for example, MENA is much more vulnerable to climate change as a result of already existing high resource scarcity. Thus, MENA will face large challenges in countering the adverse impacts from climate change. The MENA region faces increased net food imports even under the historic climate as a result of growing populations, rapid urbanization, and slow improvement in agricultural productivity—and chiefly lack of water (and land) resources. Climate change will likely further increase net food import demand in the region.

To assess the impact of climate change,[9] we use the IFPRI's International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT model). We ran several climate change scenarios of the AR3 and AR4 family through the Decision Support System for Agrotechnology Transfer (DSSAT) crop growth model. Results from the National Center for Atmospheric Research Community's Climate System Model (NCAR-CCSM3) and the Commonwealth Scientific and Industrial Research Organization's General Circulation Model (CSIRO GCM A2) scenario from the International Panel on Climate Change's (IPCC's) fourth assessment report are used for climate change simulations, as are results from the United Kingdom Meteorological Office Hadley Centre's Coupled Model, version 3 (HadCM3), using the A2a scenario from IPCC's third assessment report. Scenarios can be considered with or without the increased carbon fertilization effect. Plants produce more vegetative matter as atmospheric concentrations of carbon dioxide increase. The effect depends on the nature of the photosynthetic process used by the plant species. So-called C3 plants use carbon dioxide less efficiently than C4 plants, which benefit from elevated atmospheric concentrations of carbon dioxide. Uncertainty remains regarding the translation of mostly laboratory results to actual field conditions. The DSSAT has an option to include carbon dioxide fertilization effects at different levels of carbon dioxide atmospheric concentration. However, it is generally agreed that the carbon dioxide fertilization effect currently embedded in the DSSAT (4.02) overstates the benefits of carbon fertilization as compared with recent evidence in field trials (Boote 2009). We therefore present results only at an atmospheric carbon dioxide level of 369 parts per million (the level in 2000).

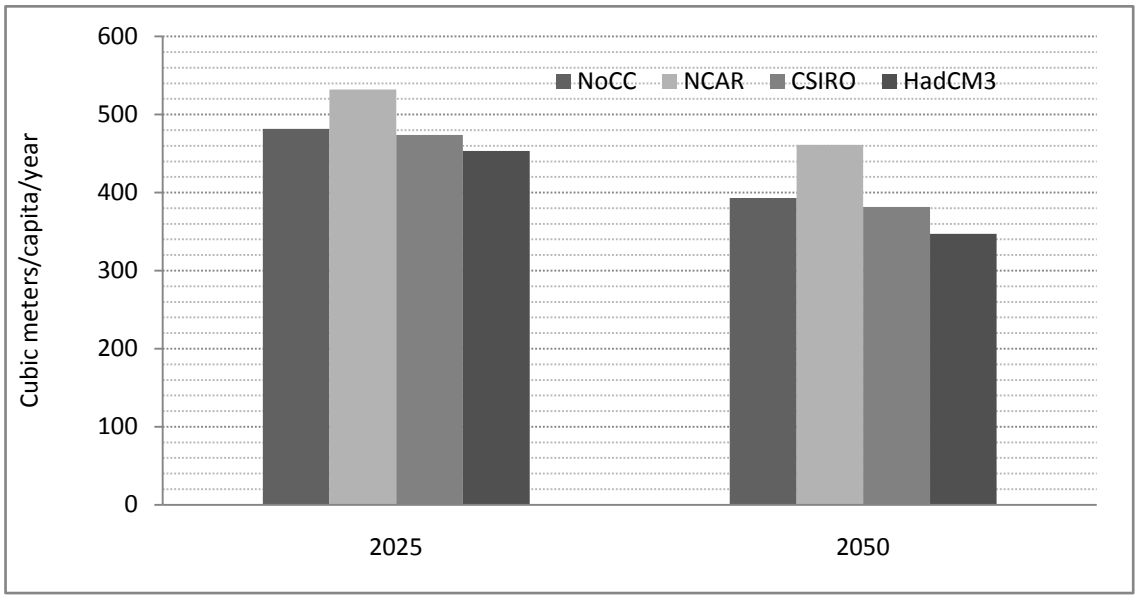
Climate change effects on crop productivity enter into the IMPACT2009 model by affecting both crop area and yield. IMPACT2009 considers impacts on crop production from altered temperature and precipitation patterns, changes in irrigation water availability and evapotranspiration potential, as well as technological change over time and economic feedback effects through changes in international food

[9]Long-term change in temperature and precipitation patterns, but not changes in the frequency and intensity of extreme events.

prices, which lead to a series of (autonomous) supply and demand responses. Thus, three impacts on crop production from climate change are considered: (1) direct effects on rainfed yields through changes in temperature and precipitation, (2) indirect effects on irrigated yields from changes in temperature and changes in water availability for irrigation (including from precipitation), and (3) autonomous adjustments to area and yield due to price effects and changes in trade flows in the economic model. Using comparisons of IMPACT2009 projections with and without climate change scenarios, the "net" impacts of climate change on agricultural production, demand, trade, and prices can be obtained.

Climate change reduces the availability of water for agricultural and nonagricultural uses. Figure 17 presents changes in per capita internal renewable water availability for the MENA region under alternative climate change scenarios. As described earlier, per capita water availability is projected to decline over time as a result of rapid population growth in many MENA countries. Higher temperatures under global warming increase evapotranspiration levels, which globally leads to higher precipitation levels. However, most climate change scenarios agree that precipitation levels in the North Africa region will decline. According to our calculations, annual per capita water availability in MENA will slightly increase under the Hadley CM3 scenario but will decrease under the CSIRO and NCAR scenarios compared with the historic climate.

Figure 17. Per capita water availability under current climate and three climate change scenarios for 2025 and 2050, MENA region



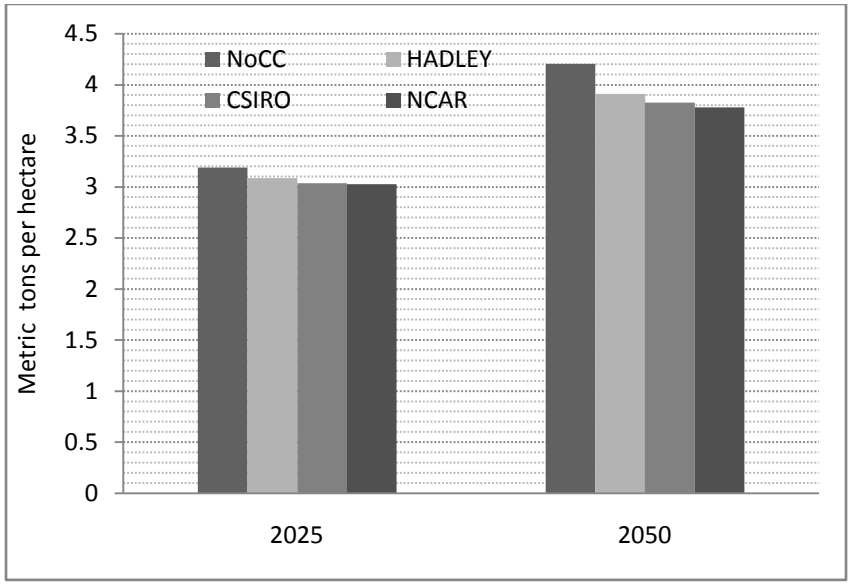
Source: IFPRI 2009.
Note: Population data of 2025 and 2050 are based on the middle variant population projection of the United Nations. NoCC = no-climate-change scenario; NCAR = National Center for Atmospheric Research; CSIRO = Commonwealth Scientific and Industrial Research Organization; HadCm3 = Hadley Centre's Coupled Model, version 3.

Figure 18 presents projections of average cereal yield for the MENA region, projected for 2025 and 2050, under historic climate and alternative climate change scenarios. As can be seen, yield levels are projected to decline only slightly by 2025, whereas declines are projected to be somewhat larger by 2050.

Climate change will increase world prices of key staple cereals (and meats) compared with a scenario with the historic climate. World prices are a key indicator of the effects of climate change on agriculture and, even more important, on food affordability and security. Figure 19 shows the price effects under the three scenarios for 2025 and 2050. Prices would be significantly lower under the historic climate scenario; by 2025, prices under various climate change scenarios are 14–18 percent higher for rice, 40–48 percent higher for wheat, and 30–45 percent higher for maize. By 2050, rice prices would be

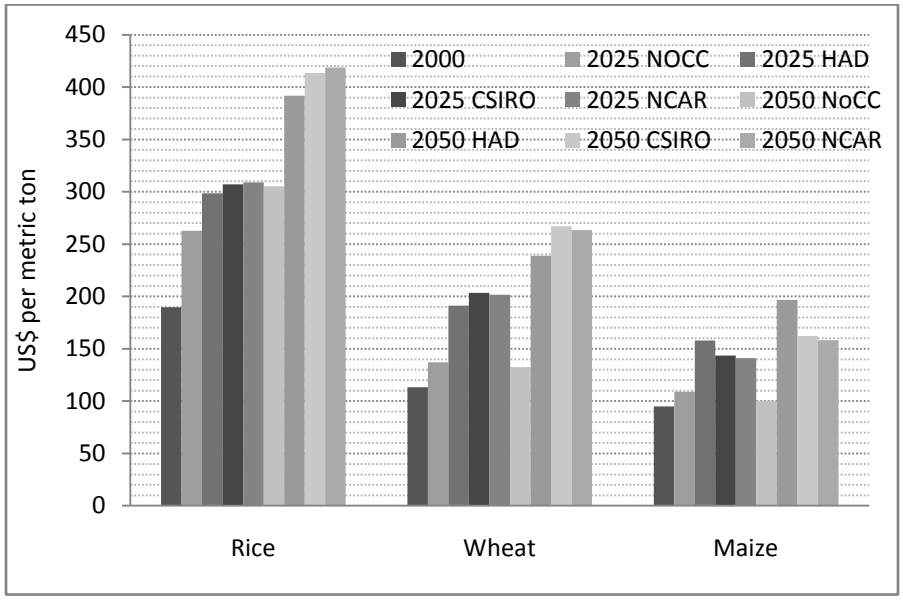
28–37 percent higher, wheat prices would be 80–102 percent higher, and maize prices would be 58–96 percent higher compared with a no-climate-change scenario.

Figure 18. Average cereal yield, projected 2025 and 2050, historic climate and alternative climate change scenarios, MENA (metric tons per hectare)



Source: IFPRI 2009.
Note: NoCC = no-climate-change scenario; CSIRO = Commonwealth Scientific and Industrial Research Organization; NCAR = National Center for Atmospheric Research.

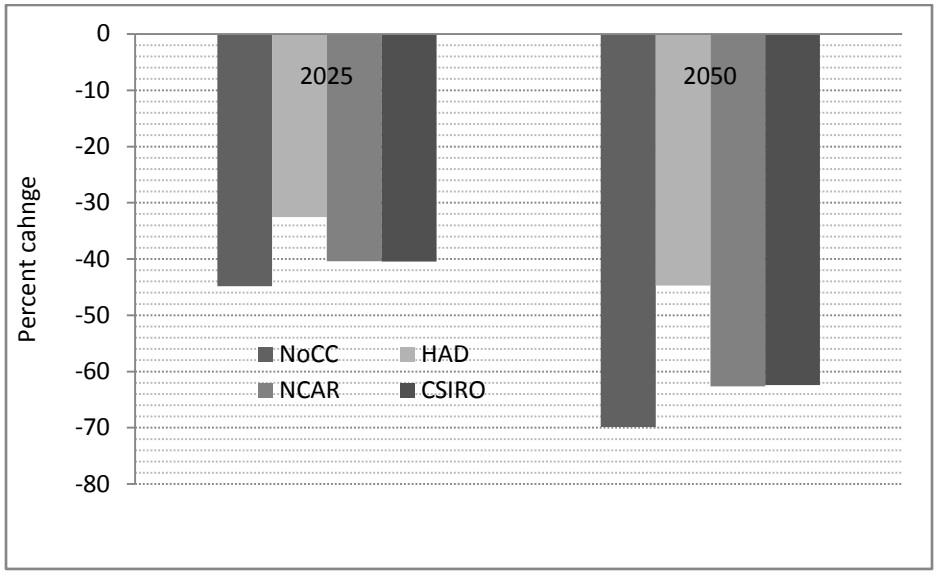
Figure 19. Selected international commodity prices, 2000 and projected 2025 and 2050, historic climate and alternative climate change scenarios, MENA (US$/metric ton).



Source: IFPRI 2009.
Note: CSIRO = Commonwealth Scientific and Industrial Research Organization; Had = Hadley Centre; NoCC = no-climate-change scenario; NCAR = National Center for Atmospheric Research.

Net cereal imports into the MENA region would decline under the climate change scenarios examined here. Research on the effects of climate change on world agricultural markets is still relatively limited. Both crop and animal production are affected by changes in temperature and precipitation. Climate change alters the comparative advantage, setting up the possibility of changes in trade flows as producers respond to changing opportunities. More generally, agricultural trade flows depend on the interaction between inherent comparative advantage in agriculture, which is determined by climate and resource endowments, and a wide-ranging set of local, regional, national, and international trade policies. Figure 20 presents changes in net cereal trade for MENA. As expected, net imports are projected to increase significantly over time in the region, to 45 million metric tons by 2025 and 70 million metric tons by 2050. Under climate change, net cereal imports would still increase over time, but at a slightly lower level compared with a historic climate scenario. This effect is due to the much higher international food prices prevalent under the various climate change scenarios, which depress local food demand in the region.

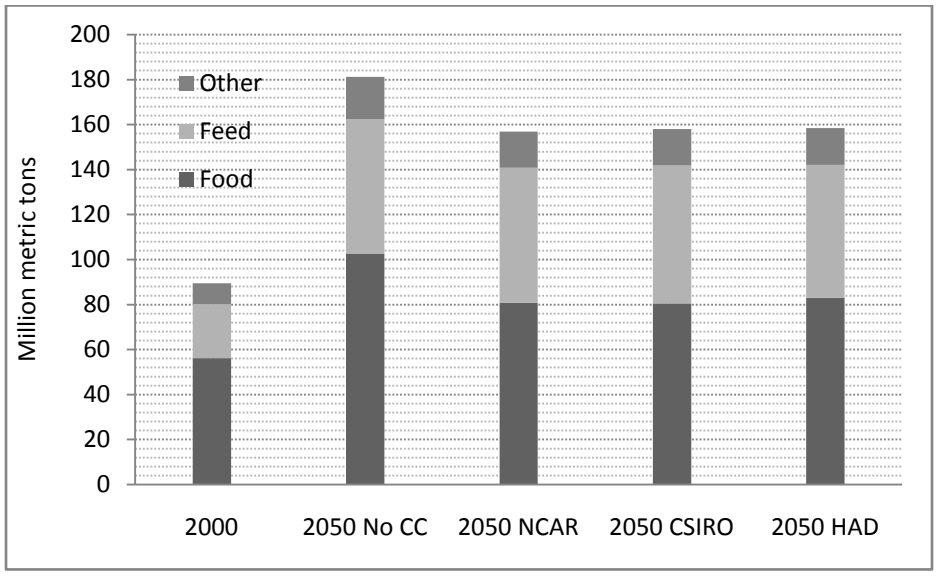
Figure 20. Net cereal trade, projected 2025 and 2050, historic climate and alternative climate change scenarios, MENA (million metric tons)



Source: IFPRI 2009.
Note: NoCC = no-climate-change scenario; Had = Hadley Centre; NCAR = National Center for Atmospheric Research; CSIRO = Commonwealth Scientific and Industrial Research Organization.

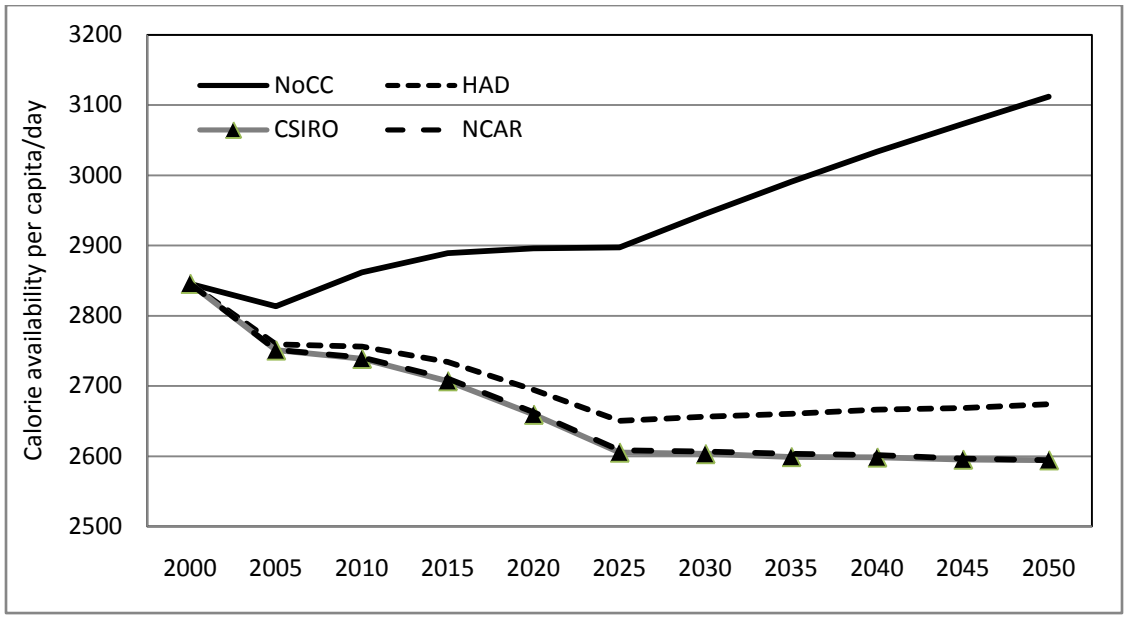
Climate change leads to an increase in the severity of malnutrition, especially among children. Higher food prices dampen demand for food as the affordability of nearly all agricultural commodities—including basic staples and livestock products—declines under climate change. As a result, both total food demand and per capita calorie availability decline in MENA under all climate change scenarios (Figures 21 and 22). For example, 2050 calorie availability per person per day would drop by 14 to 17 percent, depending on the climate change scenario.

Figure 21. Cereal demand for food feed and other uses, 2000 and projected 2050, historic climate and alternative climate change scenarios, MENA (million metric tons)



Source: IFPRI 2009.
Note: NoCC = no-climate-change scenario; NCAR = National Center for Atmospheric Research; CSIRO = Commonwealth Scientific and Industrial Research Organization; Had = Hadley Centre.

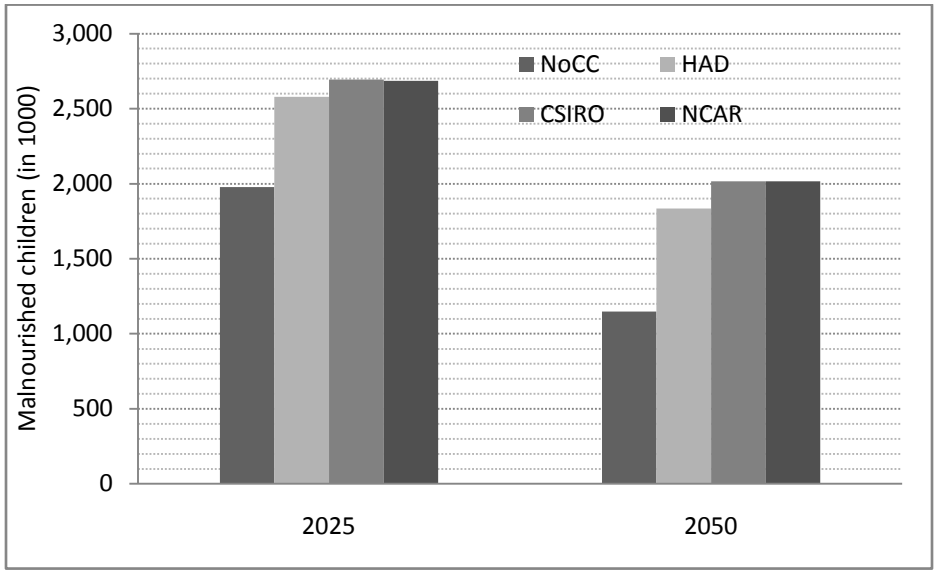
Figure 22. Calorie availability per capita per day, historic climate and alternative climate change scenarios, MENA



Source: IFPRI 2009.
Note: NoCC = no-climate-change scenario; Had = Hadley Centre; CSIRO = Commonwealth Scientific and Industrial Research Organization; NCAR = National Center for Atmospheric Research.

Lower food availability and affordability as a result of climate change will increase childhood malnutrition levels. Key nonfood determinants of child malnutrition include the quality of maternal and child care, female secondary education, and access to safe drinking water (Smith and Haddad 2000). Depressed food demand translates into direct increases in malnutrition levels, with often irreversible consequences for young children. Climate change is projected to raise the number of malnourished children in both 2025 and 2050 under climate change, compared with a no-climate-change scenario, with the largest increase under the drier CSIRO scenario (Figure 23).

Figure 23. Number of malnourished children, projected 2025 and 2050, historic climate and alternative climate change scenarios, MENA (thousand children)



Source: IFPRI 2009.
Note: NoCC = no-climate-change scenario; Had = Hadley Centre; CSIRO = Commonwealth Scientific and Industrial Research Organization; NCAR = National Center for Atmospheric Research.

In summary, predicted warming in the MENA region, combined with the high likelihood of overall declines in precipitation, makes the MENA region particularly vulnerable to climate change. Climate change will cause both declines in crop yields as a result of higher temperatures and changes in precipitation; it will also lead to higher prices for traded agricultural commodities, on which the region increasingly relies.

To reduce vulnerability to climate change in the region, general agricultural and economic development initiatives—such as developing agricultural markets, reducing distortions and subsidies in agricultural policies, continuing trade liberalization policies, enhancing social protection and microfinance, and preparing for disasters—will be crucial. In addition, mainstreaming climate change in agricultural policies—for example, through linking yield and water predictions as a result of climate change with ongoing water and agricultural development plans—will be important.

Given the significant risk of droughts in the region, the focus on risk-sharing and risk-reducing investments should be increased. This effort could include assessing the potential for weather-based index insurance, financial market innovations, and enhanced international agricultural trade, including that within the MENA region, to share climate risks. Appropriate agricultural advisory services, hydrometeorological infrastructure, and effective institutions, complemented by broad social safety nets, are necessary to minimize the risks to farmers as they make decisions about agricultural production.

The decline in precipitation in the MENA region may result in higher demand for irrigation water to maintain or increase the level of food production. This demand will impose additional challenges to the already critical water shortages and complex water governance issues experienced in the region. Several countries in the MENA region rely on groundwater mining for their water supply and irrigation. Climate change and variability in water supply, together with potential long-term changes in the cost of energy, could dramatically change the cost–benefit calculus for groundwater pumping and make larger dams more attractive. Overall, climate change will make it even less likely that the region will use water sustainably and will put further pressure on reforming water institutions, particularly for groundwater.

The overall natural resource scarcity in the region will put special demands on new technology development. Developing countries, including those in the MENA region, have chronically underinvested in science, technology, and innovation. At the same time, crop breeding, using biotechnology and genetic modification, will be an essential component of adapting to key biotic and abiotic stresses related to climate change, including drought, heat, and salinity—all of which are set to spread and intensify under climate change in the region. These technologies should be combined with the tapping of traditional knowledge in crop varieties and adaptation.

Foreign Direct Investment in Agriculture

As a response to generally limited agricultural potential and the recent global food price shock, in the past few years—especially after the 2008 food price crisis—an increasing number of countries have been undertaking large-scale investments in land for outsourcing food production. Since 2006, about 15 million to 20 million hectares of farmland in developing countries have been subject to transactions or negotiations involving foreign investors. Many of these deals are initiated by countries in the MENA region. Bahrain, Djibouti, Egypt, Jordan, Libya, Qatar, Saudi Arabia, and the United Arab Emirates have leased or are negotiating land deals of more than 1.6 million hectares of land abroad (Braun and Meinzen-Dick 2009). The rampant inflation in 2008 exposed the vulnerability of import-dependent countries to a volatile international market and raised the prospect of food insecurity for countries in the MENA region without much farmland, such as Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates, which have scoured for land elsewhere. Investment in foreign land was perceived to reduce the amount of cereal that these countries need to import at world prices.

Many governments, either directly or through public–private partnerships and state-owned entities, are in negotiations for, or have already closed, contracts on agricultural land leases, concessions, or purchases overseas (Braun and Meinzen-Dick 2009). In many instances in the MENA region, the government is in charge of negotiating the deals and provides investment incentives to the private sector. Smaller and Mann 2009 provided examples for Saudi Arabia. Saudi Arabia established the "King Abdullah initiative for Saudi agricultural investment abroad," which includes credit facilities to Saudi investors in agriculture abroad. Also, Hail Agricultural Development Corporation, a Saudi company, invested about US$45 million to develop 9,239 hectares of farmland in Sudan for wheat, vegetables, and animals, with the government providing 60 percent of the funding (Reuters 2009). Abraaj Capital, one of the Middle East's largest private equity companies, together with other United Arab Emirates companies and institutions, has acquired 800,000 acres of farmland in Pakistan with backing from the United Arab Emirates.

The scale and terms of deals differ widely, and little is known yet about the actual implementation of many deals. Some agreements have no direct land acquisition but involve securing food supplies through contract farming and investment in rural and agricultural infrastructure, including irrigation systems and roads (Braun and Meinzen-Dick 2009). A lease can be given in exchange for oil contracts or infrastructure investments in the recipient country, including construction of roads, ports, and bridges. Tax incentives, which include tax exemptions on the import or purchase of goods and machinery or income tax relief for investors, are also included in some of the deals.

Proponents of foreign land investment has touted it as a win–win situation. The investor country acquires land and can be guaranteed access to the food produced on it and, at the same time, obtains high

returns on its investment. Meanwhile, the host country gets an infusion of capital to its agricultural sector, as well as benefits from new agricultural technologies and know-how that investors may bring in. Possible benefits for the rural poor are also foreseen; they include the creation of a potentially significant number of jobs and the development of rural infrastructure, as well as poverty-reducing improvements such as construction of schools and health posts. Other supposed gains include future global price stability and increased production of foodcrops that could supply local and national consumers in addition to overseas consumers (Braun and Meinzen-Dick 2009).

However, benefits heavily depend on how investment projects are designed, implemented, and managed. According to the International Federation of Agricultural Producers, foreign investments can be a win–win situation only if increased transparency is practiced in the dealings. As it is, many deals appear murky, and some land acquisitions are made without the consent of local people. Details about the status of deals, the size of land purchased or leased, and the amounts invested are often unclear. There is concern that lack of transparency in negotiations can lead to high levels of corruption and deals that do not maximize the public interest. Furthermore, contracts often have limited information and do not specify the percentage of production for the domestic market and for export. There is also concern on the ecological sustainability of land and water resources slated for foreign investment. Introducing highly intensive farming may lead to degraded soils, dry aquifers, and ruined ecologies due to chemical infestation that will be left for host countries to deal with. Issues also arise concerning the inability of the affected population to defend their interests; land investments can displace smallholder farmers who have weaker bargaining power in negotiating these agreements. Another issue that has been raised is the potential impact on the local food production in the target countries, especially because most of these countries face food security challenges of their own.

In response to these challenges, host countries where MENA countries have secured land are becoming apprehensive about how these land investments are implemented and are questioning how displaced people will actually benefit. Indeed, benefits of these land investments will appear only if host countries have a good, strong contract with foreign investors and if the laws support it. However, land deals are with poor developing countries with weak institutional capacities and frail systems of law. Many of the host countries do not have institutional mechanisms to protect the rights of small-scale farmers, the rights and interests of the local population, or the environment (Cotula et al. 2009).

Several cases suggest that there is a need for more transparency and focus on property rights and resource use conflicts. Examples include a Libyan company, MALIBYA that has been allocated 100,000 hectares of land in the Office du Niger region of Mali, the country's main rice-growing region, as well as in West Macina in Mali's Segou region. The Malian government made this deal as part of its promotion of private investment in rice production. Based on the convention signed by both countries, this strategic project's main objectives are to guarantee both countries' food self-sufficiency, develop agricultural industry, and develop livestock farming. According to the managing director, implementation of the project started more than a year ago and is carried out in different stages, the first of which covers 25,000 hectares of agricultural land. The project will encompass farming (in particular, rice production, with around 200,000 metric tons produced each year), livestock production (with predicted production at 25,000 metric tons of meat a year), and industry (processing factories for agricultural produce, such as for tomato purée, and laboratories). Although Mali's government declares its commitment to guaranteeing food self-sufficiency for the country, concerns are raised that the project's production is primarily to supply Libya's population (Coulibaly and Monjane 2009).

Among the largest deals are by MENA countries, such as Saudi Arabia's acquisition of 500,000 hectares of land in Tanzania and the purchase of 400,000 hectares in Sudan by the United Arab Emirates. In December 2008, Qatar took 40,000 hectares of land from Kenya in exchange for a US$2.5 billion loan to allow Kenya to build a deepwater port. Because of concerns about the implementation of land deals, some projects have sparked strong protests from local smallholders in host countries who claim they are being displaced from land they have farmed for years. The Saudi Binladin Group has been forced to discontinue a US$4.3 billion project to grow rice in Indonesia after violent protests. In Kenya, Qatar is facing an uprising from local farmers who claim the land is theirs. The Food and Agriculture

Organization of the United Nations (FAO) is now pushing investors to support joint ventures with local farmers in poor nations rather than lease or buy land outright. With such an agreement, farmers will remain in control of their land and be able to sell their produce to shareholders at guaranteed prices. Hallam poses that "it's working at arm's length with smallholder groups, still putting in infrastructure and so on, and it's just as reliable with less of the political problems. You get the same results for your food supplies." One country looking into this program is Qatar—particularly Hassad Food, an agricultural firm owned by Qatar's sovereign wealth fund. Hassad Food said that it would buck the land grab trend in favor of taking stakes in farming firms. Its chairman, Nasser Mohamed Al Hajri, said, "We are not deleting the option of buying farmland but we don't feel like it is the right strategy. In many cases these deals are not win–win situations and we don't want to be in a situation where the rich are taking away food and land of the poor" (Bladd 2009). One country looking into this program is Qatar—particularly Hassad Food, an agricultural firm owned by Qatar's sovereign wealth fund. Hassad Food said that it would buck the land grab trend in favor of taking stakes in farming firms. Its chairman, Nasser Mohamed Al Hajri, said, "We are not deleting the option of buying farmland but we don't feel like it is the right strategy. In many cases these deals are not win–win situations and we don't want to be in a situation where the rich are taking away food and land of the poor" (Bakr 2009).

In addition to having potentially negative impacts on hosting countries, investing countries also may not win from foreign direct investment (FDI) in agriculture. If securing food supplies in times of crisis is the main motive for investing countries, serious doubts can be raised about the viability of this strategy. Given that several of the host countries are politically instable and may become even more so in times of crisis, it is not clear that food can be exported from them. A recent example is Madagascar, where even in peaceful times resistance of the local population over agricultural FDI has contributed to a coup d'état. Moreover, it is not clear if agricultural FDI in foreign lands is profitable, especially if led by the public sector. For example, Yemen has farmed in Ethiopia, but it is widely acknowledged today that these operations have been run with huge losses.

From the foregoing discussion, it seems that FDIs in agriculture may not be the best strategy to address food security problems by MENA countries. There is a need for further evidence that such investments have indeed resulted in win–win arrangements for all parties. Some MENA countries are considering whether this type of foreign investment is the right strategy for ensuring food security. What investors actually need is not land per se but the agricultural products of the land, and thus land acquisition may not be necessary. Innovative business models that promote local participation in economic activities may be a better option over land purchases or leases (Cotula et al. 2009). These models include contract farming, outgrower schemes, and joint equity with local communities. With the right public support and investments, small farmers themselves can supply MENA countries and benefit in the process without compromising the host countries' food security or losing their land rights while giving the private sector room to invest. Another option is for MENA countries with larger economies to invest in agricultural research and development of foreign countries over the long term. This investment would be worthwhile given the numerous empirical studies on returns from agricultural research. Estimated rates of return vary widely but are generally high (Alston et al. 2000). Investments in foreign agriculture could increase food security by raising the agricultural productivity of MENA countries' trading partners or potential partners.

Public Health, Education, and Social Policies

Public Health and Education

Addressing population growth is a key challenge for improving food security. Aside from addressing the supply side in the issue of food security, a longstanding issue in the MENA region is that structural factors driving food demand are rising faster in the region than worldwide. Population growth in the MENA region remains high, at 1.9 percent, which is much higher than the world rate of 1.2 percent (World Bank 2009). The region in fact has the world's second-fastest-growing population after Sub-

Saharan Africa (Roudi-Fahimi and Kent 2007). In 1950, the MENA population reached 89 million and then more than quadrupled in 2007 to almost 391 million because of rapidly declining death rates and slowly declining fertility rates (the average number of births per woman in the region). Despite recent fertility declines, the latest population projections for the region show the total reaching nearly 655 million by 2050.10 (Table 9). Moreover, although there is a shift from high to low mortality and from high to low fertility throughout the region, individual countries are at different stages. On average, fertility in MENA declined from 7 children per woman in 1960 to 2.8 children in 2007. The total fertility rate is less than 2.5 in Algeria, Lebanon, Morocco, Tunisia, Iran, Bahrain, Kuwait, United Arab Emirates, and Qatar, and is more than 4 in Iraq, Sudan, and Yemen.

As a consequence of the demographic transition trends, the MENA region is experiencing a fast-growing youth population that requires new educational and job opportunities. The most rapid growth in youth population is in Iraq, Yemen, and West Bank and Gaza, which are also among the countries facing the biggest economic challenges and challenges in preparedness to deal with growing unemployment (Roudi-Fahimi and Kent 2007). Moreover, population growth has aggravated natural resource constraints in the region. Given the limited natural resources and slow overall economic growth in MENA countries, bringing down population growth will have to be an integral part of the food security strategies in many countries.

Table 9. Selected demographic and reproductive health indicators

	Population in thousands			Deaths per 1,000 population		Total fertility rate		Population growth
	1950	2007	2050*	1960	2007	1960	2007	(%)
Food security challenges countries								
Mineral resource rich								
Algeria	8,753	33,853	49,610	20	5	7.3	2.4	1.5
Iraq	5,340	28,993	63,995	16	—	6.4	4.1	2
Libya	1,029	6,156	9,819	19	4	7.1	2.7	1.9
Sudan	9,190	40,432	75,884	21	10	6.6	4.2	2.2
Syria	3,536	20,504	36,911	17	3	7.5	3.3	3.5
Yemen	4,316	22,383	53,689	31	7	8.4	5.5	3.0
Mineral resource poor								
Djibouti	62	833	1,469	25	11	7.8	3.9	1.8
Egypt	21,834	80,061	129,533	19	6	6.6	2.9	1.8
Jordan	472	5,719	10,241	22	4	7.7	3.6	3.2
Lebanon	1,443	4,097	5,033	12	7	5.7	2.2	1.0
Morocco	8,953	30,861	42,583	21	6	7.2	2.4	1.2
Tunisia	3,530	10,225	12,711	19	6	7.1	2.0	1.0

Table 9. Continued

	Population in thousands			Deaths per 1,000 population		Total fertility rate		Population growth
	1950	**2007**	**2050***	**1960**	**2007**	**1960**	**2007**	**(%)**
Food security challenges countries								
Food-secure countries								
Mineral resource rich								
Iran	16,913	71,021	96,975	19	6	7.0	2.0	1.3
Bahrain	116	753	1,277	15	3	7.1	2.3	1.9
Kuwait	152	2,663	5,240	10	2	7.3	2.2	2.4
Saudi Arabia	3,201	24,157	43,658	22	4	7.2	3.4	2.0
United Arab Emirates	70	4,365	8,253	19	1	6.9	2.3	2.7
Qatar	25	1,138	2,316	18	2	7.0	2.4	12.8
Oman	456	2,726	4,878	23	3	7.2	3.1	2.1
MENA*	**89,391**	**390,940**	**654,075**	20	6	7.0	2.8	1.9

Sources: World Population Prospects: The 2008 revision (1960 and 2007); World Bank 2009.
Note: *Not including West Bank and Gaza.

Learning from family planning programs in Western nations may not be applicable to MENA countries due to cultural differences. However, programs in countries with low population growth rates within the region, such as Iran and Tunisia, might provide useful lessons, particularly for MENA countries that continue to have high population rates, such as Yemen, Jordan, and Syria. Family planning programs in these countries could have significant long-term benefits for a range of socioeconomic issues, including food security.

Iran, which has experienced the fastest decline in fertility over the last two decades, is often cited as a success story that can serve as a model for a good family planning program in promoting population stability. As exemplified in Box 1, the changes in Iran have confirmed that committed policy and financial support, easily available family planning services, and strong demand can ensure that the increase in contraceptive use and decline in fertility occur very fast. From the Iran experience, it can be learned that if family planning programs are to succeed in Muslim countries, religion must be addressed carefully and in a culturally sensitive manner. Also, investments in health infrastructure and human development are essential in making family planning programs sustainable (Fahim 2002).

Box 1. Family planning in Iran

Iran has emerged as a model for family planning, particularly for countries that are seeking ways to reduce population growth. Iran has experienced the fastest decline in fertility over the last two decades (United Nations 2009). According to the Iranian Ministry of Health and Medical Education, women went from having about 6.6 children on average to about 2 children between the mid-1970s and 2006. From an all-time high of 3.2 percent in 1986, Iran's population growth rate dropped to just 0.7 percent in 2007. It is important to note that policy played an important role in high population growth, as well as in its reduction. In 1979, at the beginning of the Islamic Revolution, existing family planning programs were removed, as they were seen as undue Western influence. During Iran's war with Iraq, procreation was encouraged by the government to bolster the nation's population. This strong pro-natalist policy led to an annual population growth of about 3 percent from 1980 to 1988. Iran's population doubled in just two decades, from 27 million to 55 million in 1988. By the late 1980s and early 1990s, Iran's rapid population growth was finally seen as an obstacle to development, and the government realized that the costs of this growing population were going to go beyond its capacity to provide adequate food, education, housing, healthcare, and employment. It then embarked on a family planning program to counter the mistakes of the past government policy.

The result has been a successful national family planning program that has drawn international attention because of its innovative structure. The program started in 1989 with goals of encouraging women to wait 3 to 4 years between pregnancies, discouraging childbearing for women younger than 18 or older than 35, and limiting family size to three children. In May 1993, a national family planning law was passed that encouraged couples to have fewer children by restricting maternity leave benefits and withdrawing food coupons and social welfare subsidies after the third child. A nationwide campaign introduced contraceptives: pills, condoms, intrauterine devices, implants, tubal ligations, and vasectomies. Moreover, the law also called for several government ministries to incorporate information on population, family planning, and mother and child healthcare in curriculum materials. For example, university students are required to take a two-credit course on population and family planning. The Ministry of Islamic Culture and Guidance was given the task of allowing the media to raise awareness on population issues and family planning programs, and Islamic Republic of Iran Broadcasting was entrusted with broadcasting such information. Money saved on reduced maternity leave was used for these educational programs. From 1986 to 2005, Iran's total fertility dropped from 7 to 2, which is replacement-level fertility.

Family planning was integrated with primary healthcare. A comprehensive health network made up of mobile clinics and 15,000 "health houses" was established to provide family planning and health services to rural people. Mobile teams that were sent to remote parts of the country offered free, modern contraceptive methods, including vasectomies and tubal ligations, to married couples. The government also had a strong information campaign, which was particularly effective because it was backed by Islamic clerics. Religious leaders have even cited having smaller families as a social responsibility in their weekly sermons and have issued fatwas (religious edicts with the strength of court orders) that permit and encourage the use of all types of contraception, including permanent male and female sterilization. Another unique aspect of Iran's family planning program is promotion of the involvement of men. Iran implements mandatory family planning classes for both men and women before they can receive a marriage license. Iran is the only country in the region that has a state-owned condom factory. Aside from the direct healthcare interventions, a broad-based effort was launched to raise female literacy, boosting it from 25 percent in 1970 to more than 70 percent in 2000.

Population and health experts attribute the program's success to the government's information and education program and to a healthcare delivery system that was able to meet reproductive health needs. Moreover, the program has succeeded in addressing religion carefully and in a culturally sensitive manner.

Sources: Roudi-Fahimi 2002; Larsen 2003; United Nations 2009

Education and Gender

Education and the participation of women in education are important drivers of development. There has been progress in the education of women[10]. Average years of schooling for women increased from 0.5 in 1960 to 4.5 in 1999, and the average literacy rate of women rose from 16.6 percent in 1970 to 52.5 percent in 2000. Female gross enrollment as a percentage of male enrollment has increased from 75 to 90 percent between 1980 and 2000 (World Bank 2004b). However, women remain a largely untapped resource for economic development and represent only 28 percent of the workforce. Women have played a vital role in emerging industries throughout history, from industrial countries a century ago to the more recent emerging Tiger States in Asia (World Bank 2004b). In the business world, companies benefit from diverse workforces, and diversity has become a key driver of competitiveness and innovation (World Bank 2004b).

Education is also important for improving food and security. For example, studies in Egypt and Mozambique (Datt and Jolliffe 1998; Datt, Simler, and Mukherjee 1999) show that ensuring that mothers finish primary school reduces the proportion of the population below the poverty line by 33.7 percent and 23.2 percent, respectively. In both of these country studies, female education had a much larger impact on poverty than did other factors, including male education. Other studies suggest that reducing gender gaps in schooling and in the control of agricultural resources by men and women in Sub-Saharan Africa has the potential to increase agricultural productivity by 10–20 percent (Udry et al. 1995; Quisumbing 1996).

The strong relationship between gender inequality and hunger suggests that reducing gender disparities in key areas, particularly in education and health is essential to reduce levels of hunger. Undernourishment and child malnutrition levels in many MENA countries remain high, especially in Sudan, Yemen and Djibouti. Even in countries with relatively high per capita incomes, child malnutrition remains about 5 percent, such as in Syria, Egypt and Morocco (Table 10). The following discussion addresses each of the subindexes of the Gender Gap Index according to the strength of its association with the GHI and proposes strategies that can contribute to reducing gender inequalities and to eliminating hunger. Box 2 gives two examples of how MENA countries have fared in terms of improving gender equality (Box 2).

Table 10. Nutrition and child mortality (Global Hunger Index [GHI])

	Proportion of undernourished in the population (%)	Prevalence of underweight in children younger than 5 years (%)	Mortality rate, children younger than 5 years	GHI
Food security challenges countries				
Mineral resource rich				
Algeria	3.0	3.0	3.7	<5
Iraq	n/a	7.1	4.4	n/a
Libya	2.0	2.9	1.8	<5
Sudan	21.0	27.0	10.9	19.6
Syria	4.0	10.0	1.7	5.2
Yemen	32.0	41.6	7.3	27.0
Mineral resource poor				
Djibouti	32.0	24.0	12.7	22.9
Egypt	3.0	6.0	3.6	<5
Jordan	4.0	3.6	2.4	<5
Lebanon	2.0	3.5	2.9	<5

[10] This section is drawn from von Grebmer et al. 2009.

Table 10. Continued

	Proportion of undernourished in the population (%)	Prevalence of underweight in children younger than 5 years (%)	Mortality rate, children younger than 5 years	GHI
Mineral resource poor (Continued)				
Morocco	4.0	9.9	3.4	5.8
Tunisia	1.0	2.6	2.1	<5
West Bank and Gaza	n/a	n/a	n/a	n/a
Food-secure countries				
Mineral resource rich				
Iran	4.0	6.2	3.3	<5
Bahrain	n/a	4.5	1.0	n/a
Kuwait	5.0	0.5	1.1	<5
Saudi Arabia	1.0	5.3	2.5	<5
United Arab Emirates	n/a	n/a	n/a	n/a
Qatar	n/a	n/a	1.5	n/a
Oman	n/a	8.8	1.2	n/a

Source: von Grebmer et al. 2009

Box 2. MENA country examples

The positive end of the MENA spectrum: Kuwait

Kuwait has demonstrated greater progress than other countries in the region in improving the status of women and ensuring gender equality. This progress is reflected in its first-place rank in the 2008 Gender Gap Index, for it has successfully closed much of the gender gap in education and economic participation and opportunity. Compared with other countries in the region, in Kuwait women have high rates of participation in the labor force, enjoy significant protections against discrimination, and can readily gain access to educational opportunities (UNDP-POGAR 2009). Women constitute two-thirds of university-level students, a situation that increases their status and better equips them to exploit economic opportunities.

The negative end of the MENA spectrum: Yemen

In a region characterized by relatively low hunger, Yemen is an outlier with an alarming 2009 Global Hunger Index (GHI) score. It is not surprising that Yemen's performance on the 2008 Gender Gap Index is abysmal. Yemen has ranked last on the Gender Gap Index for the past three years and is the only country in the world to have closed less than 50 percent of its gender gap. High rates of illiteracy, limited access to reproductive health services and family planning, and the enormous gender disparities in education and literacy have a detrimental impact on both hunger and gender disparities.

General trends in the Middle East and North Africa are similar to those observed in Sub-Saharan Africa and South Asia. Although the countries included in this region have among the lowest levels of hunger compared with the other countries assessed, the negative correlation between the 2009 GHI and the 2008 Gender Gap Index still holds—hunger levels are higher in countries with wider gender gaps. In fact, all but one of the countries in the region rank in the bottom quartile for the 2008 Gender Gap Index. These data corroborate the association between increasing hunger and increasing gender disparities, even in a region that overall experiences lower levels of hunger.

As in Sub-Saharan Africa and South Asia, the strongest correlation between the 2009 GHI and the 2008 Gender Gap Index is observed for the education subindex. The GHI for countries in the Near East and North Africa tends to increase as gender gaps in educational attainment increase. Across the region, Morocco and Yemen have the highest 2009 GHI scores and the lowest scores on the education subindex of the 2008 Gender Gap Index.

Sources: von Grebmer et al. 2009.

Lessons can be learned from countries that successfully narrow the gender gap. Countries have continued to explore new mechanisms to reduce gender disparities in education by (1) reducing the price of schooling and increasing physical access to services, (2) improving the design of education delivery, and (3) investing in time-saving infrastructure (King and Alderman 2001). Parents' decisions to invest in girls' education is more sensitive to the price of education than are their decisions to invest in boys' education. Thus, reducing the costs parents pay to send their daughters to school is one way to reduce the gender gap in schooling. Mexico's national program Oportunidades (previously called PROGRESA, for Programa de Educación, Salud y Alimentación), in which cash transfers are conditioned upon school attendance and health visits, has successfully increased girls' enrollment and is being replicated and adapted worldwide (Skoufias 2005). Bangladesh's food- and cash-for-education programs, as well as stipend programs, have helped increase girls' enrollment rates and close the gender gap in primary schooling (Ahmed and del Ninno 2002). In Malawi, conditional cash transfers are being piloted as a way to keep girls in school and delay the onset of risky sexual behavior that could expose them to HIV and AIDS (Ozler 2007).

Improving education delivery also means improving the quality, gender balance, and attitudes of teachers. In Kenya, studies based on household survey data show that the attitudes and quality of teachers affect the demand for girls' schooling more than that for boys (Mensch and Lloyd 1998). Changing attitudes among parents, teachers, and principals will require long-term efforts. To this end, training staff and reviewing and revising school curricula play important roles in ensuring that gender stereotypes are not perpetuated in the classroom. Schools also need to be safe places for children, especially girls, to learn. It is important to work at a policy level, and with teachers and parents, to ensure that both the school and the route to school are free from violence in all its forms so that girls can enroll in and complete a course of high-quality education while attaining the best possible grades.

Investments that reduce distance to school can help female enrollment rates in part by reducing the opportunity cost of schooling for girls. Similarly, increasing access to local healthcare facilities reduces the time women and girls need to spend on in-home care for sick family members. Equally important are investments in basic water and energy infrastructure. In most settings, collecting water and fuelwood is largely the responsibility of women and girls. In Ghana, Tanzania, and Zambia, two-thirds of those undertaking these tasks are women—indeed, mostly girls. They spend between 5 and 28 percent of household time in water and fuel collection (World Bank 2001). Investments in time-saving infrastructure benefit all household members and girls in particular. Low-cost childcare can help both mothers and daughters. In Kenya, a 10 percent reduction in the price of out-of-home childcare increased the demand for such care and increased mothers' participation in the labor force. Low-cost childcare can also increase girls' school attendance: in rural and urban Kenya, a 10 percent decrease in the price of out-of-home care would be expected to result in a 5.1 percent increase in the enrollment rates of 8- to 16-year-old girls (after controlling for other factors) while having no effect on the enrollment rate of boys (Lokshin, Glinskaya, and Garcia 2000).

Another strategy is to invest in women's health and nutrition throughout their life cycle and to empower women to seek better care for themselves and their children. Women's health and nutritional status is important for both the quality of their lives and the survival and healthy development of their children (Gillespie 2001). Because women's health and nutrition is a life-cycle issue, interventions must attend to female malnutrition from adolescence through pregnancy and lactation to the promotion of growth of the newborn child on into the preschool years, school years, and adolescence. Direct actions to improve women's health and nutrition complement the struggle to achieve the long-term goals of gender equity and women's empowerment. Direct nutrition action must focus on both macronutrients and micronutrients, particularly iron; on energy intake and energy expenditure; on disease prevention; and above all, on strengthening the capacity for, and practice of, caring for women and adolescent girls. Efforts are needed to space births in order to prevent maternal nutritional depletion, which is now widespread. Mothers need a recuperative interval of at least 6 months following cessation of breastfeeding. Accessible, good-quality prenatal and postnatal services run by supportive workers are

vital to early registration of pregnant women, counseling on nutrition and reproductive health, and access to contraception. Adolescent pregnancies need priority attention.

Perhaps the best-known example of interventions that directly aim to increase women's access to markets is the microfinance movement in Bangladesh. A number of nongovernmental organizations in Bangladesh have attempted to improve women's status, and the well-being of children in their households, by directing credit to women. Microfinance programs have now been launched worldwide.

Legal systems should be reformed to eliminate gender discrimination and increase political participation. Policy reform to eradicate gender discrimination promotes gender equality by creating a level playing field for women and men. The strengthening of democratic institutions through legislation, the rewriting of constitutions so that they explicitly disavow discrimination, and reforming and enforcing an antidiscriminatory rule of law are important steps toward achieving this goal. Improving women's political voice and participation, particularly at local levels, is vital to any fundamental shift in women's status. Creating a level playing field is not enough, however, when women are extremely disadvantaged because of lower educational attainment, poorer health, less representation at both national and local levels, lower levels of economic participation, and other manifestations of the power imbalance, including gender-based violence. Thus, efforts to remove discrimination need to be accompanied by specific interventions to target resources to women, to build their skills and confidence to participate in the public sphere, and to enable them to take advantage of new opportunities that may be created. Involving more women in development processes will require special outreach and training for poorer and less-educated women and for those who hesitate to voice their needs in front of men for cultural reasons.

The evidence clearly shows that gender inequality goes hand in hand with hunger in many countries. Fortunately, this evidence also points to a clear avenue for reducing hunger by improving women's educational attainment, economic participation, health status, and political empowerment. Many successful interventions in these areas have already been initiated. Many more innovations will be needed, however, to unleash women's potential to make significant contributions to the food security and well-being of their families.

Social Protection and Transfer Programs

Social protection programs (SPPs) can provide important safety nets for the poorest of the poor. SPPs can take various forms, such as transfers of cash through welfare payments, child allowances, or pensions; in-kind transfers such as food aid or school feeding programs; subsidies on goods purchased by the poor; unemployment insurance; and public works or workfare schemes (Alderman and Hoddinott 2009). Recent innovations in SPPs include the means to improve targeting (such a proxy means testing) and the means to increase the impact of transfers on capital creation (for instance, through conditional cash transfer [CCT]12 schemes and interventions that link recipients of cash or food payments to other government services and public works programs).

SPPs can also cushion the impacts of economic shocks and therefore protect the most vulnerable. During the recent 2007–2008 food crisis, MENA countries implemented various economywide policies, such as export restrictions and tax reductions on foodgrains. SPPs, such as cash transfer, food-for-work, food rationing, and school feeding programs, were also implemented or expanded in response to the food price shock to cushion its effect on the populace (Table 11). For instance, Egypt expanded its small cash transfer program, and Yemen and Jordan attempted to expand and reform their respective targeted cash transfer programs. SPPs are targeted toward the poor or those individuals who may become poor as a result of adverse shocks. They have, in particular, a triple role in responding to rising food and fuel prices: (1) forestalling to a degree the increases in poverty and inequality that the change would bring; (2) helping households maintain access to food, energy, and essential services for health and education; and (3) when perceived as fair and compensatory, playing an important role in maintaining social equilibrium and in avoiding less efficient tax, subsidy, trade, or production policies, some of which can even aggravate the problem (World Bank 2008).

Table 11. Various economywide policies and existing social protection programs of MENA countries to address recent price shock

Country	Economywide policies				Existing social protection programs			
	Reduction in taxes on foodgrains	Increase in supply using foodgrain stocks	Export restrictions	Price controls/ consumer subsidies	Cash transfer	Food for work	Food ration/ stamp	School feeding
Egypt			√	√	√		√	
Morocco	√	√		√				√
Tunisia	√	√		√	√			
Yemen		√	√	√	√			
Lebanon	√			√				√
Syria	√	√		√	√		√	√
Jordan	√			√	√			√
West Bank and Gaza	√				√		√	√
Iraq	√	√	√	√	√		√	
Djibouti	√			√		√		√

Source: World Bank, FAO and IFAD, 2009.

Although MENA countries have made some progress in setting up and improving SPPs, they are still lagging behind other regions. Many countries in the MENA region focused more on providing food subsidies, imposing price controls, and cutting import duties during the food price crisis and had limited use of school feeding and cash transfer programs (see Table 11). However, having well-designed and well-implemented SPPs is the best primary approach to addressing the poverty implications of rising prices; other approaches, such as reducing taxes or increasing subsidies, are often more costly and can have undesirable efficiency and fiscal impacts (World Bank 2008). However, most SPPs in the MENA region—particularly cash transfer programs—are small, (about less than 1 percent of the GDP). Egypt spent less than 0.1 percent of the GDP on cash transfer assistance in 2005; Morocco spends about 0.6 percent of its GDP on cash transfers; and the National Aid Fund in Jordan accounted for between 0.6 and 0.7 percent of GDP between 2002 and 2005 (World Bank, FAO, and IFAD 2009).

Existing social assistance programs are often not well embedded in the context of an integrated social protection strategy. Little or no coordination among the institutions involved in the implementation of these programs exists, and most programs are not appropriately monitored, targeted, or evaluated (World Bank 2005). A question regarding the effectiveness of the current SPPs in the MENA region also emerges: Are they reaching the poor and vulnerable? The programs mostly use categorical targeting approaches (for example, categories such as single mother, widow, unemployed, elderly, or disabled) (World Bank, FAO, and IFAD 2009). As such, they are not primarily for the poor and do not essentially cover the poorest in the nation. For instance, Egypt's social-assistance program covers less than 12 percent of the poor and had an estimated benefit leakage rate to the nonpoor of 48–60 percent in 2008 (World Bank, FAO, and IFAD 2009). The 1995 Social Welfare Fund cash transfer program in Yemen reached only 13 percent of the poor population. In fact, 70 percent of those who received transfers were not in the target group. The National Aid Fund in Jordan was able to cover less than 20 percent of the eligible population in 2005. Of those who received aid, only 14 percent were actually eligible (World Bank, FAO, and IFAD 2009).

Improvement in targeting the poor is therefore a priority to improve food security. Further research is needed in evaluating and designing SPPs in the MENA region, such as cash-for-work and schooling programs. Social protection strategies should be designed to mitigate the current shock for the

most vulnerable, as well as to prevent negative impacts in the future. Nutrition interventions, such as school feeding programs and programs for early childhood and maternal nutrition, should be strengthened and expanded to ensure universal coverage.

MENA countries can also consider exploring conditional cash transfer programs following properly evaluated pilots. Several evaluation studies on CCT programs, particularly condition transfers to households based on their meeting certain requirements such as sending children to school, have shown the benefits of such schemes. These programs can be used to reduce current poverty and, at the same time, to improve human capital formation and consequently help prevent the intergenerational transmission of poverty (Adato and Hoddinott 2009). These programs work particularly well in countries with low levels of school attendance and an adequate schooling infrastructure. The CCT program Red de Proteccion Social of Nicaragua increased school enrollments by nearly 22 percentage points. Mexico's former PROGRESA (now Oportunidades) increased enrollment in secondary school by 6 percentage points for boys and 9 percentage points for girls. PROGRESA also had significant effects on health and nutrition. Health visits rose by 18 percent in PROGRESA localities, and illnesses among PROGRESA children 0–5 years old decreased by 12 percent. In addition, stunting was significantly reduced by 10 percentage points. A study of Oportunidades also found that beneficiaries invest just more than 10 percent of their transfers and that this leads to sustained increases in per capita consumption in the following five years (Alderman and Hoddinott 2009).

Reforming inefficient food and fuel subsidies and designing targeted SPPs can help reduce vulnerability to shocks and improve food security. Many MENA countries still rely on subsidy schemes, which often disproportionately benefit individuals who are better off. Examples include food subsidies for urban retail markets (Egypt), subsidies on imported materials for food processing (Morocco), and large fuel subsidies for transport and irrigation (Yemen).

The high population growth in the MENA region is a key challenge for improving food security, as it influences food demand. Moreover, population growth has aggravated natural resource constraints in the region. Given the limited natural resources and slow overall economic growth in MENA countries, bringing down population growth will have to be an integral part of many countries' food security strategies. Programs in countries within the region with low population growth rates, such as Iran and Tunisia, might provide useful lessons particularly to MENA countries that continue to have high population rates, such as Yemen, Jordan, and Syria. As illustrated in Iran, religion must be addressed carefully and in a culturally sensitive manner for planning programs to be successful. Also, investments in health infrastructure and human development are essential in making family planning programs sustainable.

The MENA region is experiencing a fast-growing youth population that requires new educational and job opportunities. There is wide evidence that female education matters for poverty and food security. Also, the strong relationship between gender inequality and hunger suggests that reducing gender disparities in key areas, particularly in education and health is essential to reduce levels of hunger. Strategies that can contribute to reducing gender inequalities and eliminating hunger, such as cash transfers conditioned upon school attendance and health visits, need to be explored.

Even though MENA countries have some SPPs in place, there is limited use of school feeding and cash transfer programs. Cash transfer programs are small and not primarily targeted to the poor. Improvement in targeting the poor is therefore a priority to improve food security. Conditional cash transfer programs contingent on school attendance are particularly promising, as they address education and nutrition. Further research is needed in evaluating and designing SPPs in the MENA region. Social protection strategies should be designed to mitigate the current shock for the most vulnerable, as well as to prevent negative impacts in the future.

4. SUMMARY AND POLICY RESEARCH AGENDA

The MENA region faces a number of distinct and interlinked food security and development challenges. This paper presented a new typology for MENA countries and structured the discussion on food security according to macro- and household-level food security and along the three sector groups most relevant for food security.

We classify countries according to their mineral wealth and food security status (at both the macro and household levels). According to this typology, *mineral resource–rich countries with food security challenges* are Algeria, Iraq, Libya, Sudan, Syria, and Yemen. *Mineral resource–poor countries with food security challenges* are Djibouti, Egypt, Jordan, Lebanon, Morocco, Tunisia, and West Bank and Gaza. All other countries in MENA are considered food secure. Achieving food security and economic development is closely linked, and progress hinges on macroeconomic stability; broad-based growth; and advances in the trade and infrastructure, water and agriculture, and public health and education sectors.

The oil and gas sectors and related spending dominate the domestic economies of most mineral-rich countries, either directly through oil exports (mineral-rich countries) or indirectly through remittances from oil-exporting countries (to mineral-poor countries). While pro-poor growth remains the single most important driver for improving food security, job-creating economic diversification and export-led manufacturing—key for success in Asia—have been slow. The manufacturing sector continues to constitute a small share of GDP (average 11 percent) in the MENA region, especially in mineral-rich countries with food security challenges (6 percent). The manufacturing sector is biggest in Egypt, Tunisia, Jordan, Morocco, and Iran (between 14 and 18 percent of GDP), yet these shares have stagnated over the past decades except in Tunisia. Agricultural growth in MENA has been mainly driven by productivity growth in Egypt, Iran, and Sudan over the past two decades. This growth was driven by higher labor productivity, that is, a reduction of workers per hectare and the use of fertilizers and tractors.

Poverty levels remain high, and people in the MENA region are vulnerable to falling back into poverty. Twenty percent of people in the region live below US$2 a day. Reduction in poverty has been slow in Algeria and Morocco, and the poverty rate has actually increased in Yemen, Djibouti, and Sudan. In absolute numbers, the number of poor in MENA has increased. The 2007–2008 global food crisis and the subsequent global recession have further affected the region's poor, mainly through increased food prices, reduction in remittances, and reduction in export earnings. A decrease in income by only US$0.50 per day almost doubles the number of poor in Egypt, Morocco, and Jordan. The majority of the poor continue to live in rural areas, where 50 percent of the population resides in MENA countries with food security challenges, compared with 40 percent in other MENA countries.

MENA is the most oil-dependent region in the world for its exports (70 percent) and the most food import–dependent region in the world, importing 50 percent of regional food consumption. The region's food trade deficit will further rise in both mineral-rich and mineral-poor countries because of increasing food demand and severe supply-side constraints. Generally low trade diversification makes the region vulnerable to economic shocks. Despite the heavy reliance on trade, protection remains at high levels, especially in some mineral-poor countries such as Egypt, Morocco, and Tunisia. Studies on the impacts of multilateral trade liberalization on several MENA countries show mixed results on poverty, but they suggest that complementary policies and institutional reform are needed to achieve the benefits of stronger world market integration.

MENA is also the most water-scarce region in the world and will be hard hit by climate change. Agriculture contributes 12 percent to the MENA economy but uses 89 percent of the water. Thus, growing pressure on limited water resources from nonagricultural sectors poses important questions on the trade-offs between agricultural, industrial, and residential uses and the possibility of increasing the efficiency of water use. Per capita water availability in MENA is already the lowest in the world regions, with an average of 757 cubic meters (or 1/10th of the global average); water availability is especially low in Egypt, Libya, Jordan, and Algeria. Population growth alone is projected to reduce the availability to

400 cubic meters by 2050, and climate change will further reduce water availability by most projections. Technological innovations, subsidy reforms and incentives for sustainable water use, improved water management and institutions, and additional investments will be important elements for a water reform agenda.

The major constraint for agricultural development is water; significant potential for irrigation remains in a few countries, such as Iran, Iraq, Sudan, and Syria. Even during the past two decades, agricultural productivity growth has been dominated by a few countries, including Egypt, Iran, and Sudan. Agricultural growth potential exists, yet the unsustainable use of natural resources (especially water), climate change, and continued population growth pose severe challenges for keeping up per capita production levels. In light of these challenges and as a direct response to the global food price crisis in 2007–2008, several MENA countries have started to initiate FDIs in Africa and Asia. However, it is not clear that FDIs are beneficial for either the host or the investing country. Given that several of the host countries are politically instable, it is not clear that exporting food from these countries, especially in times of crises, is a viable strategy. Moreover, it is not clear whether FDI in agriculture in foreign lands is a profitable activity, especially if led by the public sector. There is also a need for further research on how these deals can contribute to economic development and food security in host countries.

Major public health, education, and social policy challenges include population control, empowerment of women, and the reform of subsidy schemes. The MENA population is projected to double by 2050 to reach nearly 655 million, and unemployment is high and increasing. Several countries in the region— such as Algeria, Tunisia, Iran, and several Gulf States—have been successful in reducing fertility rates. Iran is often cited as a successful case; a population control program with enforcement mechanisms and an integration of family planning into primary healthcare have reduced population growth from 3.2 to 0.7 percent within 20 years. Despite progress in enrollment rates, women remain a largely untapped source for spurring economic development in many MENA countries. Women have also been pivotal for improving family nutrition and children's health in many world regions. According to the IFPRI's GHI, the MENA region was the only world region that showed an increase in the proportion of undernourished people over the past decade. Finally, MENA countries maintain a high level of subsidies on oil and food. Yet many studies have shown that fuel and food subsidies mostly benefit the well-off and are not suitable tools to target the poor and food insecure. An alternative to subsidies are conditional cash transfer programs. However, existing social transfer programs are often not well targeted to the poor, and better targeting and scaling up of these programs can improve food security.

One of the objectives of this paper has been to identify interlinked food security and development challenges for the MENA region. We have also offered several suggestions on how to improve food security and accelerate development based on other regions' experience and the literature, but more research is needed to tailor policy and investment recommendations to country-specific circumstances. In the following lists, we therefore outline several research areas to conclude this paper.

Growth and Incomes

- *Pro-poor growth and food security:* Agriculture can play an important role in food security in some MENA-FSC countries, on both the macro and household levels. However, nonagricultural growth in labor-intensive and rural industries will have to provide incomes for the growing pool of young unemployed people. Research can help assess country-level growth options and thus support the design of country development strategies.
- *Investment priorities:* Investments in agriculture have been declining in MENA-FSC countries. Analyzing returns to different types of investment in both agriculture and nonagriculture can help identify the allocation of resources in terms of growth, food security, and poverty reduction.
- *Poverty and nutrition:* Research can help identify pathways out of poverty and food insecurity , as well as evaluate and design programs to overcome child malnutrition and nutrition deficiencies.

- *Migration and remittances:* The MENA food-secure high-income (FSHI) countries are host countries for millions of migrant workers from MENA-FSC, South Asia, and other world regions.
- *Institution building:* Research on reform processes of ministries that are related to food security and are in charge of agriculture and food and water resources can help make these institutions more effective and efficient in providing agricultural infrastructure and services such as irrigation and agricultural extension.
- *Political economy:* research can identify obstacles and constraints to reform and evaluate more targeted alternatives to subsidies that have proved successful in other world regions, such as cash-for-work and schooling programs.

Trade

- *Management of future food price shocks:* MENA countries are re-examining their food security strategies to provide sustainable access to food for their people in the future. Reducing food imports significantly by increasing agricultural production is feasible in only a few countries. Research can help MENA-FSC countries make strategic choices among investing in agriculture, keeping stock, hedging on international markets, and other actions.
- *Opportunities from regional and global trade integration:* Global and country-level models can help assess the impacts of trade agreements on growth, food security, and poverty.
- *Food–energy price links:* The 2007–2008 global food crisis has highlighted how sensitively global food markets react to changes in oil prices and how "panic purchases" from net food importing countries can exacerbate food crises. The fact that the MENA region holds about 60 percent of global oil reserves and is the most food import–dependent region in the world underlines the region's importance for the global food situation and its role as a major player in global markets.
- *Foreign direct investment in agriculture:* The policies and investments of MENA countries also directly affect developing countries in other world regions. Research can contribute by designing win–win "land grab" deals that are pro-poor and include technology spillovers for the host countries.

Agriculture, Water, and Natural Resources

- *Water and land resources:* Research can help assess the trade-offs of water use in rural and urban areas and find ways to improve water management and efficiency.
- *Adaptation and mitigation strategies to address climate change:* To effectively deal with climate change risks in the region, a mix of adaptation strategies (which reduce the vulnerability of the poor to climate change and other shocks) and mitigation strategies (which lessen the impact of climate change after it has occurred) are needed.
- *Emergencies:* Research on emergency response to crises and natural disasters in fragile states will be important for MENA-FSC countries, in many of which flooding and other disasters have become more frequent in the recent past.
- *Postconflict situations:* Several MENA-FSC countries, such as Iraq, Lebanon, Sudan, Yemen, and West Bank and Gaza, are either at war or in a postconflict situation. The MENA region in general is vital for global security. Thus, research on future food crises and potential future conflicts for water and other resources can make an important contribution.
- *Climate change:* Adaptation and mitigation strategies to address climate change will be very important for MENA and other regions. Research can help find ways to effectively deal with climate change risks in the region. It can also identify the right mix of adaptation and migration strategies. Adaptation strategies reduce the vulnerability of the poor to climate change and other shocks, and mitigation strategies lessen the impact of climate change after it has occurred.

- *Innovation in energy and agriculture:* Several MENA-FSHI countries are committed to investing in renewable energy and water efficiency solutions for the future. These innovations could have important spillover effects for developing countries.

Public Health, Education, and Social Policies

- *Population growth:* Region-specific strategies for reducing population growth will be key for improving food security in MENA.
- *Maternal health:* Research on how to improve maternal and child health can make an important contribution to short-term reduction in child malnutrition and long-term development in the region.
- *Poverty and nutrition:* Research can help identify pathways out of poverty and food insecurity and evaluate and design programs to overcome child malnutrition and nutrition deficiencies.
- *Social protection:* Evaluating SPPs such as cash-for-work and schooling programs can help in making strategic choices in country-specific program design.
- *Food quality and safety:* MENA-FSHI countries face important questions on food quality standards that benefit consumers and food importers.

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