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Food Security Strategies in the GCC Countries[1] [2][3]

Arab Gulf countries are heavily dependent on food imports. This dependency is expected to continue to rise as a result of rapidly growing populations, improving living conditions, sustained economic/industrial development and depleting natural resources. Moreover, climate change is expected to have a major effect on the region. To meet their food needs, Gulf countries must rely on international markets, which makes them vulnerable to the vagaries of global food production, trade policies and commodity prices. This is exemplified by the food crisis of 2007/2008, which led Arab Gulf countries to adopt strategies that include building up national strategic food reserves, scaling up subsidies, and acquiring land abroad for agricultural investments through bilateral deals. These measures may have some drawbacks in the longer term; e.g., prices remaining volatile, socio-economic disturbances impacting land deals, trade being affected by international events or

[1] This paper was prepared by a joint ESCWA-IFPRI team composed by Vito Intini (Team Leader), Clemens Breisinger, Ivana Brnovic, Fidele Byringiro, Olivier Ecker, and Kenneth Iversen, under the overall guidance and leadership of Nadim Khouri. Michelle Battat (FAO) and Arani Kajenthira (Harvard Kennedy School) provided valuable advice and insightful contributions.

2 This Paper was presented by Mr. Nadim Khouri (Deputy Executive Secretary, United Nations Economic and Social Commission For Western Asia UN-ESCWA) at the Emirates Center for Strategic Studies and Rerearch 17th Annual Meeting"Watter & Food Security in the Arabian Gulf" - AbuDhabi, United Arab Emirates on March 27, 2012.

3 The paper was not edited or revised (to be kindly inserted by CSS)

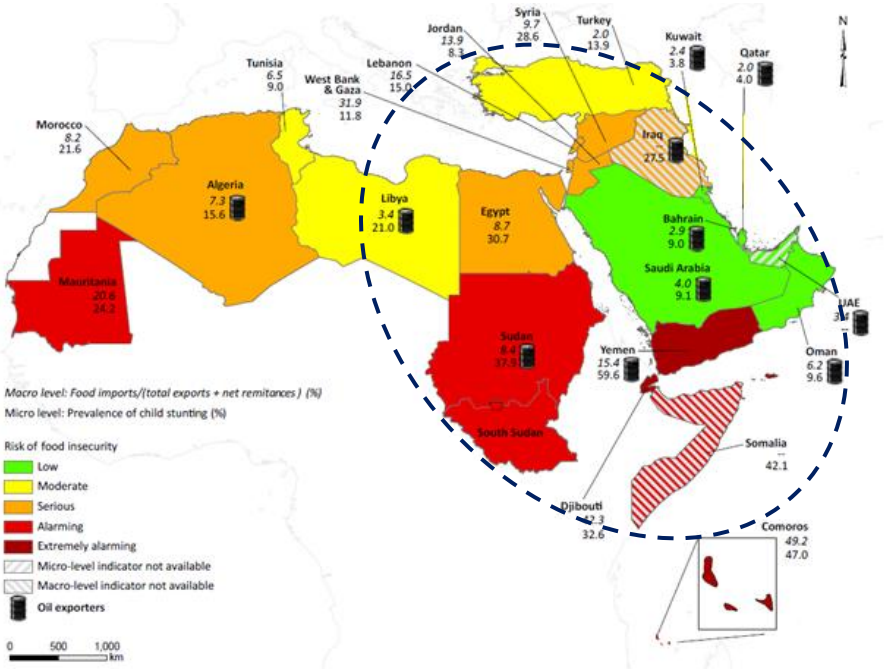
conflicts, etc. What is needed is perhaps a multi-pronged food security strategy that builds on elements of the above measures while integrating them in a GCC-wide approach. The analysis contained in this paper leads into a number of promising strategic directions including: (i) assessing the pros and cons of building a regional food reserve to reduce the risk of market disruptions; (ii) investigating challenges and opportunities for a region-wide procurement system based on innovative financial instruments; (iii) consolidating agricultural R&D systems and enhancing their impact; and (iv) achieving more efficient water use through assessing water footprint of production, consumption, and trade patterns. Other crucial elements of a comprehensive food security strategy not specifically addressed in this paper are: the analysis of food subsidy and social protection reform options; promoting comprehensive agricultural and economic development in the areas where comparative advantages lie; and encouraging changes in consumption preferences and nutrition patterns. In addition, given GCC countries' reliance on food production from (often developing) countries with large agricultural potential, smart and cost-effective strategies should be examined on how GCC countries can best engage with such countries.

Background

At a first glance, the Arab Gulf states[1] do not seem to have major food security problems. A recent food policy report produced by the International Food Policy Research Institute (IFPRI) classifies them all as countries with a low risk of food insecurity in comparison to the rest of the region (Figure 0.1).[2] This is because all GCC countries show a relatively strong export performance (especially in terms of oil) compared to the demand for food imports, high and growing per capita incomes, and relatively low levels of malnutrition in the international comparison.

Figure 0.1

Food Security in the Arab World and Turkey



Source: Breisinger, et al., 2012.

However, when looking behind the aggregate numbers, GCC countries are affected by some "vulnerabilities," especially in a more volatile world, including high levels of food import dependency and a low share of agricultural production.

Total regional consumption of main food produce such as staples, fruits and vegetables (F&V), meat, eggs, fish, dairy, sugar, and oil has regularly increased from less than 31 million metric tons (mt) in the period 2000–2005 to about 35.5 million mt in 2008, with the share of consumption of cereals hovering at around 44 percent of total GCC food consumption,[3] compared to 26 percent of F&V, and 14 percent of dairy products.[4] Wheat and rice dominate within the region's cereal consumption patterns.[5] Self-sufficiency ratios are higher in the meat, dairy, and F&V sectors, which also tend to be characterized by less volatile markets.

Table 0.1

GCC Food Balance in 2008

	SSR (%)	Available for consumption	Balance		Imports		Exports		Production
ITEM		Qty	Value	Qty	Value	Qty	Value	Qty	Qty
Cereals (total)	**15.9**	**15,760.5**	**3,940.4**	**13,251.3**	**4,082.1**	**13,798.8**	**141.7**	**547.6**	**2,509.3**
Wheat and flour	**59.2**	3,358.5	440.9	1,378.8	509.8	1,587.5	68.9	137.9	1,989.7
Maize	**7.6**	2,322.9	537.4	2,147.3	541.3	2,162.2	3.9	14.9	175.6
Rice	**0.0**	2,270.8	1,583.2	2,270.8	1,624.5	2,349.3	41.2	78.6	0.0
Barley	**0.4**	7,692.9	1,392.3	7,662.7	1,394.9	7,675.9	2.6	13.2	30.2
Potatoes	**74.3**	**657.8**	**66.3**	**169.1**	**82.1**	**224.8**	**15.8**	**55.7**	**488.8**
Pulses (total)	**1.7**	**127.9**	**63.5**	**125.7**	**77.4**	**147.3**	**14.0**	**21.6**	**2.2**
Vegetables (total)	**70.3**	**4,869.3**	**513.5**	**1,447.6**	**616.8**	**1,664.5**	**103.3**	**198.9**	**3,421.7**
Fruits (total)	**65.1**	**4,294.8**	**924.9**	**1,500.8**	**1,089.7**	**1,852.0**	**164.8**	**351.3**	**2,794.0**
Sugar (refined)	**0.0**	**1,757.8**	**624.5**	**1,757.8**	**1,172.9**	**2,859.4**	**548.4**	**1101.7**	**0.0**
Fats & oils (total)	**0.4**	**495.7**	**340.2**	**258.1**	**674.5**	**580.1**	**334.4**	**322.4**	**2.0**
Meat (total)	**44.4**	**1,933.9**	**1,900.5**	**1,077.1**	**2,045.9**	**1,153.0**	**145.4**	**75.9**	**857.8**
Red meat	**40.2**	435.2	740.5	260.4	786.0	285.1	45.4	24.7	174.8
Poultry meat	**45.5**	1,498.7	1,160.0	816.7	1,259.9	867.9	99.9	51.2	682.0
Fish	**81.7**	**461.1**	**145.4**	**84.2**	**430.3**	**202.6**	**284.9**	**118.4**	**376.9**
Eggs	**89.6**	**259.8**	**92.4**	**27.0**	**130.4**	**59.9**	**38.1**	**32.9**	**232.8**
Milk & dairy prod.	**25.1**	**4,899.7**	**1,788.6**	**3,669.8**	**2,392.4**	**5,052.6**	**603.8**	**1382.8**	**1,229.8**
TOTAL	**33.5**	**35,518.3**	**10,400.2**	**23,368.5**	**12,794.5**	**27,595.0**	**2,394.6**	**4,209.2**	**11,915.3**

Notes: Qty (thousand mt); value (million USD); self-sufficiency ratio (SSR) is the ratio between domestic production and availability.

Source: staff calculations from Arab Organization for Agricultural Development, "Arab Agricultural Statistical Yearbook," 2009.

Agriculture accounts for only 1–2 percent of the overall GCC GDP and employs less than four percent of the active population in countries such as Kuwait and Qatar.[6] The following constraints affect the sector: (i) environmental constraints and water scarcity that limit commercially

viable primary production potential;[7] (ii) increasing reliance on food imports (60–90 percent of total food demand is imported and this trend is set to increase) and consequent exposure to external food price shocks and volatility along with risks of imported inflation and irregular availability of cereals on international markets;[8] (iii) challenges in acquiring farmlands in land- and water-rich countries characterized by poor governance of such resources. The impact of some of these constraints is expected to deteriorate even further given the region's demographic growth (over two percent, although decreasing, equal to about twice the world average)[9] and increasing urbanization patterns,[10] as well as its trends in dietary characteristics.[11]

Table 0.2

Arable Land and Agricultural GDP in GCC Countries

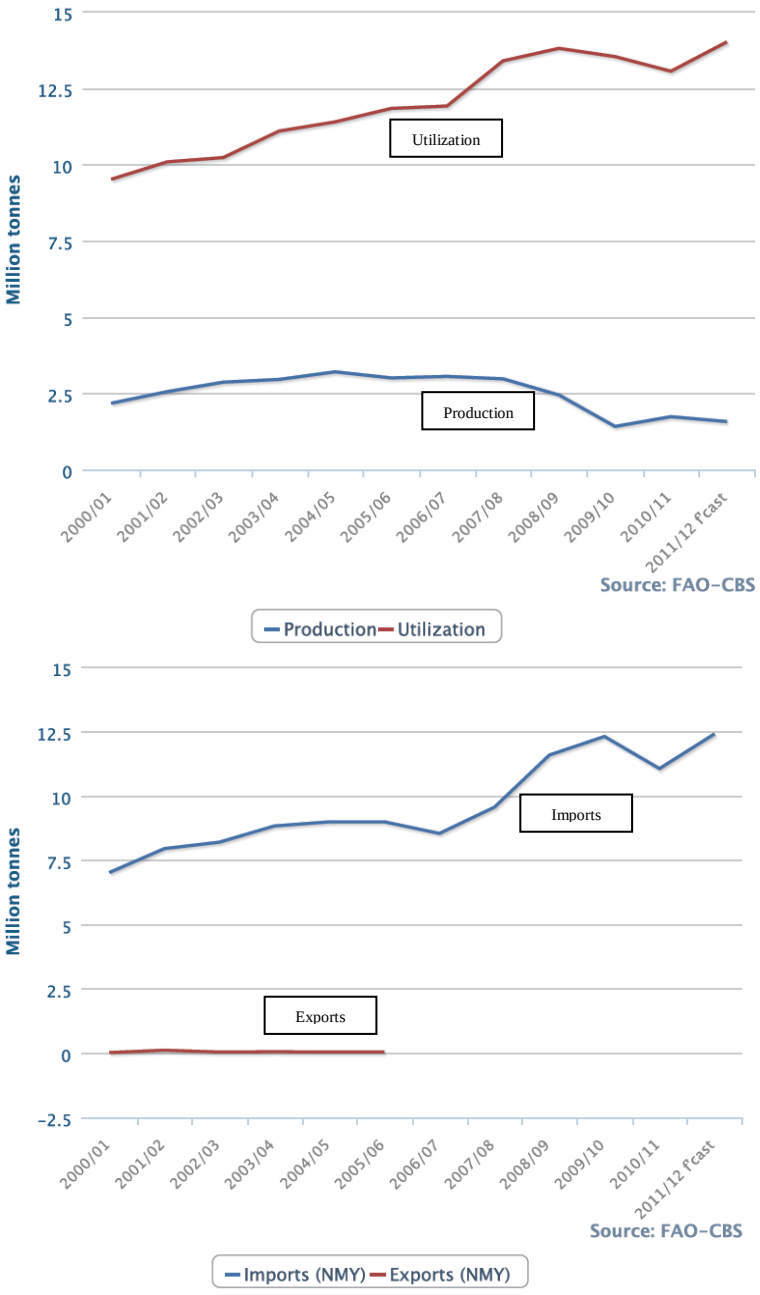
Country	Arable land (%)	Contribution to GDP (%)
Saudi Arabia	1.7	2.7
UAE	0.8	0.9
Kuwait	0.8	0.3
Qatar	1.6	0.1
Bahrain	2.9	0.5
Oman	0.1	1.4

Source: FAO, Bloomberg as reported in Alpen Capital (2011).

As a result, the food import bill has constantly increased over the last decade, with Saudi Arabia and the UAE accounting for almost half (equal to US $5.8 billion) and over one quarter ($3.5 billion) of the bill, respectively. With food normally accounting for more than 20 percent of the consumer price index (CPI), GCC inflation spiked in 2008 as a result of the food crisis.[12] In addition, these countries have pegged exchange rate regimes that, on the one hand, provide macroeconomic stability but, on the other, limit autonomy of their monetary policy, thereby limiting the array of choices to neutralize inflation transmission channels from imported food and mainly relying upon non-market administrative measures to mitigate inflationary pressures such as subsidies and other transfers.

Figure 0.2

Trends in Cereal Production, Utilization (consumption), Import, and Export, Saudi Arabia



[7]

Figure 0.3

Trends in Wheat Production, Utilization, Import, and Export, Saudi Arabia

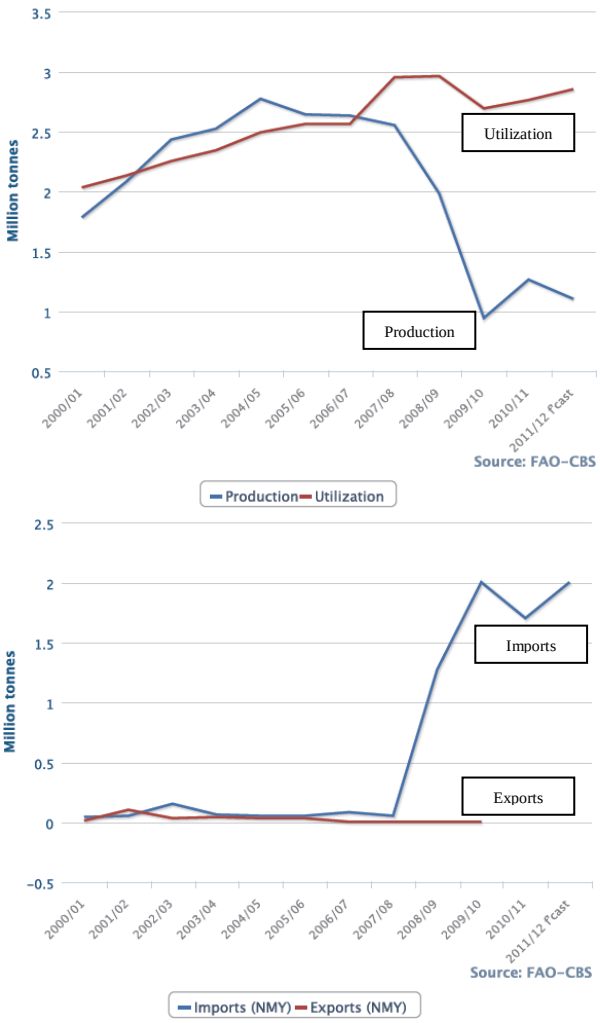
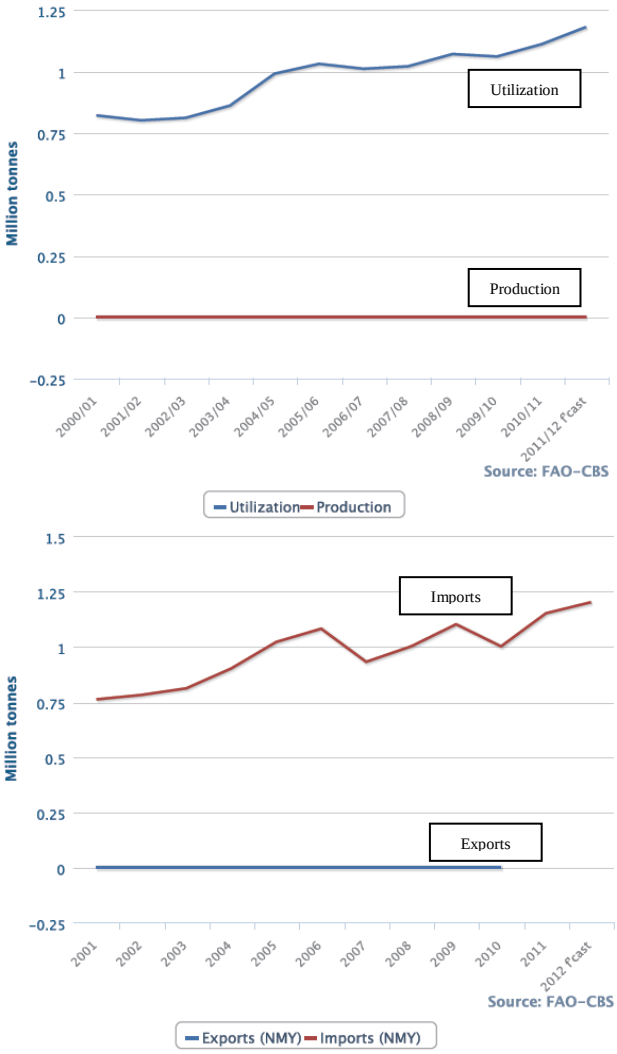


Figure 0.4

Trends in Rice Production, Utilization, Import, and Export, Saudi Arabia



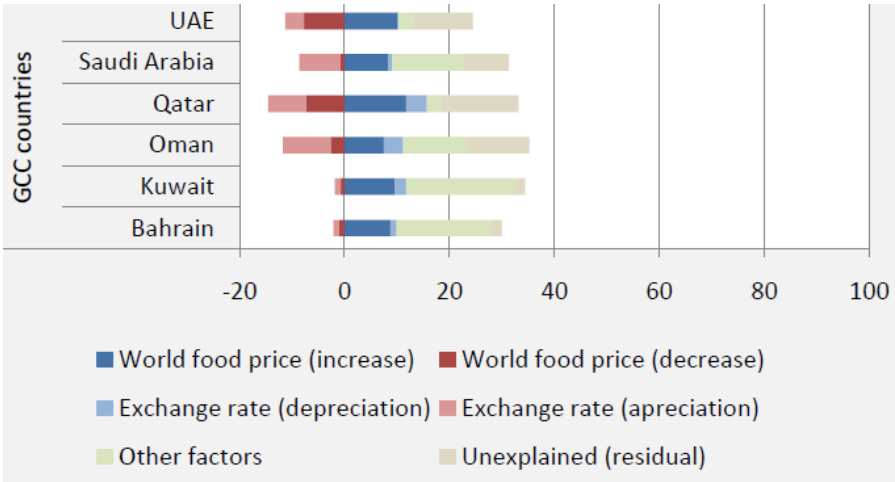
Source: AMIS database available at http://statistics.amis-outlook.org/data/index.html (accessed on March 25, 2012).

The GCC states are price-takers, and therefore their consumers are relatively more exposed to international price fluctuations. All these countries have pass-through effects of an increase in world food prices with coefficients above 0.2 (Bahrain and Qatar are above 0.3) and, in the

case of the UAE, above 0.4.[13]Most reports predict that the volatility of global food prices is likely to remain high in the years to come.[14]

Figure 0.5

Decomposition of Domestic Food Price Increases (end-2006 – mid-2011).



Source: E. Ianchovichina, J. Loening, and C. Wood, "How Vulnerable are Arab Countries to Global Food Price Shocks?" World Bank, 2012. Note: world food price decrease and exchange rate appreciation contribute to a decrease of food prices, whereas all other factors contribute to their increase.

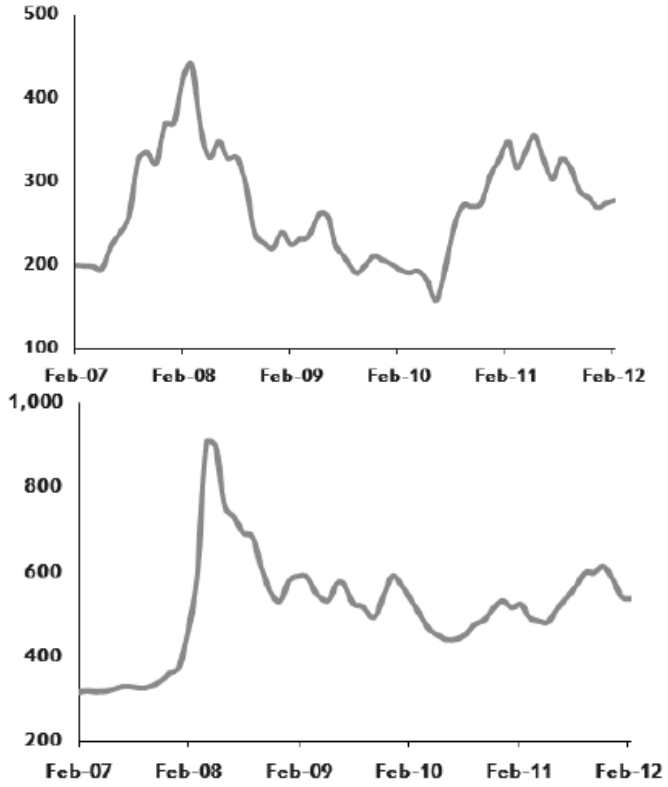
The most recently reported cereal prices (February 2012) have remained higher than the pre-2008 crisis level (2.27 times 2005 average prices).[15] The high pass-through effects are likely to have relatively higher impacts in the cereal sector, since demands for wheat (by the Arabs) and rice (by the Asian diaspora) are relatively inelastic, resulting in limited substitution even when prices are high.[16] However, from an overall microeconomic perspective, the share of household expenditure is relatively lower in the GCC countries thereby reducing the overall impact of food price rises (see Figure 0.6). Moreover, from a macroeconomic perspective, and consistent with IFPRI's food security typology for the Arab world, recent cereal price hikes do not constitute a problem for GCC countries, as a co-movement of oil and cereal prices has been noticed when the oil price is above $50.[17] In this situation, the inflow of oil

revenues is much higher than expenditures on cereal imports, resulting in a decisive surplus in the balance of payments.

Figure 0.6

Price Trends for Wheat (US hard red winter, top)

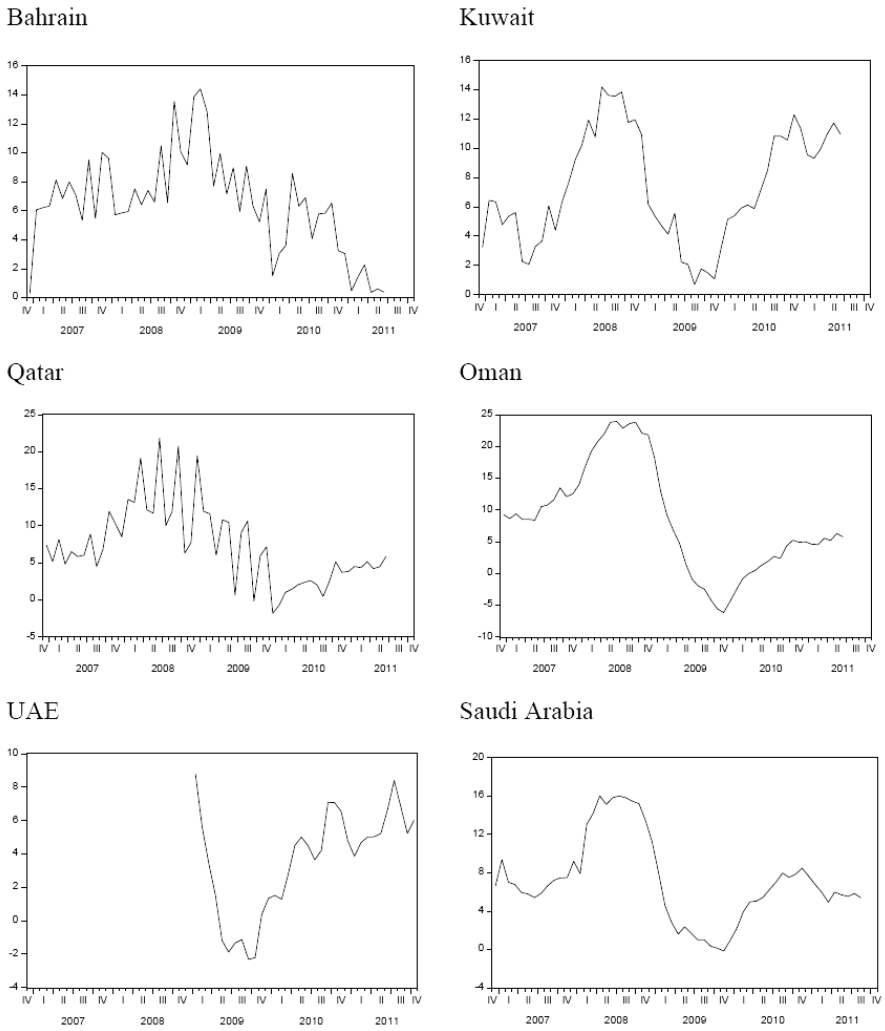
and rice (Thai 5%, bottom); ($/mt)



Source: World Bank, "Commodity Markets Review," no. 121, February, 2012.

Figure 0.7

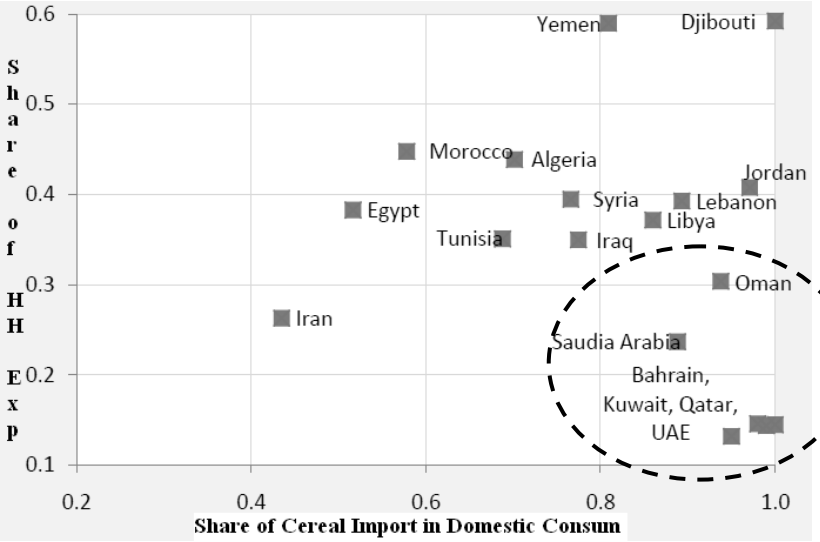
Food Price Trends in GCC Countries (December 2006 – April 2011, % change year-on-year)



Source: Ianchovichina, et al., op. cit.

Figure 0.8

Household- and Country-level Vulnerabilities

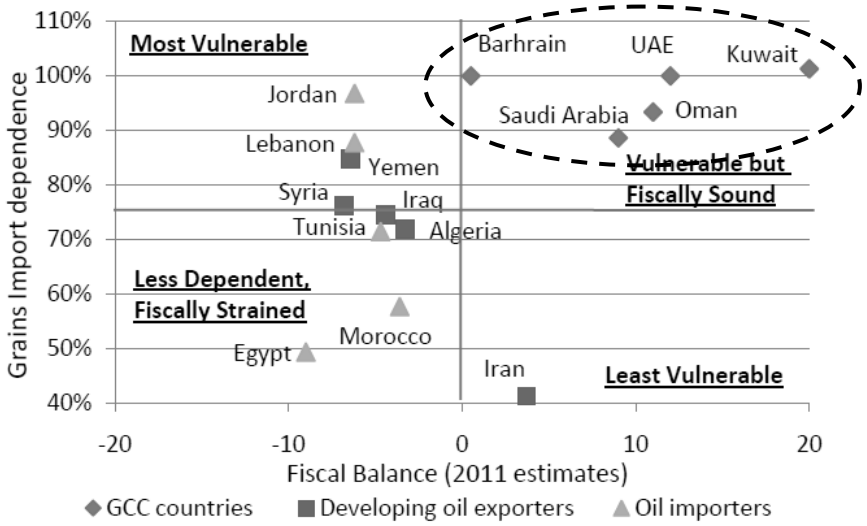


Note: Share of household (HH) food expenditure in total HH consumption.

Source: adapted from World Bank, "Regional Economic Update: MENA Facing Challenges and Opportunities," Middle East and North Africa Region, 2011.

Figure 0.9

Macro-level Grains Vulnerability of MENA Countries



Source: adapted from World Bank, op. cit., 2011.

The major determinant of micro-level food security is poverty, and a key indicator is the nutritional status of children. Despite the relatively high per capita GDP, child malnutrition persists in many Arab Gulf states, and the Human Development Index (HDI) values are lower than expected when considering per capita GDP levels. For example, in Saudi Arabia, Bahrain and Oman, around nine percent of children are estimated to be malnourished (Figure 0.1); and while Qatar and the UAE have the highest and third highest per capita incomes globally (2008, purchasing power parity), they only rank 37 and 30, respectively in the 2011 HDI.

Table 0.3

GDP per Capita (PPP, 2005 US$) and HDI, 2011

	GDP per capita		HDI	
	Value	*Rank*	*Value*	*Rank*
Bahrain	23,755	44	0.806	42
Kuwait	-		0.757	63
Oman	24,646	41	0.702	89
Qatar	77,108	1	0.825	37
Saudi Arabia	20,565	50	0.760	56

UAE	51,361	3	0.835	30

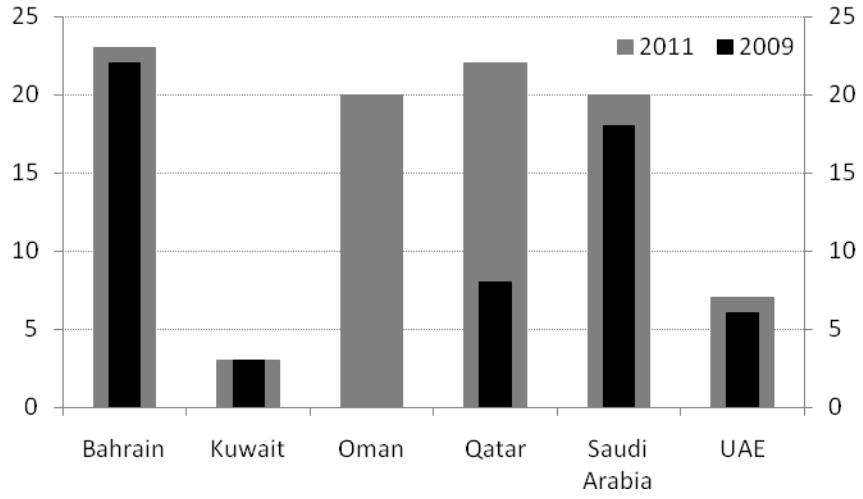
Source: Based on World Development Indicators available at http://data.worldbank.org/data-catalog/world-development-indicators (accessed in March 2012) and UNDP HDI (2011) (accessed in March 2012) available at: http://hdr.undp.org/en/data/profiles/.

Note: GDP data available for 209 countries and HDI data for 174 countries.

Data from the Gallup World Poll suggests that at least one-fifth of the people in Bahrain, Oman, Qatar, and Saudi Arabia consider themselves food insecure. The level of perceived food insecurity suggests a consistent deterioration over the recent period, with the share of food insecure people increasing by 1–3 percent in Bahrain, Saudi Arabia, and the UAE, while it almost tripled in Qatar. This deterioration is likely to be a result of the combined effects of the global crisis and food price spikes.

Figure 0.10

Perceived Food Insecurity (% of population)



Source: Based on Gallup World View (2012).

To address these various sources of food insecurity, government-supported initiatives have drastically expanded in the wake of the global

financial crisis, which caused steep job losses in the GCC countries because of their high exposure to credit financing (particularly domestic property loans) and global markets.[18] The labor market was hardest hit in Dubai because of the sharp contraction in the real estate sector. The job cuts have been particularly tough for many expatriates, who typically lack social security and unemployment benefits and are most likely to be affected by price surges.[19]

Table 0.4

Government-supported Initiatives following the Food Crisis

	Economic Support		**Consumer Support**			**Production Support**					
	Reduction/suspension of taxes and tariffs	Food Reserves	Price Controls/ Subsid.	Cash Transf./ Wage Increases	Food Ration/stamps	Input Subsid.	Subsidized Credit	Land Deals	Support Price	R&D and Extension Services	Infrastruct.
Saudi Arabia	√	√	√	√		√	√	√	√		√
Bahrain		√	√		√	√	√	√	√?		√
Oman		√	√	√		√	√	√	√?	√	
Qatar	√	√	√			√	√	√			
Kuwait		?	√	√	√	√	√	√		√	
UAE	√	√	√	√		√	√	√			√

Source: ESCWA.

Main GCC agricultural policy support actions have included:

- Unregulated well digging.
- Subsidized inputs (fertilizers, seeds, veterinary services, and, in the case of Saudi Arabia, farmland).
- Consumer price support.
- Lower taxation for farmers.

Price stabilization through food subsidies has been the favored approach in the past. However, this does not remove the price risk; it only transfers the risk to the government and tax payers through subsidy pay-outs, which often tend to be untargeted and inefficient.

The most recent literature[20] has identified three thrust areas to pursue in order to improve food security in the GCC and wider Arab region: (i) strengthening safety nets, and access to education and health (including family planning) services; (ii) enhancing agricultural production through investment in infrastructures and R&D based on economic, social, and environmental sustainability principles; and (iii) reducing exposure to market volatility through a mix of government- and market-based interventions. In the remaining part of this study, we will utilize these thrust areas as a multi-pronged analytical toolkit that could be used to enhance food security through a regional lens.

After investigating future trends in the region's food security, we will analyze potential key components of a GCC-wide food security strategy. The paper will then attempt to assess the pros and cons of building a regional food reserve as an instrument to tackle potential cereal market disruptions. Next, it will investigate challenges and opportunities for a region-wide procurement system based on innovative financial instruments. The final two sections of the study will focus on the consolidation of agricultural R&D systems, and an analysis of current water use through assessing water footprint and water balance of production, consumption, and trade patterns in the region.

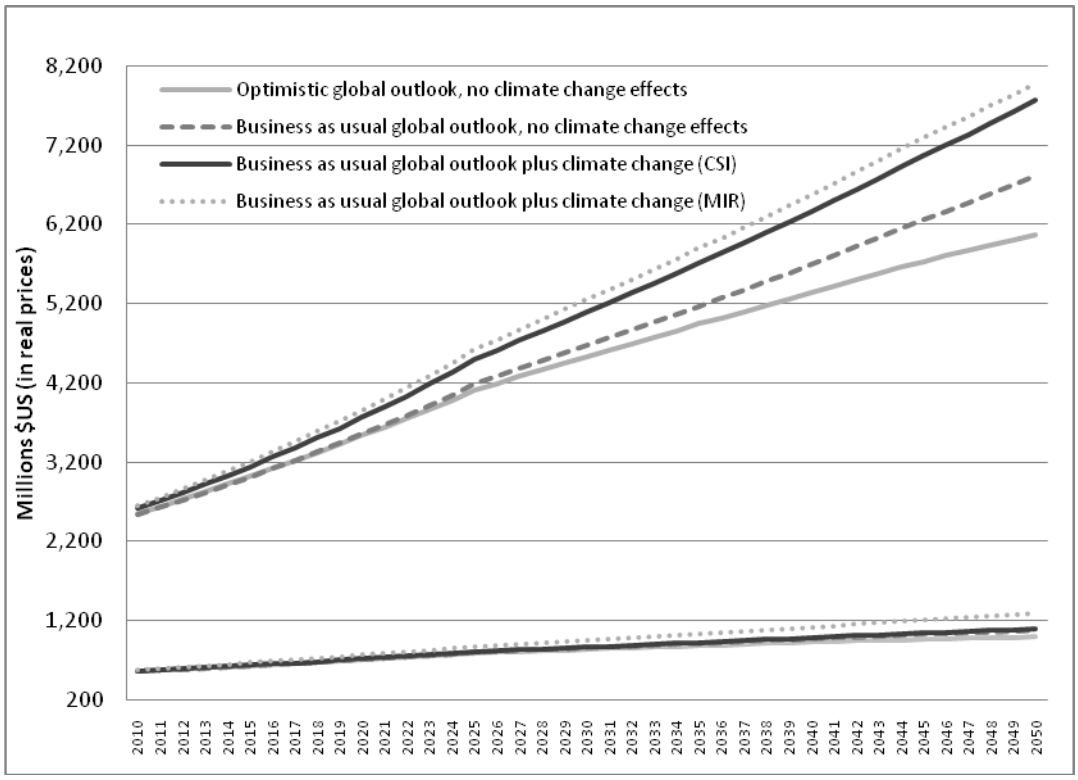
The Future of Food Security in the Arab Gulf Region

Food import dependency in Arab Gulf states will further increase in the future; the size of the increase will depend mostly on external factors. Figure 0.11 shows how demand (the higher series) and production (the lower series), in monetary terms, are likely to change under four different scenarios: the first scenario describes an optimistic outlook, where population growth in Gulf countries and globally is modest and economic growth is high.[21,22] The next series depicts a scenario where population growth and economic growth in Gulf Arab states and the rest of the world follow the same trend as in the past (business as usual, no climate change effects), while whereas the next two scenarios take the effects of climate

change into account (using two different models). Results show that even under the optimistic scenario, the annual value of cereals consumed in the Arab Gulf states will increase from $2.5 billion in 2010 to about $4.5 billion in 2030, up to $6.1 billion by 2050 (in real prices). Under the business-as-usual scenario, the consumption of cereals in Arab Gulf States will almost triple to $6.8 billion.

Figure 0.11

Projected cereals demand and supply for Gulf countries (in million USD, 2010-2050)



Notes: Arab Gulf countries include GCC plus Yemen. CSI and MIR are two out of 22 global climate models used in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

Sources: Authors' compilation based on Nelson et al. (2010)

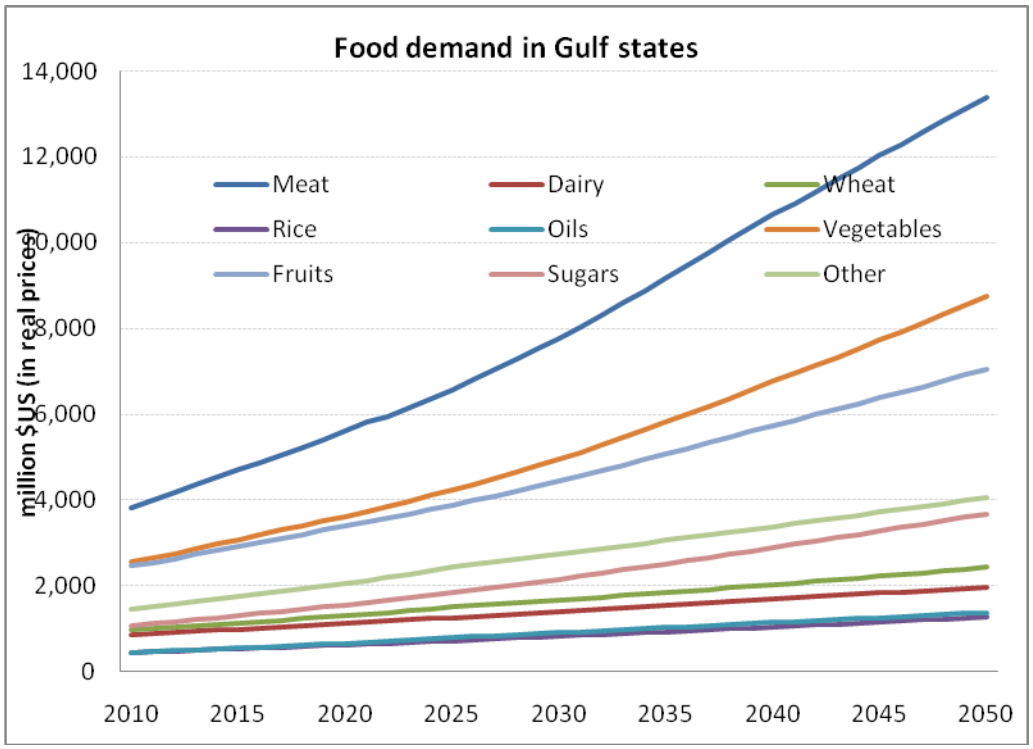
The effects of climate change will further raise the value of cereals consumed in Arab Gulf states, while the local production of cereals under all scenarios will lag behind rapidly rising demand. Compared to the business-as-usual scenarios, the annual value of cereals consumed in Arab Gulf countries is projected to increase by $1–1.2 billion by the year 2050, depending on the climate change scenario. The production side cannot keep up with this rapid increase in demand. Under all four scenarios, cereal output increases because of assumptions about technological change and the increase in cereal prices. Yet, cereal output only reaches $1–1.3 billion in 2050, or $5–6.7 billion less than projected aggregate demand.

The total annual demand for food commodities consumed in the Arab Gulf states is projected to more than triple from $14 billion to $44 billion between 2010 to 2050. Figure 0.12 shows the results for different food commodity groups from the business-as-usual scenario, excluding the impacts of climate change. The strongest increase in demand from the Arab Gulf countries is projected for meat and F&V. In relative terms, the top three items are meat, vegetables and sugar, for which demand is projected to be about 3.5 times higher in 2050 than in 2010. These results are mainly driven by the fact that (a) populations grow, (b) per capita incomes increase, and (c) consumption shifts from staple crops such as cereals to more high value foods such as meat and vegetables. These three effects occur in the Gulf Arab states and in the rest of the world, thus increasing the world market prices for foods and therefore also the domestic prices in the region. If climate change effects are also taken into account, the costs of importing food to the region will likely further increase.

However, the Gulf states spend little of their earnings from exports and remittances to import food (Saudi Arabia spends only four percent, Bahrain 2.9 percent, the UAE 3.4 percent, Oman 6.2 percent, Kuwait 2.4 percent and Qatar two percent). Thus, as long as the value of exports keeps up with the increasing costs of food imports, no change in macro food security is expected.

Figure 0.12

Projected food demand in Gulf countries (in millions USD, 2010-2050)



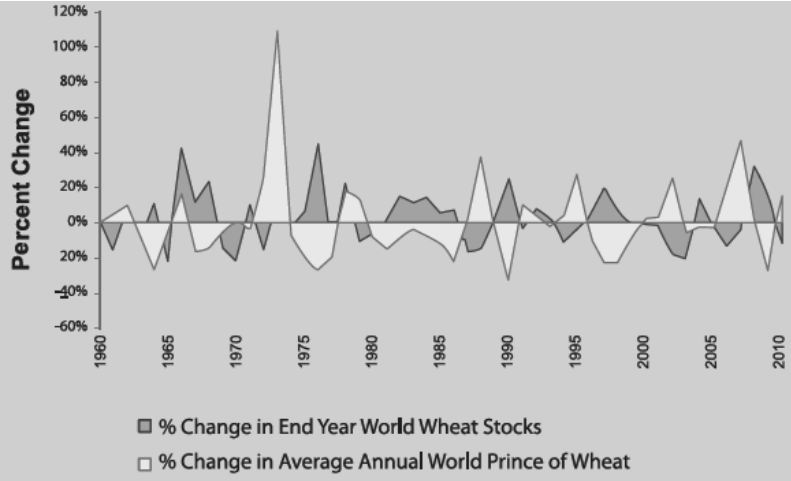
Source: Authors' compilation based on Nelson et al. 2011. Note: Gulf countries include GCC plus Yemen.

Do GCC Countries require a Regional Strategic Reserve?

Cereals are the food group that was most affected by the 2007–2008 food crisis. Conventional wisdom has it that many concurrent factors contributed to the crisis, among which serious deficiencies in the quality of information, particularly with respect to the levels of global stocks (stock-to-use and major exporters' stock-to-disappearance ratios)[23] and short-term forecasts. All spikes observed in the last four decades have been associated with low stock ratios (Figures 0.13 and 0.14).[24] This, together with market thinness,[25] lack of capacity in analyzing early warning signs, uncoordinated and nervous policy actions, has contributed to excite the markets even further.

Figure 0.13

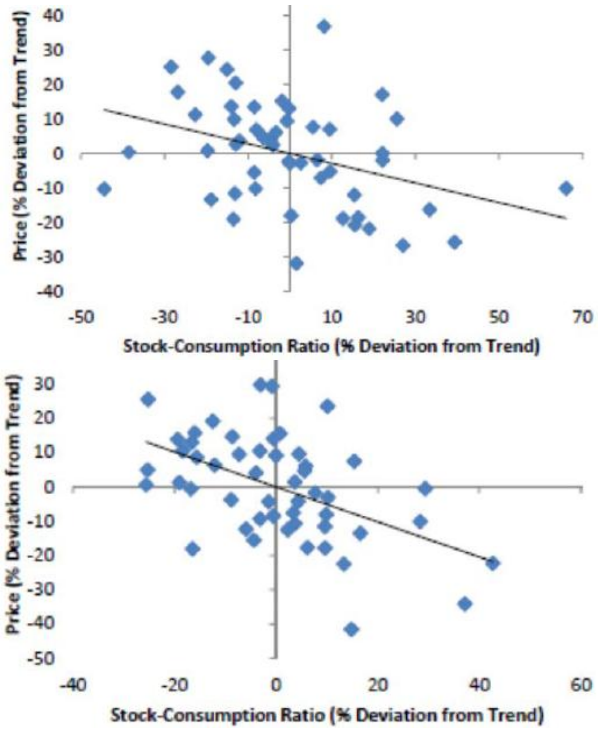
Specular Trends of Changes in Wheat Stocks and Prices



Source: World Bank as reported in FAO. Near East Food Security Update (2012). Note: correlation is –0.8.

Figure 0.14

Inversed relationship between commodity prices and stock-to-use ratio (excluding China).



Source: Arsenau and Leduc (2012).

Wheat accounts for more than half of GCC cereal consumption. Only Saudi Arabia imports around two million mt, and is projected to import over three million mt of wheat after the phase-out of domestic wheat production taking place from 2016 onward.[26] The region relies primarily on South Asia (India and Pakistan) for rice imports, and the EU, Australia and Canada for wheat imports.[27] Given regional economic and production characteristics, as well as the world grain market trends, the region is highly vulnerable to both supply and price risks.[28]

As in many countries, there is little information on stocks in GCC countries. Oman and the UAE seem to have each established national cereal reserves equivalent to 3–6 months of their national demands. Saudi Arabia has a policy of holding wheat reserves of at least six months of domestic consumption that can rely on 12 silos with a total storage

capacity of about 2.5 million mt.[29] Over one million tons of rice is imported (mainly from India) annually to Saudi Arabia, and rice reserves amount to less than one fifth of this quantity. Many GCC countries are planning to increase their storage capacity (double in the cases of Bahrain and Qatar, and more than three times for Oman; see Figure 0.15).

Table 0.5

Cereal Stocks in Saudi Arabia (million metric tons).

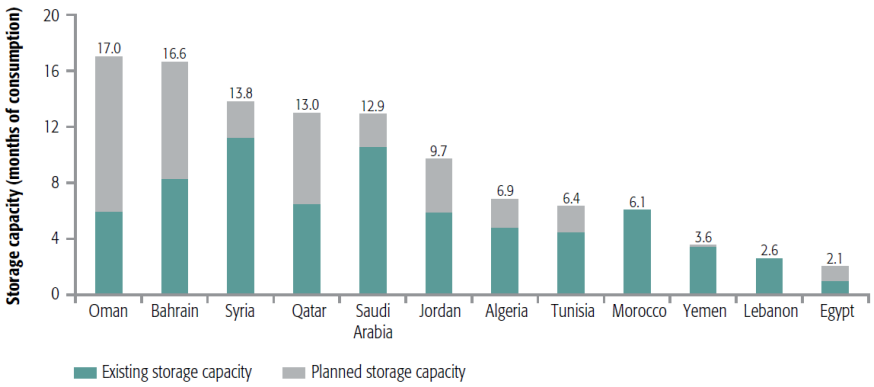
	2008–2010	2011[i]	2012[ii]
Cereal	3.5	3.4	3.3
Wheat	1.4	1.9	2.2
Rice	0.2	0.2	0.2
Barley	1.8	1.3	0.9

Notes: (i) estimate; (ii) forecast.

Source: UN Food and Agriculture Organization (FAO), "Food Outlook," Rome, November 2011.

Figure 0.15

Planned increases in storage capacity in the Arab region.



Source: FAO and World Bank (2012).

Historically, however, national food stocks[30] have not shown great success in reducing price volatility – and particularly price spikes – in view of their often limited capacity when compared with the size of the markets they are supposed to calm, and the limited market information

pool they are based on. Storage in the Arab region costs on average of $2.15 per mt/month.[31] Based on available data, Saudi Arabia has storage costs slightly below this benchmark ($1.9), while in Qatar the average is over $3.3.[32] Therefore, if Saudi Arabia imports three million tons of wheat per year (likely lower-end scenario soon after 2016) and wants to keep its current 10-month average of strategic stocks, this will result in at least $50 million per year in storage costs.[33]

Reducing import risks would clearly entail a multi-pronged strategy that includes trade openness,[34] functioning and integrated supply-chain logistics and infrastructures, and an effective procurement and hedging strategy. These three thrust areas show the potential importance of international or regional coordination mechanisms. In addition, some think tanks and scholars, including IFPRI,[35] have suggested, as a forth pillar, that an international food reserve would help prevent overshooting of cereal prices based on the following three-pronged approach:

- An small international physical stock for food emergencies composed of basic grains dislocated in strategic locations around the world and managed by the World Food Program.
- A global reserve to ease excessive national hoarding and able to quickly respond to supply shocks.
- An international fund or virtual reserve that operates on the financial markets to curb excessive speculation and price volatility.

This long-awaited international food governance is far from implementation.[36] However, regional cooperation among GCC countries on IFPRI's above-proposed policy actions could prove itself as an intermediate option. A regional grain reserve would provide GCC countries with critical lead-time to secure alternative wheat supplies in times of crisis. Despite being the largest importer of wheat, the Arab region holds only a small share of the world's wheat stocks. Such reserves, if equipped with sufficient capacity, would allow inter-temporal arbitrage that would normally smooth supply responses and would also offer psychological relief that may prevent hysteric hoarding.[37] Therefore, the following questions naturally arise: could GCC countries move in this direction by establishing a regional reserve given that they historically

view food security as a national security issue? Would such a reserve help stabilize the regional market? And what are its preconditions?

The first consideration to make is that determining the optimal level of strategic reserves is difficult, as it depends on the combination of underlying factors such as extent of import dependency, vulnerability to supply and price shocks, rigidity of demand, availability of alternative food items, tolerance to risk, etc. Thus, building a comprehensive model to support decision making on stock sizes under different scenarios would be the best first option to support decision making. In the absence of such a tool, we can draw on global experiences. It is broadly accepted worldwide that reserves should be equal to at least three months of domestic consumption, so as to give enough lead-time to import and distribute new stocks purchased from international markets. The second consideration is that the optimal location for the storage is usually at the port of entry, so as to tap into economies of scale. Third, it is of the utmost importance that a set of clear principles and rules are established, including a domestic price ceiling that will trigger the release of reserves, target reserve levels, purchasing modalities, rate of replenishment,[38] viable ownership models, and so on.[39] Fourth, the independence and wider governance arrangements of the agency that manages the reserves is crucial in order to allow it to professionally and effectively administer them (although based on politically-driven strategies and principles).[40]

In the case of the GCC, setting a price band would not make much sense, as the threshold price aims at stabilizing the price for producers (which are gradually fading away from the region). Therefore, a price band would be more easily administered as it would only have a ceiling that will trigger the drawdown. It is also advisable to select a relatively high level of the ceiling which would prevent the reserve from turning into a safety net instrument rather than a supply stabilization tool.

Since Saudi Arabia is the largest cereal market in the region and has the largest reserve capacity and a lower average cost, it would make sense that the potential regional reserve system centers around such a country. However, from a logistics standpoint this country is not among the region's top performers and lags behind the UAE, Bahrain, and Kuwait. Indeed, recent analysis suggests that the Kingdom's costs of port logistics, inland transport, and management are about 50 percent higher than those

of its neighbors.[41] Investment to improve logistics infrastructure in the Kingdom will not only reduce cereal import supply chain costs – which would offer great opportunities for smoothing domestic fluctuations – but will also benefit other industries that are likely to use the same transport corridors and storage facilities.

Table 0.6

GCC Logistics Performance Index Comparisons

Country	LPI	Customs	Infrastructure	International shipments	Logistics competence	Tracking & tracing	Timeliness
Korea, Rep.	3.64	3.33	3.62	3.47	3.64	3.83	3.97
United Arab Emirates	3.63	3.49	3.81	3.48	3.53	3.58	3.94
Bahrain	3.37	3.05	3.36	3.05	3.36	3.63	3.85
Kuwait	3.28	3.03	3.33	3.12	3.11	3.44	3.70
Saudi Arabia	3.22	2.91	3.27	**2.80**	3.33	3.32	3.78
Brazil	3.20	2.37	3.10	2.91	3.30	3.42	4.14
Mexico	3.05	2.55	2.95	2.83	3.04	3.28	3.66
Qatar	2.95	2.25	2.75	2.92	2.57	3.09	4.09
Oman	2.84	3.38	3.06	2.31	2.37	2.04	3.94

Source: World Bank, Logistics Performance Index database, March 2012.

Policy makers will need to carefully assess the potential impact of public stocks on private grain traders. Public stocks will have to be rotated in order to minimize spoilage (i.e., releasing reserves and replenished them with new stocks). These releases will have to be conducted in a way to avoid crowding out effects[42] by: (i) releasing grains at market prices; (ii) re-exporting the released grains so as not to impact the domestic market;[43] (iii) auctioning the stocks among the private traders; (iv) combining the strategic grain reserves with food aid for other Arab and African countries that are mostly vulnerable such as Sudan or Yemen.[44]

The reserve could be governed jointly by the GCC countries with the support of specialized international agencies. The management body of

the reserve would have legal custody of the reserve stocks and would be responsible for the following:

- Setting a high enough price ceiling so that it will not disrupt market dynamics and will only address serious price spikes.[45]
- Monitoring international and regional market conditions and early warning indicators on a continuous basis.
- Adjusting price ceilings according to changes in market conditions.
- Managing stock rotation.
- Establishing a balanced mix of physical and virtual reserves.
- Having sufficient multi-annual funding so that market operations can be effectively carried out.

The regional stock and related food security information systems could also support other food-insecure Arab countries with more limited administrative and financial capacities during crises.

The Potential Role of Financial Instruments

In principle, physical stocks can be more efficient and effective if they function in coordination with a system of "virtual reserves" that are managed through financial instruments. Risk management using financial instruments has become a quite common strategy. Several industries have embraced the use of futures markets to manage price risk. For example, the airline industry frequently uses forward and futures contracts to fix the price of fuel in the future in order to increase the predictability of cash flow.[46]

Financial instruments may be grouped into two main categories: exchange traded contracts (futures and options)[47] and over-the counter instruments (forwards and swaps). The table below summarizes the purpose, advantages and disadvantages of these different financial instruments. Selection of the appropriate instrument must be tailored after identification and quantification of the risk, since there is no "one-size-fits-all" solution for risk management.

Table 0.7

Snapshot of Relevant Financial Instruments.

Instrument	Purpose	Benefit	Disadvantage
Futures	• Hedge price risk • Lock in value of inventories or finance part of storage costs	• No need to negotiate contract specification • Minimal counterparty risk • Delivery is not necessarily implied	• Working capital is frozen up in margins • Possibility of profiting from favorable spot market developments is lost
Options	• Obtain protection against unfavorable price movements while retaining the possibility of benefitting from favorable ones	• Available in standardized form on exchanges • No funding risk: the costs of protection are known up-front • Possibility of benefitting from favorable price movements	• Up-front premiums can be expensive, especially in times of volatile prices
Forwards	• Facilitate planning and marketing • Lock in future prices	• Tailor-made for the needs of the contracting parties • Ensures physical market delivery of the commodities needed	• Major counterparty risk • Possibility to profit from favorable spot market developments is lost • Pricing is not transparent
Swaps	• Guarantee income streams of operations • Obtain easier and cheaper access to capital by securing future cash flows • Lock in long-term prices	• Combination of price-hedging and securing investment • Long-term and tailor-made • Less-strict margin calls • Low administrative burden and known counterparty	• Counterparty risks • High design/set-up costs • Difficult to assess the "fair" price for the deal • Possibility of benefitting from favorable price movements may be lost

Source: Adapted from UN Conference on Trade and Development (UNCTAD), "A Survey of Commodity Risk Management Instruments," 1998.

Financial instruments are increasingly used by grain-importing countries with the aim of locking in volume, quality, and price of imports 3–18 months in advance of delivery. This can help counterbalance short-term speculation and therefore smooth prices. Futures and options are the

two main types of financial instruments commonly used in agricultural commodity markets. Recent studies suggest that spot prices tend to be discovered in futures markets and therefore futures could potentially be used to address excessive spikes in grain prices through their signaling effects. Although such derivatives are seldom used in the region, other governments have successfully used them as risk management tools.[48] They can either be managed directly by government institutions or by private partnering companies within a clear reporting and oversight mechanism.

The World Bank, FAO and IFAD[49] present an interesting simulation for Egypt, which imported seven million tons of wheat from November 2007 to October 2008, at a cost of around $2.75 billion. Simulations show how Egypt could have reduced the import bill by using either futures or options, and a discretionary or non-discretionary approach to hedging.[50] They estimated that Egypt could have reduced the import bill by around $600 million during that period.

The main obstacles to the use of financial instruments for food price risk management are financial capacity, technical skills,[51] volume of trade, liquidity and access to credit, stable import needs, and low exchange rate fluctuations. All of these obstacles could be overcome in the GCC countries which have fiscal space, an educated labor force, a fixed exchange rate policy, and a low share of domestic production that does not vary according to climatic trends.[52]

A particular challenge related to the use of financial instruments in the GCC countries is how to ensure they are Shariah compliant. Although the elimination of risk is desirable under Islamic law, conventional derivatives contracts are not accepted by many Shariah scholars. However, it should be noted that Shariah compliant derivatives exist and therefore the instruments highlighted in this paper are relevant in the Shariah context, but their specific format should be developed by the Islamic banking community.

Figure 0.16

Shariah Compliant Derivatives

From the standpoint of Islamic law, financial contracts must satisfy a number of requirements, which are often not present in conventional derivatives. Most Shariah scholars maintain that derivatives are priced according to assets that are not in the possession of the seller, therefore violating the *hadith* principle. Shariah also prohibits *gharrar* (exposing oneself to excessive risk) and *riba* (paying or receiving a premium or interest). Legal scholars also claim that derivatives encourage speculative behavior akin to gambling (*maisir*). Despite these objections, scholars and practitioners acknowledge the important benefits of hedging instruments and the opportunity cost imposed by the lack of Islamic hedging tools. Recently, so-called synthetic derivatives, which are close equivalents of conventional derivatives have been developed. Another important step has been the Tawawwut (hedging) Master Agreement which standardized Shariah compliant swap-based hedging transactions. Users of derivatives should demonstrate that their transactions constitute true hedging behavior and the use of derivatives is more likely to gain the approval of Islamic scholars if changes in asset value can bring some kind of benefit to both parties.

Source: A. Jobst and J. Sole, "Operative Principles of Islamic Derivatives: Towards a Coherent Theory," IMF Working Paper, WP/12/63, 2012.

A regional approach could help overcome the remaining barrier related to the volume of trade, since financial contracts are often traded with large volumes that might be too large for the smaller GCC countries. For example, wheat future contracts are of a minimum of 5,000 metric tons, which is similar to the total monthly wheat import of Bahrain. A regional approach can also provide other benefits in terms of economy of scale for training, research and operational cost. The regional approach might also be valuable for negotiations, especially in terms of over-the-counter instruments which are negotiated bilaterally.

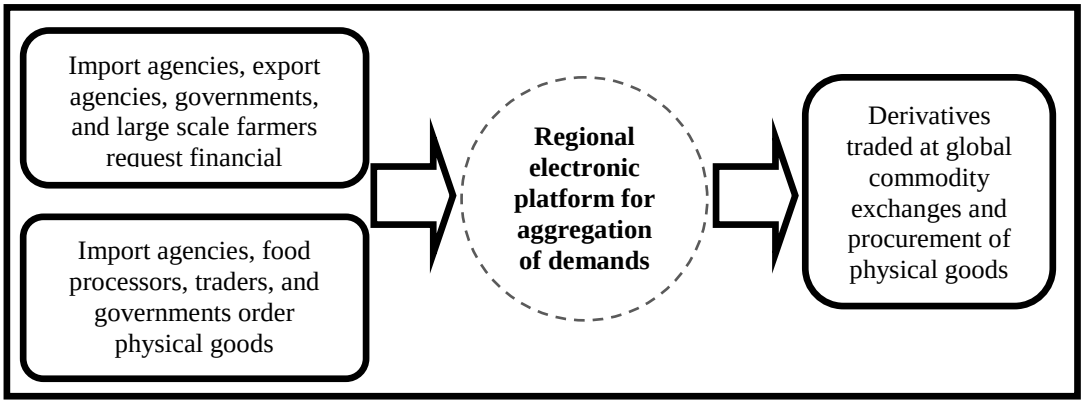
The GCC countries could also make joint use of the global commodity exchanges in order to hedge their food price risk. A regional approach might be useful to obtain the necessary volume of trade and would offer cost reductions. Research in supply chain management has focused increasingly on strategic management of procurement operations through purchasing consortia where different entities combine their individual needs to gain the increasing pricing, quality and service advantages associated with volume buying. Electronic purchasing consortia, employing ICT-based communication infrastructure, enable the efficient coordination of different entities at a low transaction and communication cost.[53]

Such systems are already in practical use for various purposes and could be adjusted to serve as a platform for risk management for different import and export agencies, farmers, governments and other entities that seek to hedge their food price risk. The different entities would place an order for a quantity of a specific commodity to be hedged. The orders from different entities would be aggregated before derivatives are traded on a global commodity exchange. This would enable small and large entities alike to manage their food price risk, without incurring large upfront investment and overhead costs. GCC countries face a number of supply and price risks and therefore a mix of various hedging instruments with different maturity mix could serve their purposes.

An integrated electronic platform could also include the procurement of physical goods. The regional approach will have some implications on the terms of procurement as the countries will have to coordinate procurement needs and tender dates. The regional electronic platform could facilitate this coordination between countries. Orders for physical goods could also be channeled through an electronic system and after aggregation orders could be placed on the global markets. This would facilitate price risk management as well as to ensure the delivery of physical goods.

Figure 0.17

Regional Aggregations of National Demands



A Region-based Agricultural R&D System

Worldwide, investments in agricultural research and development (R&D) proved to have high rates of return (RoR). The median of RoR estimates is 48 percent for research per year, and 62.9 percent for studies that improve extension services. These estimates have not changed significantly over time.[54] However, current trends show a misleading picture of global public investments because the increasing financial contribution to R&D in agriculture has been concentrated in just a few countries.[55] As agricultural development is highly dependent on R&D, a key component of the regional strategy proposed in this paper is thus a joint agricultural innovation system in the Gulf region that may also benefit other food insecure Arab countries.

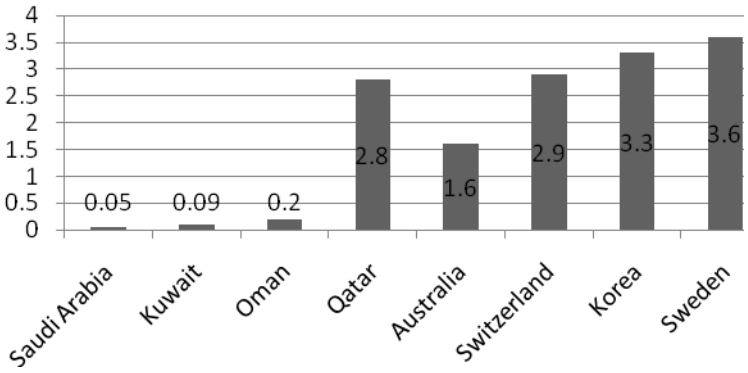
In the past two decades, much has been done in GCC countries to stimulate regional research and innovation. A regional GCC patent office has been established for technical and scientific research and to facilitate technological transfer. The International Center for Agricultural Research in the Dry Areas (ICARDA), through its Arabian Peninsula Regional Program (APRP) has not only been dedicated to research, but also to strengthening institutions and capacities, developing human resources, and information technology. Countries have been individually investing in national food security programs, in infrastructure such as Agro-Industrial Parks in Qatar, in education through partnerships with international universities, research centers and international organizations.

Despite these initiatives, innovation system indicators in GCC countries show low performance. The first challenge facing agricultural R&D is the lack of data on public spending. Despite this constraint, the limited evidence suggests that R&D public investment in agriculture is significantly low. In the absence of specific data, overall R&D public spending has been examined.[56] Here, it emerges that GCC countries have allocated significantly low expenditures to R&D. For example, in 2007 selected Gulf states spent (as a percentage of GDP) 0.05 percent on R&D (Saudi Arabia), 0.09 percent (Kuwait), and 0.2 percent (Oman). With the exception of Qatar, the region spends well below developed countries in this area (Figure 0.18). ICARDA's study of national innovation systems in GCC countries shows that the lack of financial resources in Bahrain, UAE and Oman represents a major constraint. APRP has been supported by two international funds – the International Fund for Agricultural Development

(IFAD) and the OPEC Fund for International Development – and only one Arab fund, the Arab Fund for Economic and Social Development.

Figure 0.18

R&D spending as % of GDP (2007).



Sources: Data for Saudi Arabia and Kuwait are from WDI available at http://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS; data for , Oman and Qatar are unofficial estimates from Andersson, 2012; others are from the OECD-iLibrary - Expenditure on R&D, OECD Factblog available at:

http://blog.oecdfactblog.org/?p=12 (); OECD figures latest available year is 2007.

Private R&D in agriculture is also limited. Economies characterized by capital-intensive industries and services provide generally less, if not insufficient incentives for private sector R&D investments.[57] A very limited private sector engagement in total R&D expenditure is observed. In Saudi Arabia, private sector spending in R&D activities reached a mere 10 percent of the total in 2007, with a predominant concentration in the oil sector.[58, 59]

The knowledge and innovation rankings of GCC countries are significantly low. The UAE and Qatar are among the Gulf countries with somewhat higher ranks in the knowledge economy index, while Oman and Saudi Arabia are ranked the lowest.

Table 0.9

GCC Rankings on Knowledge Economy and Competitiveness

Country/Index	Knowledge Economy Index KEI	Pillar 1 : Education	Pillar 2 : ICT	Pillar 3 : Innovation	Quality of scientific research institutions*	University-industry research collaboration*
Bahrain	49	60	40	80	112	101
Kuwait	52	76	46	70	83	99
Oman	66	86	76	71	63	53
Qatar	44	67	27	48	32	38
Saudi Arabia	68	80	52	86	37	37
UAE	45	79	21	46	53	39

Sources: World Bank Institute, knowledge assessment methodology [KAM] (www.worldbank.org/kam), 2009. Quality of scientific research institutions and university industry research collaboration were taken from: Klaus Schwab (ed.), "Global Competitiveness Report 2009–2010," World Economic Forum, Geneva, 2009.

Excluding growers and extension agents, the number of researchers in agriculture in the region appears significantly low for its population. On the quality of the scientific research institutions, some countries perform better, namely Qatar and Saudi Arabia, while Bahrain showed the lowest performance.

Effectiveness of innovation systems does not only depend on mere investments and individual researchers but also on the environment in which they operate. An effective innovation system provides an enabling environment for actors across the chain to interact and coordinate collective actions.[60] To assess the environment for an agricultural innovation system in GCC, the indicators presented in Table 0.10 are examined:

Table 0.10

An Agricultural Innovation System: Regional Indicators

Knowledge transfer	Openness to international research, accumulated knowledge and expertise: • Increasing imports of knowledge and expertise through partnerships with foreign universities, research centers and experts. • The provision of training for researchers, growers and extension agents. Developed by ICARDA's APRP, there exists a system in place for knowledge transfer across the

	chain in the region, although at an embryonic stage, that could be strengthened further.
Linkages and infrastructure	Mixed picture with promising initiatives on the ground: • Establishing a network for researchers and scientists in the region via regional programs such as that of ICARDA. • University–industry research collaboration in agriculture is relatively weak. • ICT is a critical platform for innovation systems and some countries have made a significant progress in ICT, notably Qatar and the UAE. • In the current inter-regional cooperation dialogue with the EU's INCO-NET (international cooperation network), GCC countries are defining common interests and research areas where food and agriculture are on the menu.[61]
Policies and governance	Weak policies, but some institutional set-up in place. General lack of governance persists: • Research in agriculture in most countries remains traditional, with a lack of vision and priorities. No clear distinction between research policies and those meant to enable adoption of improved technologies and practices. The research agendas are not based on a commodity chain approach.[62] • The GCC patent office has granted over 1,800 patents to date, with only 0.01 percent of those related to agricultural activities, including water improvement and chemical related activities.[63] Data on granted patents in the three national patent offices is not available.

Regional cooperation in research and innovation can enhance the pool of resources, in particular specialized financial resources and know-how. In other words, the high risks of investments in R&D and innovation are significantly reduced through diversification of resources, and efficiencies are achieved through the resulting economies of scale.[64]

One of the examples of a cross-border cooperation system in research and innovation is the European Union. The European innovation system comprises an overall framework and various programs which have led to the creation of several supporting funds – the European Institute for Innovation and Technology and the European Research Council – and several other coordinating mechanisms. The European model confirms that innovation occurs in an institutional, political and social context and that learning is facilitated by a regional research and innovation governance framework.[65]

GCC countries have great potential for regional cooperation in research and innovation. Besides geographic proximity and the social and political contexts set through the Gulf Cooperation Council, the countries have financial resources and have shown their openness toward striving for knowledge generation and transfer.

These establishments would satisfy three main pre-conditions for effective coordination:[66] appropriate incentives through the joint R&D fund; a committed and capable leadership of high-level decision-makers and regional experts; and an enabling environment, through the regional program, where stakeholders would interact and coordinate their activities. Consolidation of financial resources across sectors needs to be encouraged to tackle the complexity and multi-sector nature of food security effectively. Contributions should not only come from the six governments, but also from the GCC quasi-public development funds, *ad-hoc* research funds and the private sector.

In an attempt to get an idea of a benchmark for an R&D fund in agriculture, we compare the GCC countries with Australia,[67] a country with a research intensity ratio of five percent,[68] spending on R&D totaling 1.6 percent of GDP, and with 6.5 percent of its total R&D expenditure allocated to agriculture ($723 million).[69] We compared the size of Australian R&D expenditure to total R&D expenditure of the four GCC countries (with available data).[70] We found that Australia spent US $9.8 billion more on total R&D than the four GCC countries combined. Australian R&D spending in agriculture alone was equivalent to 75 percent of the total expenditure on R&D by the four GCC countries lumped together. Finally, if we were to take Australian R&D expenditure in agriculture as a minimum yearly contribution to the joint R&D fund,

the GCC countries would each be required to contribute roughly $120 million per year. If all the funding institutions, both public and private, joined forces and consolidated their payments to the joint R&D fund for agriculture, this minimum target could be met.

A regional fund could provide two types of services:

- Competitive grants/loans to stimulate and create demand for innovative research in agriculture; fellowships for PhD and post-doctoral research in agriculture at foreign universities to enhance knowledge transfer to the region; support to foreign researchers willing to focus on research in the GCC; grants/loans for agricultural research in reputable institutes abroad with established capital from GCC countries.
- Grants/Loans to enhance absorptive capacities (similar schemes exist in the Arab Fund for Economic and Social Development). Funding of feasibility studies and project preparations, seminars and conferences, institutional support and training, general studies and research.

R&D system performance is linked to strong governance. Examples of strong governance referred to here are independent legal entities with their own governing boards, and various mechanisms to ensure accountability. Autonomous governance would involve representatives of each participating sector in its governing board and supervisory board. The governing board would have responsibility for all strategic decisions, aligned with the objective of the fund to safeguard resources for research and extension in agriculture. This board should be accountable and legally liable to a supervisory board comprised of members and beneficiaries. The composition of the governing board should include a wide range of skills and competences—from specialized knowledge in agriculture to the expertise required to oversee all the functions performed by the fund.

To ensure coordination and consensus-based priority setting, a platform of regional experts and high-level political representatives is desirable. However, the sustainability of the system is not guaranteed without stable public sector support.[71] Therefore, political support and commitment are critical in defining policy frameworks and institutionalizing various coordination mechanisms. The main role of the platform would thus be to set priorities and regional strategies for

agricultural research, as well as to revise them based on regular progress assessments.[72]

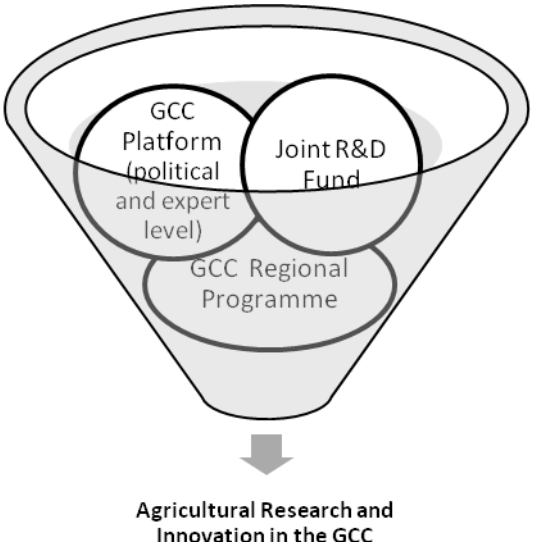
The network established by ICARDA's program could serve as a starting point for region-wide governance of scientific and technical expertise. Building on the established coordination mechanisms of this program, a stronger platform will allow actors from across the chain to further strengthen regional research capacities and human resources through education and training, and to improve agricultural extension. This program should also involve the private sector across the chain (besides growers, producer organizations, agroprocessors, importers, input suppliers, other credit agencies, standards agencies, etc.) and ensure their presence at all levels of coordination.

Some of this coordination should emerge spontaneously once appropriate incentives are put in place (sustainability of funding through the joint R&D fund), as well as regional priorities and strategy have been defined through policies and instruments. Innovations do not require thorough advanced planning. Once the enabling environment has been established, creative actors across the chain guide adaptation and elicit changes in their organizations.[73]

Figure 0.19

Framework of a GCC Agricultural Innovation System

1. **GCC R&D Fund for Agriculture** to ensure increased financial support for R&D activities based on regional priorities in agriculture.
2. **GCC Platform for Agriculture at political and expert level** to decide on research priorities and research policy instruments for the region.
3. **Expansion of ICARDA's Arabian Peninsula Regional Program** to further build on the areas and priorities decided by the GCC Platform for Agriculture.



The Water–Food Security Nexus

Most of the water utilized in GCC countries comes from rain, springs, groundwater reserves, and increasingly from desalination, while to a lesser extent from treated wastewater. The agricultural sector accounts for the overwhelming majority of the withdrawal of water resources, followed by the domestic and then the industrial sectors. While water demand is rising rapidly in all sectors, it is increasing the most in the domestic sector as a result of population growth and changing living standards.

Without rainwater,[74] GCC countries are water deficient by more than 19 billion m^3 meaning that they are withdrawing more water than they are replenishing. This is worrisome, particularly with regards to groundwater resources, as they are the main source of water that most GCC countries rely upon. With the advent of climate change, additional pressure on water resources is expected.

Table 0.11

Water Resources Availability in GCC (MCM/yr)*

Type water resources		Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	United Arab Emirates	Total
Rainfall		63.1	2156.0	38690	857.7	126800.0	6521	175088
SGW**	Surface water	4.0	0	1050	0	2200.0	150	3404
	Groundwater	112.0	20.0	1300	58.0	2200.0	120	3840
Non-conventional	Wastewater	61.9	250.0	37	58.0	547.5	289	1243.4
	Desalinated	102.4	420.2	109	180.0	1033.0	950	2794.6
SGW+ non-conventional		280.3	690.2	2496	296.0	5980.5	1509	11252
Total supply with rainfall		343.4	2846.2	41186	1153.7	132781.0	8030	186340.3
Withdrawal	Agricultural	159.2	491.9	1168	262.0	20830.0	3312	26223.1
	Industrial	20.3	23.3	19	8.0	710.0	69	849.6
	Domestic	177.9	448.3	134	174.0	2130.0	617	3681.2
Total withdrawal		357.4	963.5	1321	444.0	23670.0	3998	30753.9
Balance	without rainfall	-77.1	-273.3	1175	-148.0	-17689.5	-2489	-19501.9
	with rainfall	-14.0	1882.7	39865	709.7	109111.0	4032	155586.4

Notes: (*) Million cubic meters/year; (**) surface and ground water

Source: UN Food and Agriculture Organization (FAO), Aquastat Database, 2012 (http://www.fao.org/nr/water/aquastat/main/index.stm), accessed February 2012.

Average GCC per capita water consumption hovers at around 800 m^3 per year (which is higher than Japan or China) while there is much less total renewable water per capita. Regional water demand is expected to double by 2030. This prospect, together with low groundwater recharge ratios, heralds a gloomy picture.

Table 0.12

Water Resources and Withdrawal in GCC (2003–2007 average)

	Annual Renewable Water per Capita	**Annual Water Withdrawal per Capita**
Bahrain	125.3	386.0
Kuwait	8.2	441.0*
Oman	546.7	515.8
Qatar	49.2	376.9
Saudi Arabia	94.1	928.1

UAE	27.7	739.5

Notes: (*)Data for 1998–2002.

Source: FAO, Aquastat Database, op. cit.

Compared to other countries, the GCC states tend to have a large water footprint, which is not in line with the prevailing scarcity of water resources.[75] For example, the GCC water footprint is much larger than most other countries reported in Table 0.13, when agriculture is not taken into account, while these are not water scarce countries.[76]

Table 0.13

Water Footprint: World Comparisons (1996–2005)

Country/ Region	Production (m^3/yr/cap)			Consumption (m^3/yr/cap)			Total
	Agriculture	Industry	Domestic	Agriculture	Industry	Domestic	
GCC	589	27	116	1835	75	118	2761
ESCWA	978	64	75	1463	40	64	2683
Australia	7001	22	58	2128	129	58	9395
Brazil	2647	46	56	1926	46	56	4775
Germany	637	42	27	1259	140	27	2131
Netherlands	336	18	10	1259	198	10	1829
Turkey	1629	37	63	1510	70	63	3370
USA	3289	246	111	2398	334	111	6489

Source: M.M. Mekonnen and A.Y. Hoekstra, "National Water Footprint Accounts: Production and Consumption; Vol. 1: Main Report," Research Report Series No. 50, UNESCO-IHE, University of Twente, The Netherlands, 2011.

Water footprints related to agricultural activities take the largest share of the total water footprint of the region, accounting for 88 percent (with the highest rates in the UAE, Oman, and Saudi Arabia) despite the fact that the sector contributes only 1–2 percent of the region's GDP. The water footprint related to agricultural and industrial and domestic sectors for the period 1996–2005 in the GCC was 22.2 billion m^3 per year, of which 27 percent was from rainfall, 50 percent from ground and surface water, and the remaining 23 percent from desalination and wastewater.

Table 0.14

Water footprint in the GCC (1996-2005)

	Agriculture	Industry	Domestic	Total
Production (m^3/yr/cap)				
- Rainfall	200.4	--	--	200.4
- SGW(*)	349.8	1.4	12.0	363.2
- Wastewater	39.2	26.0	103.9	169.2
- Sub-total	589.4	27.4	115.9	732.8
Consumption (m^3/yr/cap)				
- Internal	478.2	13.6	117.9	609.7
- External	1357.3	61.6	--	1418.9
- Sub-total	1835.4	75.3	117.9	2028.6
Total water footprint	2424.8	102.7	233.8	2761.3

Notes: (*) = surface and ground water.

Source: Mekonnen and Hoekstra, op. cit.; and ESCWA calculations.

The largest segment of the water footprint of the region results from the consumption of goods and services – 73 percent of the water footprint – while productive activities account for the remaining 27 percent.

The virtual water flow for the period 1996–2005 for the GCC was positive and amounted to about 33 billion cubic meters per year or approximately 1,000 cubic meters per year per capita.[77] Keeping in mind the fact that GCC countries are well below the severe water scarcity threshold of 500 cubic meters per year per capita in terms of water availability, the importance of virtual water for the region becomes apparent. Of the above virtual water flow, about 73 percent is accounted for by rainwater (mostly as a result of imported rain-fed products such as cereals), 15 percent by surface and ground water, and 12 percent by wastewater. The largest share of the virtual water flows in the GCC is related to international trade in agricultural related products (96 percent), while trade in industrial products represented the remaining four percent.[78]

Table 0.15

Virtual Water in the GCC (1996–2005)

	Agriculture		Industry	Total
	Crops	Livestock		
Water import (m^3/yr/cap)				
- Rainfall	756.8	243.9	--	1000.7
- SGW(*)	218.9	27.5	9.6	256.0
- Wastewater	103.6	9.3	118.0	234.0

- Total	1082.3	280.7	127.7	1490.7
Water export (m^3/yr/cap)				
- Rainfall	164.5	39.5	--	203.9
- SGW(*)	73.7	9.1	4.9	87.8
- Wastewater	28.9	2.3	75.6	106.8
- Total	267.1	50.9	80.5	398.5
Balance (m^3/yr/cap)				
- Rainfall	592.4	204.4	--	796.8
- SGW(*)	145.1	18.3	4.7	168.1
- Wastewater	77.7	7.1	42.5	127.2
- Total	815.2	229.8	47.2	1092.2

Notes: (*) = surface and ground water.

Source: Mekonnen and Hoekstra, op. cit.

There is a question of to what extent the prevailing water scarcity is reflected in the price of water in the GCC countries and in their production patterns. Given the fact that externalities and scarcity are seldom included in the price of water, most particularly for agricultural water, it cannot be expected that production and trade patterns will automatically account for regional water scarcity patterns.[79,80] Therefore, the import of virtual water is often unrelated to relative water scarcity.[81]

Moreover, as a development tool, irrigation can also have developmental opportunity costs, as it involves the transfer of resources from other activities to subsidize the schemes, though without adding significantly to domestic value added.[82] The resources mobilized to promote irrigation – financial and others – could be used more effectively in supporting other economic areas such as agricultural R&D, agro-processing, or in assisting producers of such commodities as fruit and vegetables or fisheries so they could adopt more efficient production techniques.[83]

Figure 0.20

Fertilizers and Water Returns

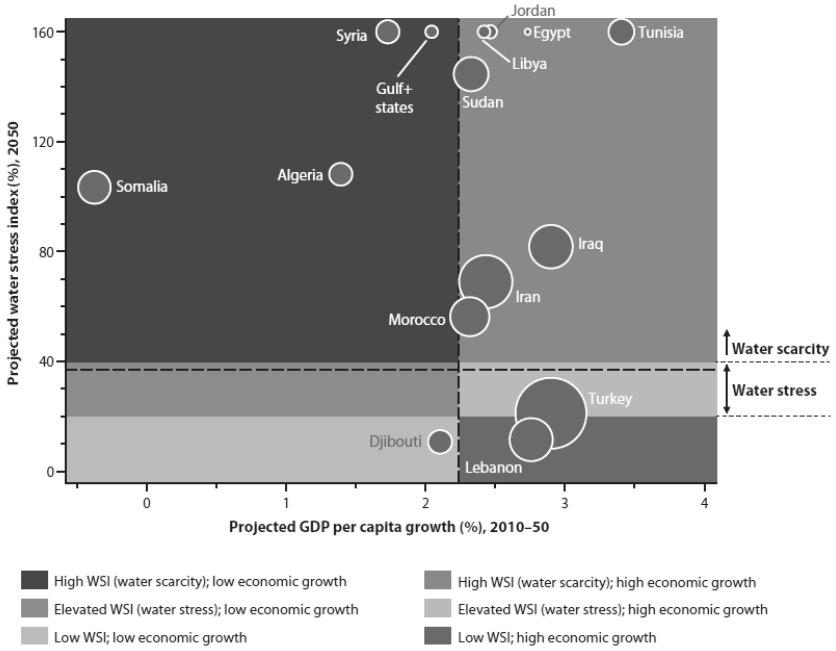
Although the application of fertilizers can improve yields and returns to water, this is not always an economically viable option, particularly in dry climatic zones, as some fertilizers – e.g., nitrogen – do not respond well when annual rainfall is below 900 mm. Irrigation poses serious environmental risks (increased salinity, drop of the water table, etc.) and high costs, while the use of desalinated

water, despite becoming gradually competitive with groundwater withdrawals, is not a viable alternative either because one needs to add high energy, the environmental impact of its processing cycle, as well as high transport costs to inland areas. Thus, small increases in yield levels would have to be expected, which would not be sufficient to generate enough gains to pay for the cost of fertilizers let alone other costs such as irrigation and water.

Projections of IFPRI's IMPACT model indicate that the Gulf+ countries (GCC+Yemen) and are further following a growth path of inefficient water use, where water stress levels are far above regional and world averages. In addition to sea water desalination, improving water use efficiency and waste water recycling should be considered within a package of measures to promote sustainable growth.[84]

Figure 0.21

Water Stress and Economic Growth Outlook



Notes: Gulf+ states include GCC and Yemen.

Source: C. Breisinger, O. Ecker, P. Al-Riffai, and B. Yu, "Beyond the Arab Awakening: Policies and Investments for Poverty Reduction and Food Security," IFPRI Food Policy Report no. 25, 2012, based on IFPRI's IMPACT model estimation.

Figure 0.21 shows the relationship between projected water stress in 2050 and projected long-term economic growth from 2010 to 2050. Water stress in a country is measured by the Water Stress Index (WSI)—an index developed by Veolia Water (2010). A country is considered "water stressed" if the WSI value is between 20 and 40 percent, and "water scarce" if the index value is above 40 percent. The volume of a bubble is proportional to the total internal renewable water resources per capita in 2010. The dashed horizontal line represents the global average WSI value projected for 2050. The dashed vertical line represents the global average economic growth rate projected for 2010–50.

The GCC countries will hence have to switch in the long run from productive efficiency to allocative efficiency. Productive efficiency implies that current users would endeavor to use their water more efficiently through the adoption of techniques such as drip irrigation to replace flood irrigation while, on the other hand, allocative efficiency requires that the available water is used in areas where it could be the most efficient. Thus, water would have to be re-allocated within agriculture as well as to sectors such as industry or domestic, where it would have a much greater value and could generate more income from a unit of water than cereal production[85,86] (see Figure 0.22 for an example).

Figure 0.22

Allocative Efficiency

Wheat yields in the GCC and other selected countries are as follows: Kuwait (3.5 mt/ha), Oman (3.6), Qatar (3.0), Saudi Arabia (6.5), United Arab Emirates (2.6); and then Canada (2.8), France (7.0), United States (3.1) and the world average (3.0).[87] Wheat production in Canada, France and USA is largely rain-fed, while in GCC countries it is irrigated. Generally speaking, under irrigated conditions yields tend to be well above average and in our case they will be assumed at an average of about 5 mt/ha, assuming that an adequate amount of fertilizers is used. This production will require about 7,500 cubic meters of water per hectare. At an average 2012 price of $300 per mt of wheat, the value added to each cubic meter of water is thus $0.2 ($1,500/7,500 m^3). In contrast, about 333 cubic meters of water are needed to produce one mt of melons. In 2011, one ton of melons was

worth $575,[88] for a value added of about $1.7 for each cubic meter of water consumed, which is nearly ten times more efficient than producing wheat. This is an example of allocative efficiency that could be expected by switching crops.[89, 90]

Table 0.16

Water Use Efficiency for Selected Commodities

	Wheat	**Beef**	**Poultry**	**Milk**	**Melon**	**Oranges**	**Aluminum**
Yield*	5,000	210	1.6	7,000	30,000	20,000	1,000
Price ($/Ton)	300	4,500	2,000	421	575	750	2,203
Water (m^3/kg)	1.5	20.6	5.5	0.748	0.333	0.4	0.005
Total water consumed	7,500	4,317	8.8	5,236	9,990	8,000	5
Total value**	1,500	945	3.2	2,945	17,250	15,000	2,203
Value added per unit of water ($/$m^3$)	**0.20**	**0.22**	**0.36**	**0.56**	**1.73**	**1.88**	**441**
Efficiency to wheat	---	1	2	3	9	9	2,203

Notes: (*) kg/hectare for crops, kg/animal for livestock and output for aluminum; (**) $/hectare for crops and $/ton for livestock and aluminum.

Sources: UN Food and Agriculture Organization (FAO). FAOSTAT, 2012 (http://faostat.fao.org/default.aspx); M. Krieth, "Water Inputs in California Food Production," Water Education Foundation, 1991; G. Lucier and L. Glaser, "Vegetables and Melons Outlook," VGS-3445, ERS, USDA, Washington DC, 2012; and A. Earle, "The Role of Virtual Water in Food Security in Southern Africa," Occasional Paper No. 33, Water Issues Study Group, SOAS, University of London, UK, 2001.

In most parts of the region, water consumption is not properly billed and therefore is heavily affected by generalized free-riding problems. Moreover, indiscriminate incentives – such as price support, subsidized credit, and energy subsidies (Table 0.17) – encourage excess water use for irrigation. Consequently, water consumption continues to increase.

Table 0.17

Water Irrigation Subsidies

	Price Support	**Subsidized**	**Energy**

		Credit	Subsidies
Saudi Arabia	X	X	X
Bahrain		X	X
Oman	X	X	X
Qatar		X	X
Kuwait		X	X
UAE	X	X	

Source: Breisinger, van Rheenen et al. (2010).

Traditionally, governments have focused on increasing the supply of fresh water by identifying and developing new sources of water supply, regardless of cost. GCC countries have been increasingly turning to options such as desalination[91] and treatment and reuse of wastewater[92] to complement the usual methods of water supply, i.e., groundwater pumping, rainwater and runoff harvesting, and so on. However, now emphasis should be increasingly devoted to managing water demand through innovative policies and programs that promote more desirable patterns and levels of water use.

Water would need to be priced at a rate that reflects its scarcity in order to encourage productive efficiency. Doing so would encourage farmers to switch to productions that are less water intensive or crops that have a higher market value. Such a move would constitute a first step towards a gradually more radical allocative efficiency.

Moreover, a number of water-saving initiatives can be taken as follows:

- Adopt regulations and subsidies to help shift from flood irrigation to modern water-saving technologies such as drip, sprinkler, fertigation, and hydroponic irrigation. These modalities allow localized application of both water and fertilizers resulting in their savings and lower environmental impact.
- Water cost recovery through metering and billing.
- Heavily invest in wastewater collection, treatment, and redistribution.[93]
- Raising awareness and community participation.

Closing Remarks and Next Steps

Given the globalized markets characterizing the cereal sector and consequently the limited capacity of the small GCC countries to effectively stabilize them, the regional level takes particular prominence because of the interconnectedness of challenges and markets in the GCC region.

A multi-pronged and multi-scale strategy is therefore advisable to effectively address food security concerns in this region. Analysis conducted in this paper leads into the following strategic directions: (i) assessing more thoroughly a regional food reserve to reduce potential market disruptions; (ii) investigating opportunities for a region-wide procurement system based on innovative financial instruments; (iii) consolidating agricultural R&D systems and enhancing their impact; and (iv) achieving more efficient water use and governance through assessing water footprint of production, consumption, and trade patterns.

The implementation of viable safety nets and sustainable land deals abroad are crucial complementary tools for an effective and comprehensive food security strategy. If well-targeted, safety nets may be less costly than establishing strategic reserves,[94] but they do not protect consumers from potential cereal supply shortages and resultant panic that often results in hoarding or pilferage in times of acute crisis. Knowing that such reserves are available may prevent potential panic and reduce future market disruptions.

Below are some immediate key steps to move in the proposed direction, divided into two main clusters:

1. Data Collection, Feasibility Studies and Future Research Activity

- As a matter of priority, consumer price statistics and price monitoring systems in the GCC should be strengthened in order to allow a proper analysis of price trends and their impact on the vulnerable income groups.
- Systematically use such data for the design and implementation of evidence-based and accurately targeted safety net systems.
- More research is needed in analyzing food price transmission channels and dynamics, as well as their tendency toward downward stickiness in the GCC countries.

- Conduct a feasibility study on the potential realization of a GCC-wide grain reserve including suitable governance options.
- Conduct a feasibility study on the opportunity of establishing a GCC-wide harmonized and, eventually, joint cereal procurement system based on an integrated platform.
- Further investigate the basis risk constraining potential hedging strategies for specific cereal markets in the GCC.
- More research is also needed between the trade-offs of water use in agriculture, residential and industrial use taking into account new technologies available for wastewater treatment and reuse.
- Make more systematic use of water footprint and water balance analytical toolkits in the food security policy discussion.
- Finally, regional dietary patterns of over-consumption of food items such as sugar, cooking oil, and meat with high fat content can increase the risk of obesity, coronary disease, diabetes mellitus, and colon cancer. This is an area that deserves closer investigation.

2. Short- and Medium-term Policy Actions

- Small GCC countries such as Qatar and Bahrain could benefit from importing cereals on vessels shared with larger countries such as Saudi Arabia or the UAE.
- Consolidate grain purchases around a few reliable traders that can reduce risks of non-compliance with procurement contracts.
- Target investment in key bottlenecks in supply-chain logistics and infrastructures.
- Have a regional discussion and adopt clear proposals on how to make commodity-based financial instruments compliant with cultural and religious criteria, and start reforming the legal and regulatory framework accordingly.
- Increase budget allocations and strengthen the governance of the regional agricultural R&D system, capitalizing on already existing

initiatives such as ICARDA's APRP, in support of sustainable agricultural and water-saving R&D activities.

- Gradually move towards economically and environmentally viable water governance arrangements, including better cost recovery through metering and billing.
- Sustainable and evidence-based strategies should be further examined on how GCC countries can best engage in land deals with developing countries endowed with large agricultural potential.
- But first and foremost, a food security regional platform could be created and could serve as a vector for policy discussion of all the above-mentioned actions that may eventually feed into a region-wide food security strategy.

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Notes

[1] In this paper, "Arab Gulf states" are the GCC countries, namely Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE.

[2] Food security has a macro and a micro dimension. The macro-level dimension largely depends on the food import dependency relative to a country's ability to finance those imports at any point in time (*availability* of food). The micro-level dimension refers to households' *access* to healthy and nutritious food.

[3] According to FAOSTAT, wheat and rice together account for 39%, 44%, and 40% of total energy intake in Saudi Arabia, UAE, and Kuwait, respectively.

[4] Saudi Arabia's share of cereals is 52% of the country's food consumption accounting for over three quarters of GCC total cereal consumption despite constituting around two thirds of the GCC total population, in 2007. Overall, Saudi Arabia imports two thirds of GCC total food imports. Economist Intelligence Unit, "The GCC to 2020," London, 2009.

[5] However, in Saudi Arabia there is a very particular preference for barley, followed by wheat. In Bahrain, Kuwait, and Qatar there is a relatively higher demand for animal produce compared to cereals.

[6] Various Authors, "Food Security," *Special Issue: Food Security in the Arab World*, vol. 3, supplement 1, Springer, February 2011.

[7] Despite the drastic cereal yield improvement in the past three decades due to mechanization and an increasingly input-intensive production pattern, with latest yields being around five times those of the early 1980s, poor soil quality and

scanty water resources are an insurmountable obstacle to cereal production in the region.

[8] With the exception of Saudi Arabia, the GCC region imports all of its cereal demand, which averages less than 90% when Saudi Arabia's wheat production is included. However, the Saudi decision to put an end to the subsidized production of wheat by 2016, although totally sensible, will eventually lead to a higher cereal import dependence of the region. Maize and rice are already totally imported.

[9] In 2010, the GCC population was about 41.5 million and expected to reach 53.4 million by 2020 (Economist Intelligence Unit, op. cit.). Around 63% of the GCC total population is Saudi. Almost 70% of the Saudi population is less than 30 years old, while the share in Bahrain, Kuwait, Qatar, and UAE is estimated to be 54%, 48%, 50%, and 44%, respectively.

[10] Urbanization rates in Kuwait, Oman, Saudi Arabia, and UAE are 98%, 72%, 82%, and 78%, respectively. The overall GCC average is around 86%.

[11] Obesity rates in the region have continuously increased with Saudi Arabia being the country with the highest obesity rate in the world at 35.6% (when Pacific islands are not considered) followed by the United States (33.9%). Four GCC countries (UAE, Bahrain, and Kuwait in addition to Saudi Arabia) are ranked in the top ten (WHO BMI Database accessed on March 20, 2012). This also reflects on diabetes rates that are among the highest in their income groups.

[12] Consumer price statistics and price monitoring systems in the GCC are still insufficient and do not allow a proper analysis of price trends and their impact on various income groups.

[13] This means that for any 1% point increase in world food prices, domestic prices tend to increase by at least 0.2%. However, with the exception of the UAE, the price transmission is asymmetric and highly downward-sticky: a decline in world food prices does not transmit into domestic food markets as much as an increase does (see Figure 0.5). These transmission patterns are also due to a number of country-specific factors, such as exchange rate regimes, inefficiency of subsidy systems, levels of competition among importers and wholesalers, supply chain characteristics, infrastructure, etc. Food price transmission typically takes about one year to show its effects on domestic markets. However, in most of the GCC countries it takes on average about seven months (World Bank, "Regional Economic Update: MENA Facing Challenges and Opportunities," Middle East and North Africa Region, 2011; E. Ianchovichina, J. Loening, and C. Wood, "How Vulnerable are Arab Countries to Global Food Price Shocks?" World Bank, 2012.

[14] See, for example: UN Food and Agriculture Organization (FAO), "Safeguarding Food Security in Volatile Global Markets," 2011; and World Bank, "Managing Food Price Risks and Instability in an Environment of Market Liberalization," Agriculture and Rural Development Department, Report No. 32727-GLB, 2005.

[15] Fertilizer prices have also been quite volatile and remained at higher levels, with February 2012 prices being 2.59 times 2005 average prices (Word Bank, Commodity Markets Review, March 2012).

[16] Low elasticities also imply that small shocks to production can have large price impacts. According to the FAPRI database, demand and supply elasticities for wheat in the Middle East region are -0.15 and 0.09, respectively, compared to -0.16 and 0.24 for Mexico, -0.39 and 0.41 for Argentina, and -0.34 and 0.29 for Eastern Europe. Saudi demand elasticity for rice is set at 0.1 *vis-à-vis* 0.46 for Mexico, 0.11 for Argentina, 0.38 for the EU. Saudi demand elasticity for barley is estimated at -0.19, vis-à-vis -0.24 for Mexico, -0.17 for Argentina, -0.35 for Eastern Europe (www.fapri.iastate.edu/tolls/elasticity.aspx).

[17] World Bank (2009).

[18] For example, in the 2010 budget, Saudi Arabia allocated $12.3 billion to the agriculture and water sectors *vis-à-vis* $10.4 billion of private investment on agricultural projects (NCB Capital, "GCC Agriculture: Bridging the Food Gap." Economic Research, March 2010).

[19] About 40% of the GCC population is made up of expats, with the UAE, Qatar, and Kuwait ranging between 69% and 85%, while Oman, Saudi Arabia and Bahrain range in the 28–39% share (International Labor Organization [ILO], "International Labor Migration and Employment in the Arab Region," Thematic Paper, Beirut, 2009; and EIU, op. cit.). Three quarters of the UAE labor force is estimated to be made up of Asian expats. The share of Arab labor in the Gulf has declined from a peak of 72 percent of all inward migration in the beginning of the 1970s to an estimated 23% in 2005 (ILO, op. cit.). Qatar, Saudi Arabia and Kuwait tend to employ the highest number of non-national Arab workers (between 30% and 40% of the total foreign workforce) among the GCC countries, whereas in the United Arab Emirates and in Oman the share of Arabs among non-national workers is below 10%.

[20] Various Authors, 2011, op. cit.

[21] There is a clear relationship between population growth and increased demand for cereals for human consumption, on the one hand, and between rising income and growing demand for feedstock, on the other.

[22] Highest of the four GDP growth rates from the Millennium Ecosystem Assessment GDP scenarios, and the rate used in the baseline. Low variant of UN population forecasts (http://esa.un.org/unpp/index.asp). For further methodological details, please see: Gerald C. Nelson, Mark W. Rosegrant, Amanda Palazzo, Ian Gray, Christina Ingersoll, Richard Robertson, SimlaTokgoz, Tingju Zhu, Timothy B. Sulser, Claudia Ringler, Siwa Msangi, and Liangzhi You, "Food Security, Farming and Climate Change until 2050: Scenarios, Results and Policy Options," IFPRI Research Monograph no. 172 2010.

[23] Usually, international agencies do not have reliable data on changes in cereal stocks and estimate these as a residual of production, consumption and trade

estimates. Major exporters' stocks-to-disappearance ratio measures the share of stocks held by the top five exporters on their total consumption plus exports.

[24] For example, in 1972–1973, a reduction in world wheat production of less than 2% at a time when stocks were very low, caused the grain price to more than double (B. Wright, "International Grain Reserves: And Other Instruments to Address Volatility in Grain Markets," FAO Working Paper, 2009; and S. Wiggins, S. Keats, and Julia Compton, "What Caused the Food Price Spike of 2007/08? Lessons for World Cereals Markets," Overseas Development Institute, London, UK, 2010).

[25] Over the period 2009–2011, 12–13% of world grains production was exported. Wheat recorded the highest ratio among grains hovering around 20%, while rice has the lowest ratio with only about 7% (US Department of Agriculture [USDA], "World Agricultural Supply and Demand Estimates," WASDE 503, February 2012).

This entails that small shifts in supply or demand can lead to large shifts in prices. Rice is particularly affected by market volatility as it is also characterized by a highly segmented market along different types and qualities.

[26] Saudi Arabia is also the world's largest importer of barley (averaging 7–8 million metric tons) that is used as feedstock for its large domestic livestock industry.

[27] Cereal supply on international markets is concentrated in six main exporters, namely Argentina, Australia, Canada, EU, Russia, and USA. The world's largest exporters (i.e. USA, for wheat, and Thailand and Vietnam, for rice) are underrepresented in the GCC region's trade exchanges. Russia and Central Asia have been large suppliers of the region for a short period but alleged lower quality grains and the 2010 Russian export ban led to supply disruptions and a quick shift in the geography of suppliers.

[28] Although supply risk usually arises from poor logistics such as few import entry points and limited unloading capacity, the GCC region is potentially affected by this type of risk because of the supply disruptions experienced in some key exporters in the recent past.

[29] The wheat stock levels at the Grain Silos and Flour Mills Organization (GSFMO) silos have been estimated at around two million mt, equal to about 9–10 months of domestic demand, which is one of the highest known levels (USDA, op. cit.). Within the Arab region, Egypt is reportedly the largest holder. According to available estimates, China, India and USA hold around half of the world's wheat reserves (USDA, op. cit.).

[30] These reserves often serve as both operational and strategic storages.

[31] UN Food and Agriculture Organization (FAO) and World Bank, "The Grain Chain, MENA Region," 2012. Here there is an assumption of constant unit costs which should be considered a good approximation in regions like the Arab Gulf where humidity is low, modern infrastructure is available, and are integrated in the global markets. The overall cost summing up port logistics, storage, inland transport, and management (which in turn includes product loss, cost of capital,

and overheads) are on average $42 per mt of wheat, equal to around one eightieth of the current price of wheat on international markets (D. Larson, J. Lampietti, C. Gouel, C. Cafiero, and J. Roberts, "Food Security Storage in the Middle East and North Africa," World Bank, 2012). To this one needs to add transport costs which in the case of the Arab region is set on average at $35.5 per mt (FAO and World Bank, op. cit.). Therefore the total cost which includes transport, logistics, storage, and management sum up to around $77.5 per mt or around one quarter of the wheat price of one metric ton. In Saudi Arabia, all these operations are carried out by the Grain Silos and Flour Mills Organization (GSFMO). In Oman, Qatar, and Bahrain a milling company controls most of the supply chain in each of those countries. The company often has both private and public shareholders.

[32] Jordan reports the lowest storage costs in the region ($1.7) while Tunisia the highest ($3.5).

[33] To this cost one needs to add the market cost of wheat, which is currently around $270–300/mt (US wheat), thereby resulting in a purchase of about $700 million and therefore in an overall cost of around $750 million. In terms of opportunity cost, low interest rates resulting from the global financial crisis reduce the relative price of storage and global economic uncertainty encourages the purchase of real commodities (J.A. Frankel, "The Effect of Monetary Policy on Real Commodity Prices," in John Y. Campbell (ed.), *Asset Prices and Monetary Policy*, NBER Working Paper 12713, 2008).

[34] Martin and Anderson emphasize the reversibility of trade openness, as evidenced by collective action problems posed by recent episodes of export restrictions (W. Martin and K. Anderson, "Export Restrictions and Price Insulation during Commodity Price Booms," *American Journal of Agricultural Economics*, vol. 94, no. 1, 2012, pp. 422–427). Storage–trade complementarity and the right mix of these policies have therefore been increasingly studied and found to provide a powerful stabilization tool while tapping also into efficiency gains (S.S. Makki, L.G. Tweeten, and M.J. Miranda, "Storage–Trade Interactions under Uncertainty: Implications for Food Security," *Journal of Policy Modeling*, vol. 23, no. 2, 2001, pp. 127–140; C. Gouel, and S. Jean, "Optimal Food Price Stabilization in a Small Open Developing Country," World Bank, 2012). Hence. strengthening WTO rules on export control would be an important pillar of a global multi-pronged strategy.

[35] M. Torero and J. von Braun, "Alternative Mechanisms to Reduce Food Price Volatility and Price Spikes," IFPRI, Washington DC. 2009.

[36] Since Saudi Arabia is part of the G20, it should become an active member of such discussions, bringing up in that forum the interests of the other GCC members and of the wider Arab region, given that many of the challenges and stakes are common to all.

[37] Some regional economic groups have already responded to the price hikes by establishing or strengthening their regional responses. For instance, in West Africa, ECOWAS has launched a program promoting regional value chains for rice and maize. The East Africa Community is developing a regional food

security strategy. ASEAN has recently reformed the ASEAN Emergency Rice Reserve (AERR) and established the East Asian Emergency Rice Reserve which has expanded its regional stocks and strengthened its governance framework.

[38] When a replenishment rate is to be chosen, logistics costs need to be taken into account, as there is an inverse relationship between the latter and the cost of replenishment. In addition, a high rate needs to factor in the risk of purchasing reserves exactly when international markets are tight and spikes have emerged. Conversely, a low rate tends to smooth the cost curve over a longer time period. All else being equal, a large stock size would typically allow a lower replenishment rate (for an in-depth discussion, please see: Larson, et al., op. cit.).

[39] For instance, given that national wheat prices do not systematically co-move as reported in Figure 0.7, prices can exceed the ceiling in one country but not in another. This kind of situation would need to be clearly regulated.

[40] The closest example to this organizational and governance framework is that of a central bank whose independence and arm-length relationship with governments is crucial for implementing a successful monetary policy. However, independence is normally a serious challenge since food security is a highly politically-charged topic.

[41] More specifically, when comparing Saudi Arabia's average vessel turnaround time with that of Bahrain or Qatar, it shows 3–4 times higher turnaround time. (FAO and World Bank, 2012, op. cit.).

[42] Given the ownership structure of grain reserves in the GCC countries (see note no. 31), the risk of crowding out seems relatively lower.

[43] This is one more reason that supports the idea of holding a storage hub at the main entry ports of the GCC countries so as to save logistic-related costs.

[44] C. Breisinger, O. Ecker, J. Funes, and B. Yu, "Food as the Basis for Development and Security: A Strategy for Yemen," IFPRI Discussion Paper 01036, 2010.

[45] The Chicago Board of Trade uses a system that examines price and volume data to determine an "accepted" price range based on their distribution. The prices that make up 70% of the trade are normally considered the "value area" and prices about two standard deviations away from the mode are deemed as outside the range bound (Agricultural Market Information System [AMIS], "Enhancing Market Transparency," Rome, 2011). However, the economic literature has been divided on whether a clear commitment to a pre-announced price band can be really effective in limiting the risk of hoarding and speculations (see Newbery and Stiglitz, 1981, in favor of this position; and B. Wright, "International Grain Reserves: And Other Instruments to Address Volatility in Grain Markets," FAO Working Paper, 2009; and J.C. Williams, and B. Wright, *Storage and Commodity Markets* [Cambridge: Cambridge University Press, 1991], showing that price bands actually tend to increase price volatility and speculations). According to the latter, if speculators sense that the price is dangerously getting closer to the price band limit and stocks are insufficient to maintain the targeted price band, they will rush to buy the necessary amount of

extra stocks that will shoot price up beyond the set band. This contributes to explain the rationale that commodity price cycles tend to exhibit long flat bottoms punctuated by occasional sharp peaks.

[46] Some cereal producers, such as Quaker Oats, also lock in the price of corn and oats using forward contract with growers. Anheuser Busch and Dole, two large beverage companies, use such a contract to lock in the price of grains and fruits used to make their beverages.

[47] The former is an agreement to receive a commodity on a pre-determined date at an agreed upon price with a standardized delivery period, contract size, and quality; the latter is a contract that gives the client the right to buy a commodity future contract at a negotiated price and time. Options are therefore a kind of insurance mechanism against the occurrence of future price rises. The right to call the option costs a price premium.

[48]Practical case studies come from Malawi and Mexico, which employed a hedging strategy for food security. Malawi is self-sufficient in maize, but in years of poor growing conditions and a shortfall in domestic production the Government of Malawi must fill the gap by imports. The government needed not only to hedge the financial cost, but also to ensure the delivery of physical maize. In September 2005, Malawi bought a physical call option to purchase 60,000 mt of maize at the September price of physical maize for delivery from November 2005 to February 2006. The option premium was $25.5/mt. In December, when maize shortage became apparent and since maize and transportation prices had increased, the Government exercised the option. Compared to buying at December prices for immediate delivery, the Government of Malawi made significant savings of around $25–$65/mt and delivery took place smoothly. If prices had decreased between September and December, the Government of Malawi would not have exercised the option and the cost would have been limited to the option premium (World Bank, "Risk Management & the Global Food Crisis," Agriculture & Rural Development, 2008).

[49] World Bank, UN Food and Agriculture Organization (FAO), and International Fund for Agricultural Development (IFAD), "Improving Food Security in Arab Countries," 2009.

[50] Discretionary hedging means hedging when the price is thought to be favorable, while non-discretionary hedging means purchasing hedges at regular intervals irrespective of price.

[51] Financial derivatives are risky as they can often lead to losses. Human resource capacity is therefore a particularly binding constraint because it is crucial to rely on a team of professionals able to forecast future commodity prices based on the available information on the markets. As a telling example, Southwest Airlines stayed one of the very few profitable airlines during the 2008 crisis because they rightly forecasted oil prices, unlike Continental which had large losses because they purchased fuel futures at a time when prices dropped precipitously.

[52] The possibility that spot and futures prices will not move together is called basis risk and the appropriate hedging strategy will depend on this factor. The

basis risk is due to factors such as cost of freight, handling, and storage as well as local supply and demand factors. In the GCC region, the cost of these factors should be rather stable, which should ensure low or at least predictable basis risk. However, the issue of basis risk would need to be further investigated in the specific case of food commodities in the GCC countries.

[53] Huber, Sweeney and Smyth (2004). B. Huber, E. Sweeney and A. Smyth, "Purchasing Consortia and Electronic Markets: A Procurement Direction in Integrated Supply Chain Management," *Electronic Markets*, vol. 14, no. 4, 2004 pp. 284–294.

[54] International Food Policy Research Institute (IFPRI), "A Meta Analysis of Rates of Return to Agricultural R&D," Washington DC, 2002.

[55] World Bank. "Agricultural Innovation Systems, an Investment Sourcebook," 2012.

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[56] Public expenditure on agriculture in GCC countries in 2007 varied from 0.1% of GDP in Bahrain, 0.2% in Kuwait and Oman, to 0% in the UAE (the UAE government spent 0.6% of its total expenditure on agriculture). Governments' expenditure on agriculture may vary across a wide range of activities that may not include R&D components. A recent example in Saudi Arabia is a case in point, while not necessarily applicable to other GCC countries. The Saudi government announced in 2012 the total of 0.09% of its total expenditure committed to the agricultural sector to support creation of new wheat storage and building mills in addition to the support of its existing local and foreign projects. The announcement on this budget did not, however, have any indication of intended investments in research and innovation (saudi-agriculture.com).

[57] Anderson, op. cit.

[58] A. Djeflat A, "Absorptive Capacity and Innovation Demand as driving Engines for Emerging Innovation Systems (EIS): Evidence from GCC and Maghreb Countries," 2010.

[59] A micro survey of innovative firms was undertaken in Abu Dhabi, where it has been found that innovation at the firm level predominately occurs in services rather than innovation in goods, which shows the firms' reluctance to invest in high-risk R&D (Anderson, op. cit.).

[60] World Bank, op. cit. (2012).

[61] INCONET-GCC (www.inconet-gcc.eu).

[62] Summary of E-consultation of West and North Africa (WANA) Region, by Mohammad Majdalawi for the Global Forum on Agricultural Research (GFAR), GCC participants: Bahrain, Kuwait, Oman and UAE.

[63] GCC Patent Office website (http://www.gccpo.org/)

[64] UN Industrial Development Organization (UNIDO), "Strategies for Regional Innovation System," 2003.

[65] D.A. Wolfe, "Program on Globalization and Regional Innovation Systems," Program on Globalization and Regional Innovation Systems, Centre for International Studies, University of Toronto, 2005.

[66] World Bank, op.cit. 2012.

[67] A comparison between the GCC and Australia may be sensible as they both have similar aggregate GDP, as well as climatic conditions and challenges.
[68] This ratio measures R&D investment in agriculture relative to the size of agricultural GDP.
[69] Mullen, et al. "R&D: A Good Investment for Australian Agriculture." Based on presentation to the 51st Annual Conference of AARES, Queenstown, February 13–16, 2007; latest figures available from 2005.
[70] GCC countries with available R&D spending are Kuwait, Oman, Qatar and Saudi Arabia.

[71] World Bank, op.cit (2012).

[72] Two top priority areas for the region's R&D will be: (i) solar-energy-induced water desalination and wastewater recycling; and (ii) R&D capacity building and application in Sudan that will in turn benefit the GCC region given its huge production potential and trade links (current maize yields are around 1.2 mt/ha that could be increased to about 7 mt/ha with proper technology adoption and extension services).

[73] World Bank, op.cit. (2012).

[74] Rainfall is very erratic and cannot be counted upon for activities such as agriculture.
[75]The 'water footprint' is a measure of the appropriation of freshwater resources as it assesses the water volumes consumed, evaporated or incorporated into a product or polluted.[75] The internal and external water footprint brings into play the issue of virtual water, which assesses the water embedded in a product which is exported or imported. Thus, the sum of the domestic water footprint and the virtual water imported minus the virtual water exported provide the water balance of a nation or region (M.M. Mekonnen and A.Y. Hoekstra, "National Water Footprint Accounts: Production and Consumption; Vol. 1: Main Report," Research Report Series No. 50, UNESCO-IHE, University of Twente, The Netherlands, 2011; and World Water Council, "E-Conference Synthesis: Virtual Water Trade: Conscious Choices," March 2004).
[76] The high footprint for GCC is due to domestic use (even higher than the United States) while for most other countries it is the industry which is higher, meaning that GCC countries need to seriously curb their domestic water use imbalance.

[77]In arid regions, when crop fields are watered either through rainfall or through irrigation, part of the water is absorbed by the plant, while the remainder is mostly lost through evaporation into the atmosphere, leaving a small amount of water locked inside the end-product. Yet, the quantity of water that was involved in its production was large, up to 1,500 cubic meters in the case of one mt of wheat. This is the concept of virtual water, which allows to establish a link between water, food and trade (M. Krieth, "Water Inputs in California Food Production," Water Education Foundation, 1991).

[78] It has been argued that the flow of virtual water into the Arab region – mostly in the form of grain imports – is equivalent to the annual flow of the Nile (J.A. Allan, "Virtual Water: The Water, Food and Trade Nexus: Useful Concept or Misleading Metaphor?" *Water International*, Vol. 28, no. 1, 2003). Since Saudi Arabia imports around 7.5 million mt of barley yearly that is used as feedstock (mainly from Ukraine), it is saving around 9.1 billion m^3 of water, which is about half of the current agricultural water demand. However, in 2007, the country still used 3.2 billion m^3 of water to grow 2.4 million mt of wheat.

[79] M.M. Mekonnen and A.Y. Hoekstra, "The Green, Blue and Grey Water Footprint of Crops and Derived Products," *Hydrology and Earth System Sciences* no. 15, 2011, pp. 1577–1600.

[80] D. Renault, "Value of Virtual Water in Food: Principles and Virtues," paper presented at the UNESCO-IHE Workshop on Virtual Water Trade, December 12–13, 2002, Delft, The Netherlands.

[81] D. Zimmer and D. Renault, "Virtual Water in Food Production and Global Trade: Review of Methodological Issues and Preliminary Results," World Water Council and FAO, Rome, 2011.

[82]Ibid.

[83] D. Renault, 2002, op. cit.

[84] Kajenthira, et al. analyze waste water reuse in Saudi Arabia by incorporating energy use into the water equation (A. Kajenthira, A. Siddiqi, and L. Diaz Anadon. "A New Case for Promoting Wastewater Reuse in Saudi Arabia: Bringing Energy into the Water Equation," *Journal of Environmental Management*, no. 102, 2012, pp. 184–192).

[85] Ibid.

[86] K.W. Easter and Y. Liu, "Cost Recovery and Water Pricing for Irrigation and Drainage Projects," Agriculture and Rural Development Discussion Paper 26, The World Bank, Washington, DC, 2005.

[87] FAOSTAT http://faostat.fao.org/default.aspx (last accessed 02/2012)

[88] G. Lucier and L. Glaser, "Vegetables and Melons Outlook," VGS-3445, ERS, USDA, Washington DC, 2012.

[89] D. Renault, 2002, op. cit.

[90] UN Economic and Social Commission for Western Asia (ESCWA). "ESCWA Water Development Report 3: Role of Desalination in Addressing Water Scarcity." United Nations, New York, 2009.

[91] GCC desalination capacity has been expanded and now the region accounts for almost 60% of the world's capacity (CSIS, February and March 2011), with Saudi Arabia providing up to 70% of total drinking water through the desalination process. Investment to expand desalination capacity has amounted so far to about $3 billion in the UAE and $21 billion in Saudi Arabia, and more investment has been planned for the current decade. However, desalination plants consume high amounts of fuel, thereby providing high opportunity costs.

[92] Particular emphasis should be placed on this type of reuse as wastewater is the only non-conventional water resource that will increase as GCC population, municipal and industrial sectors increase.

[93] Cognizant of the fact that it treats and reuses only 18% of the total wastewater produced, Saudi Arabia's Ministry of Water and Environment has anticipated investment needs for $23 billion in this field (U.S.-SABC. "The Water Sector in the Kingdom of Saudi Arabia." U.S.-SaudiArabian Business Council, 2009.).

[94] Larson et al. (2012).