

Food and Agriculture Organization
of the United Nations
Regional Office for the Near East



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Water-scarcity Conditions: The Case of GCC Countries**

by

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7th Gulf Water Conference

organized by

Water Science and Technology Association

Kuwait, 19-23 November, 2005

Policies for Water Management and Food Security under Water-scarcity Conditions: The Case of GCC Countries

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Abstract

After a brief presentation of the common physical and economic characteristics of the GCC countries, the paper reviews past policies on agriculture and water management in these countries, focusing on the incentive framework aimed at diversifying the economies and increasing the level of food security. It analyzes the impacts of these policies on agricultural development and highlights the main achievements in terms of increasing the level of food self-sufficiency, particularly with respect to cereals, fruits and vegetables, although the contribution of agriculture to national gross domestic products remained generally meager. In a second stage, the paper presents the water resources situation in the region, which consists essentially of non-renewable groundwater and non-conventional waters, and analyses the impacts of the above policies on the management of these resources, focusing on the depletion of strategic groundwater, water pollution problems and the low productivity and economic competitiveness of agriculture. To address this non sustainable situation, the paper proposes a strategic option, in which some countries are already embarking, for planning water resources use in a pro-active manner, based on a framework that links agriculture and water policies and which is conducive to sustaining both water resources and a competitive level of agricultural production. Elements of the policy framework are also provided and include: 1) an in-depth analysis of supply and demand, 2) an assessment of the economic and social impacts of irrigated agriculture on national economies, 3) adoption of economy-wide agriculture policies, 4) adoption of policies to promote improved water use efficiency in agriculture, 5) introduction of water services cost recovery and their linkage to incentives, 6) and enhancement of water supply and alternatives to freshwater.

Key words: water management, non-renewable groundwater, water-scarcity, virtual water, food security.

Introduction

In the GCC countries, water resources are in short supply, while demand for water is growing. Given this situation, the question of the optimal management of water resources is clearly of crucial importance, with implications not only for the future development of those countries, but also for the sustainability of their past economic and social achievements. The dilemma arises from continuing growth in demand, which is the result of population increase and other social factors, in conjunction with the fact that the region is already exploiting all its annual surface water resources, while its aquifers are becoming depleted.

Until recently, water management policies concentrated on the supply side. Driven by the optimistic agricultural policy of achieving food self sufficiency, the governments of the GCC countries directed water development projects to the continuously expanding agriculture sector. In addition, economic incentives in the form of subsidies helped in boosting agricultural production, and consequently put more stress on the available water resources.

Lacking necessary planning and future insights has led to the consumption of fossil (non-renewable) groundwater aquifers as demands exceeded the renewable water resources. It is now feared that groundwater depletion will eventually lead the GCC countries to an even more severe water crisis. During the past few years, these countries started changing their water management and food security policies, but additional measures are still needed.

The GCC countries are facing a water crisis that is becoming more critical. It is imperative to adopt realistic policies and institutional arrangements that will enable to control demand for water, apportion the available quantities along economically efficient lines, and ensure that water is used more efficiently in various sectors.

This paper reviews and outlines the agricultural and water resources policies in the GCC countries with respect to food production and their impacts on water resources sustainability. It provides a rationale for a review of these policies and gives basic elements for a policy framework that links water resources and food security, with a view of balancing water supply and demand and sustaining economic development as it relates to these sectors.

1. Background and Main Characteristics

Countries of the Gulf Cooperation Council (Bahrain, Kuwait, Oman, Qatar, Kingdom of Saudi Arabia, and the United Arab Emirates) occupy most of the Arabic Peninsula and share similar economic, social, and physiographic characteristics. They have a typical desert climate, with the exception of the coastal strips and mountain ranges, characterized by long, hot, dry summers and short, cool winters, for the interior regions, and hot, somewhat more humid summers and mild winters, for coastal regions.

The total population of the region has more than quadrupled between 1970 and 2000, going from less than 8 million to over 30 million. It stands currently at around 36 million and is expected to reach about 58 million by the year 2030. In general, the GCC countries have a similar socio-economic situation in terms of features and development with the booming of oil industry and high revenues during the last 40 years. The economy is dominated by petroleum, which accounts for 80% to 90% of merchandise export earnings except in Saudi Arabia and Oman. Agriculture accounts for a small portion of the GDP and does not constitute an important source of employment, except in Oman and, to a lesser extent, Saudi Arabia (Table 1). However, agriculture is also embedded in the population culture and bears

an important social value through amenity farms and secondary recreational residences, despite the non-profitability of this type of farming which covers an important part of the agricultural lands. However, agriculture in all GCC countries depends on irrigation and uses 80% to 90% of the water resources. .

Table 1: Agricultural contribution to GDP of the GCC countries in 2002

Country	Agricultural Labor Force (1000)	Agricultural GDP (million)	Total GDP (million)	Agricultural GDP in % of total GDP
Bahrain	3	54 US\$	7683 US\$	0.7
Kuwait	14	142 US\$	35369 US\$	0.4
Oman	358	650 US\$	20309 US\$	3.2
Qatar	4	70 US\$	17466 US\$	0.4
Saudi Arabia	680	9612 US\$	188479 US\$	5.1
UAE	71	2555 US\$	70960 US\$	3.6

Source: FAO (2004) Compendium of food and agriculture indicators

http://www.fao.org/es/ess/compendium_2004/default.asp

2. Agricultural Production and Food Security

Over the past 20-30 years, the GCC countries aimed at achieving greater level of food self-sufficiency and accordingly most of these countries adopted a policy to expand the irrigated area through economic incentives. Table 2 shows the evolution of the area under irrigation during the period between 1965 and 2002. In general, this area increased by 5% per year up until 1990, then by 1.2% per year thereafter. The areas of most crops increased steadily between 1980 and 1999 in most countries, although there were marked declines in cereals in Saudi Arabia and the UAE between 1990 and 2003 (Table 3).

The net productivity of agriculture increased two-and-half folds between 1980 and 2000 (Table 4). It increased steadily in Oman and very rapidly in the UAE, but declined in Saudi Arabia reflecting the abandoning of some areas where groundwater resources have been exhausted and because of declining prices for some crop products. A severe drop in agricultural productivity in the UAE occurred between 2000 and 2004; it is also attributed to the depletion of groundwater resources and the consequent change in agricultural policy.

Table 2: Evolution of the area under irrigation in GCC countries during 1965-2002 ('000 ha)

Country	Year								
	1965	1970	1975	1980	1985	1990	1995	2000	2002
Bahrain	1	1	1	1	1	2	4	4	4
Kuwait	0	1	1	1	2	3	5	10	13
Oman	23	29	34	38	41	58	62	62	62
Qatar	1	1	1	3	5	6	13	13	13
KSA	353	365	375	600	1,150	1,600	1,620	1,620	1,620
UAE	35	45	50	53	58	63	68	76	76
GCC Countries	413	442	462	696	1,257	1,732	1,772	1,785	1,788

Source: FAOSTAT 2004

Table 3: Evolution of cropped areas in GCC countries during 1980-2003 ('000 hectares)

Country	Vegetables and Melons				Cereals				Fruit (including dates)			
	1980	1990	2000	2003	1980	1990	2000	2003	1980	1990	2000	2003
Bahrain	0.6	0.8	1.1	0.9	-	-	-	-	4.5	1.6	1.5	2.3
Kuwait	1.3	2.9	3.8	3.9	0.1	0.5	1.2	1.7	0.0	0.4	1.4	1.4
Oman	5.3	9.4	9.2	9.4	2.7	2.4	2.5	2.5	27.1	33.4	41.6	42.0
Qatar	1.3	2.2	3.3	2.8	0.2	1.1	1.6	1.5	1.2	1.4	1.8	2.0
KSA	53.5	102.3	79.5	100.7	453.0	974.6	616.4	666.1	72.0	90.9	193.4	194.0
UAE	4.7	7.5	38.0	10.9	0.4	1.3	0.1	0.0	7.7	25.1	187.8	188.2
Total	66.7	125.0	134.9	128.6	456.4	979.8	621.7	671.8	112.6	152.9	427.5	429.9

Source: FAOSTAT 2004

Table 4: Agriculture net productivity index in the GCC countries during 1965-2004

Country	Year									
	1965	1970	1975	1980	1985	1990	1995	2000	2004	
Bahrain	44.1	45.0	79.2	141.4	100.3	87.8	101.0	103.2	110.2	
Kuwait	14.4	19.8	23.1	44.4	64.9	53.0	55.0	91.0	124.6	
Oman	13.6	15.4	21.5	35.0	53.5	59.3	66.7	97.5	91.1	
Qatar	16.6	23.2	10.9	23.6	30.6	63.4	103.5	111.7	143.9	
KSA	15.4	18.6	30.5	26.5	56.6	104.0	87.2	93.0	108.2	
UAE	3.1	4.5	5.7	10.1	15.2	21.3	41.8	140.9	53.4	
GCC Countries	107.2	126.6	171.0	280.9	321.0	388.8	455.2	637.2	631.4	

Source: FAOSTAT 2004

The policy of GCC countries to diversify their economies and to increase the level of food self-sufficiency focused on economic incentives for expanding the area under irrigation and improving crop productivity. Government provided subsidies in several forms, including wells, fuel, energy, inputs, price support programs, trade protection, and free access to unlimited amounts of groundwater most of which is non renewable. The absence of administrative and legal regulations to control pumping encouraged unlawful drilling and resulted in inefficient irrigation practices that led to the loss of more than 50% of the amounts of applied water. The subsidies increased the irrigated areas as well as agricultural production, but resulted in the mining of fossil aquifers. As a result, many farms have been abandoned in all countries and several aquifers have been either depleted or highly polluted. From the economic standpoint, the subsidies distorted costs and revenues and many of the agricultural activities were financially profitable only because of government subsidies and incentives. Although agriculture consumed about 80-90% of the available water in most countries, it contributes for less than 1% of Gross Domestic Product.

Implementation of the policy to increase the level of self-sufficiency achieved its objectives to a certain extent, but at an extremely high economic cost and the loss of huge amounts of traditional reserves of fossil water resources. Yet, the countries continued to have low food sufficiency rates for the main food commodities, with the exception of fruits and vegetables to a certain extent, as indicated in table 5.

Table 5: Self sufficiency percentages for main commodities in the GCC Countries (2003)

Country	Commodity	Production (1000 MT)	Imports (1000 MT)	Supply (1000 MT)	Self-Sufficiency Rate (%)
Bahrain	Cereals	0	76,532	76,532	0.00
	Fruits Total	22,010	77,479	99,489	22.12
	Vegetables Total	8,394	83,243	91,637	9.16
Kuwait	Cereals	3,300	559,976	563,276	0.59
	Fruits Total	11,511	73,952	85,463	13.47
	Vegetables Total	184,065	132,178	316,243	58.20
Oman	Cereals	5,771	425,630	431,401	1.34
	Fruits Total	294,636	108,692	403,328	73.05
	Vegetables Total	183,673	80,745	264,418	69.46
Qatar	Cereals	6,385	76,292	82,677	7.72
	Fruits Total	17,990	22,891	40,881	44.01
	Vegetables Total	45,630	80,880	126,510	36.07
KSA	Cereals	2,379,000	9,858,802	12,237,802	19.44
	Fruits Total	1,250,000	635,398	1,885,398	66.30
	Vegetables Total	1,854,000	382,285	2,236,285	82.91
UAE	Cereals	120	2,405,068	2,405,188	0.00
	Fruits Total	797,800	362,595	1,160,395	68.75
	Vegetables Total	546,129	461,018	1,007,147	54.23
GCC Countries	Cereals	2,394,576	13,402,300	15,796,876	15.16
	Fruits Total	2,393,947	1,281,007	3,674,954	65.14
	Vegetables Total	2,821,891	1,220,349	4,042,240	69.81

Source: FAOSTAT 2004

3. Water Resources Availability and Use

Under the prevailing climatic conditions, the GCC countries receive only scanty rainfall (less than 100 mm on the average) whereas the mean evaporation exceeds 300 mm per year. The region is devoid of perennial surface waters such as rivers or lakes. Freshwater demands have been met by groundwater extraction until the introduction of desalination of seawater in the 1960s and recycling of treated wastewater. The main sources of freshwater are groundwater, most of which is non renewable, and a limited amount of renewable surface water. Non-conventional sources, including brackish water, desalinated seawater and wastewater constitute important components of the annual water balance (Table 6.)

The other main source of water is non-renewable fossil groundwater stored in sedimentary deep aquifers. Huge amounts of groundwater are stored in these deep aquifers with a reserve estimated at 2200 billion cubic meters out of which about 1920 billion cubic meters are located in Saudi Arabia. The bulk of these resources is of brackish quality, with great variations in total dissolved solids (200 to 20,000 ppm), which allows the suitable use for domestic purposes in few areas.

Another feature of groundwater in the GCC region is quality degradation. As water tables drop due to excessive extraction, salinity increases and intrusion of seawater takes place in coastal areas. Several aquifers in Bahrain, Oman, Qatar and UAE are already severely affected by this phenomenon.

Table 6: Water resources in the GCC countries by source (millions of cubic meters)

Country	Conventional water resources				Non-conventional water resources	
	Surface water	Ground water recharge	Ground water use	Total Renewable Resource	Desalination	Wastewater (+ drainage reuse)
Bahrain	0.2	100	258	100.2	75	17.5 (3)
Kuwait	0.1	160	405	160.1	388	30
Oman	918	550	1 644	1468	51	23
Qatar	1.4	85	185	86.4	131	28
KSA	2 230	3 850	14 430	6080	795	131 (24)
UAE	185	130	900	315	455	108
Total	3334.7	4875	17822	8209.7	1895	364.5

Source: Compiled by ESCWA from country papers presented at expert group meetings and international sources, 1995, 1996, 1997 and 1999.

The increase in demand for potable water led the GCC countries to resort to desalination of seawater which started in the 50s and early 60s. The region has gained significant experience in desalination and produces more than 40% of the total desalinated water in the world. The use of natural gas as a fuel for desalination promises to be more efficient, less costly and more environmentally safe than the use of petroleum. However, the use of desalinated water for agricultural production is still not economically feasible.

The collection and treatment of municipal wastewater has reached about 60% in the GCC countries. In most countries, treated water is used for the irrigation of landscaping after treatment to the tertiary level. It is inevitable that these countries will depend largely on the use of this type of water, although its proper use is still controversial. Table 7 gives an indication of desalination and wastewater treatment capacity and production, by country, in the year 2002,

Table 7: Desalination and wastewater capacity and production in GCC countries in 2002

Country	Installed Capacity (Mm ³ /year)	Desalination Production (Mm ³ /year)	Treated Wastewater Production (Mm ³ /year)	Treated Wastewater Used (Mm ³)
Bahrain	138	138	24	24
Kuwait	522	444	258	250
Oman	103	103	10	9
Qatar	178	158	44	44
Saudi Arabia	1278	1022	475	n/a
UAE	952	811	227-265	205

Source: unpublished reports

Table 8 gives an indication of the amounts and fractions of different sources of water allocated to various uses, around the end of the last century. Based on these trends, the following quantified insights analysis for the water situation in the region can be given:

Table 8: Water resources allocation by country

Country	Resource Type	Municipal (Mm ³)	Agricultural (Mm ³)	Industrial (Mm ³)	Total Use (Mm ³)
Bahrain	SW		0.2		0.2
	Ren.GW	52	48		100
	Fossil GW		120.3	37.7	158
	Desal.Sea	75			75
	TWW		20.5		20.5
	Total	127	189	38	354
Kuwait 2002	SW		0.1		0.1
	Ren.GW		76	84	160
	Fossil GW		587		587
	Brackish	112	300	3	415
	Desal.Sea	375	27	18	420
	TWW	12	66		78
	Total	499	1056	105	1660
Oman	SW		918		918
	Ren.GW		465	85	550
	Fossil GW	474	620		1094
	Desal.Sea	51			51
	TWW		23		23
	Total	525	2026	85	2636
Qatar 2003	SW		1.4		1.4
	Ren.GW	2.35	35.8	1.85	40
	Fossil GW	25.65	174.35		200
	Desal.Sea	119		42.8	161.8
	TWW		27		27
	Total	147	239	45	430
KSA 2000	SW	470	1760		2230
	Ren.GW		2450	550	3000
	Fossil GW	1300	11740		13040
	Desal.Sea	1150			1150
	TWW		150		150
	Total	2920	16100	550	19570
UAE	SW		185		185
	Ren.GW		130		130
	Fossil GW	295	1060	130	1485
	Desal.Sea	455			455
	TWW		25		25
	Total	750	1400	130	2280
Total GCC	SW	470	2865	0	3335
	Ren.GW	54	3205	721	3980
	Fossil GW	2095	14302	168	16564
	Brackish	112	300	3	415
	Desal.Sea	2225	27	61	2313
	TWW	12	312	0	324
	Total	4968	21010	952	26931

- Irrigated agriculture is by far the largest water user with around 78% of the total water use in all GCC countries, in comparison with 18% and 4% for municipal and industrial uses respectively¹. Most agricultural water (85%) is taken from groundwater, out of which 81% is non renewable.
- Domestic water use relies on both desalination and good quality groundwater (usually fossil) with the exception of Saudi Arabia where surface water is available to some extent. Another striking feature with respect to municipal water use is that GCC countries have the highest per capita consumption in the world, in contrast with being the least endowed with renewable water resources. Potable water demand is around 70 percent higher than in rich countries considered to be high users of water such as the USA or Australia. Inadequate demand management and inefficient service delivery are believed to be the main reasons behind this situation.
- Although domestic wastewater is about 4860 Mm³ and there are significant treatment facilities in most countries, the amount reused in agriculture is very small and almost negligible in all countries (about 2% of total water use).
- When considering all six countries, domestic water supplies depend equally on desalination and fossil groundwater (about 50% each). The percentage of desalination becomes 73% when excluding Saudi Arabia and Oman. The latter depends on groundwater for 90% of its drinking supplies, in comparison with 61% for KSA. Qatar and Kuwait rely essentially on desalination for domestic water supplies because of the depletion of fresh groundwater; they are followed by UAE and Bahrain.
- According to the available information, Kuwait is the only country reported to use treated water for municipal purposes (most probably toilet flushing).
- Industrial water use (4% on the average in all countries) relies for 94% on groundwater (of which 80% is non renewable) and 6% on desalination (Kuwait and Qatar). However, treated wastewater is not used at, despite its suitability for some industries. Excluding Saudi Arabia and Oman, the ratio of industrial water consumption becomes 7% in the other 4 States.
- Total amount of domestic water in the GCC countries is 4856 Mm³, while the amount of reused treated wastewater (according to the available information) is only 324 Mm³. This represents about 6.6% of the domestic water or 1.2% of the total water resources in the GCC countries. Excluding Saudi Arabia and Oman, this ratio becomes 10.7% for the other 4 States. Assuming that 50% of the municipal water can be treated and reused for agricultural purposes in the future, an amount of 2428 Mm³ can be deducted from the agricultural demands, which represents about 11% of the irrigation water, or about 17% of the extracted fossil groundwater.
- However, if we exclude Saudi Arabia and Oman, the 50% of treated domestic wastewater for the remaining 4 States is 705 Mm³. The corresponding agricultural water uses for these countries is 2584 Mm³ from which 1942 Mm³ is fossil groundwater. This indicates that it is

¹ There are common features from the standpoint of water allocation from different sources, between Bahrain, Kuwait, Qatar and UAE, on one hand, and KSA and Oman, on the other. This is mainly due to the fact that KSA and Oman have some renewable surface water resources. When considering only the first four countries, the municipal water use ratio from water resources becomes 33% instead of 18%.

possible to save about 27% of irrigation requirements or about 36% of the abstracted fossil groundwater.

- The sustainability indicator of renewable water resources shows a gleam future for all countries, unless courageous policy measures are taken and implemented urgently (Table 9). Figures of 10 to 20 percent indicate good management practices, whereas those over 40 per cent indicate mismanagement.

Table 9: Sustainability indicator of water resources use by country in the year 2000

Country	Total Renewable W. Resources (Mm ³)	Total Annual Water Use (Mm ³)	Annual/capita potable water Use (m ³)	Annual/capita water Use (m ³)	Sustainability indicator (%)*
Bahrain	100.2	282	196.43	419.64	281.44
Kuwait	160.1	590	168.16	264.57	368.52
Oman	1 468	1847	107.29	756.35	125.82
Qatar	86.4	347	242.57	572.61	401.62
KSA	6 080	17765	109.38	826.89	292.19
UAE	315	2180	230.98	671.39	692.06
Total	661.7	23011	175.80	585.24	360.28

*Water use sustainability indicator = water use/renewable resource

4. Need for a Water and Agriculture Policy Framework

While water is a vital element for economic development, it is clear from the above analysis that the current policies on water resource use in agriculture are not viable on the medium and long range. Achieving a sustainable economic development under the prevailing water-scarcity conditions in the GCC region requires elaboration and implementation of water and agriculture policies that are closely linked under a consistent framework and which are likely to meet future development challenges. Such a policy framework would help countries to plan in a pro-active and most effective manner for appropriate measures such as investment in water resources, water allocation, water tariff application, support to the agriculture sector, cropping patterns, food security, etc. The social and environmental dimension should also be given due consideration. The strategic policy framework will be instrumental in moving countries towards well known objectives; however, it can have adverse effects when it no longer serves the purpose and becomes an end itself.

Some countries of the GCC are already embarking in this direction, in collaboration with FAO² and other organizations³, although not all the recommendations below are being considered at present. The basic elements of the recommended policy framework are described below:

1. Water supply and demand analysis

The starting point would be an analysis to establish a baseline water balance, specifying supply and demand. The projection of supply is based on assessment and availability of

² FAO is collaborating with the government of Kuwait, Qatar and UAE for reviewing/establishing their agriculture strategies including water use. A collaboration programme also exists between FAO and KSA.

³ In the case of KSA, the World Bank is collaborating with the Ministry of Water Resources and Electricity for elaborating a national water resources strategy.

surface and groundwater for agriculture, domestic and industrial uses; whereas water demand is based on economic parameters such as population, income and agriculture economy. This important component will determine the scale of the problem of water scarcity and its deficit, to assess how far ongoing measures are succeeding and to offer options for supply enhancement and demand management policies to meet the growing demand.

2. Assessment of economic and social impacts of irrigated agriculture on national economies

The objective of this assessment is to evaluate the actual economic and social impact of irrigated agriculture on the economy, with a view of identifying the level of competitiveness of irrigated agriculture in comparison with other water use sectors. When a hectare of land is converted from rainfed to irrigation, it requires an investment the level of which depends on the irrigation system introduced and the associated land betterment, in addition to the required management. In return, this investment results in a value-added on the economy and for the farmer.

The traditional way of assessing the impact of irrigation is through a comparison of the financial situation of farmers' income with and without the project, in addition to the social improvements in the irrigated area in the case of medium and large irrigation schemes. It does not take into account the impacts of water use in agriculture on prospects for meeting pressing alternative demands as well as on the economy at large. To overcome this limitation, economic equilibrium models can be used for analyzing national economic data and extracting the macro-economic impacts of water use in agriculture. The latter includes both the economic value added upstream of farms and the impacts induced by irrigation downstream. These impacts, coupled with micro-economic and social impacts, constitute important decision tools for areas of investments on water use based on comparative advantages.

3. Economy-wide agriculture policies

Past food security policies were based on area expansion to support the objectives of increased self-sufficiency and enhance exports. The supply enhancement era witnessed unprecedented growth not only in irrigation but also in groundwater development with the advent of new technology, subsidy in credit and low energy costs. That era seems to have peaked out and its continuation has proved to be non-sustainable. Future increases in agricultural production must come from the increased land and water productivity, both in terms of higher yields and cropping intensities for which scope still exists. This will lead to greater water savings by reducing wasteful water losses to low economic value crops and achieving more efficient water use and better agronomic practices.

It is also important to assess the incentive structure facing key food security crops like wheat and other strategic crops and to assess the comparative advantage in producing these commodities in the region. The cost of water is the prime determining factor in mapping economic feasibility of producing these crops. It is well known that the more a resource or input factor gets scarce, the more it becomes the limiting factor for its different uses. Under these conditions, both science and common sense indicate the necessity of optimizing the use of this factor. The activity of a product to which water is allocated should bear a value that justifies the amount allocated under the social and economic conditions of the country. The opportunity cost of water is determined by the highest value associated with its possible uses; but under severe scarcity conditions the real value of water becomes even higher and is more

difficult to determine. The opportunity cost of water should also consider comparison between the cost of producing a commodity locally or importing it.

The reliance on virtual water for water scarce countries is obviously a policy option which can theoretically lead to a win-win solution. Importing countries save precious water resources and can reallocate them to more valuable uses in agriculture or in other sectors. At a global level this usually generates water savings. However, there are many obstacles that should not be underestimated: barriers to market access and lack of reciprocity in trade, issues of quality and safety of food products in developed countries markets, warranty and reliability in accessing staple food supplies for importing countries. In the case of GCC countries which are already large food importers, the concept of virtual water is well founded and its comparative advantage can easily be translated into a competitive advantage since these countries are politically strong and have well developed and diversified economies. Policies to eliminate high water consuming, low-value crops such as cereals, forages and other crops, can bring about a balance to water supply and demand in many countries of the GCC.

Food security and water link at micro level is also very important. Under reform programs, most of the input subsidy other than water have been removed or are in the process of being removed. The emerging incentive structure is bringing cost/profit squeeze on the farm sector. The key question is to cost water or design a cost recovery program that keeps the delicate balance between farm profitability, food availability and food costs, considering the issues of efficiency, equity and environment. This is a policy challenge that needs to be addressed and requires more analytical work. As the issue of virtual water should be analyzed in the above framework, any reform in the water policy area, such as putting a cost on water, has to be evaluated in the context of economy wide and sectoral policies.

4. Policies to promote water use efficiency in agriculture

Water demand management in agriculture opens avenues for producing more with less water. This potential for improvement resides in the generally poor performance of irrigated agriculture in the GCC countries in terms of productivity per unit of water, even under modern irrigation techniques. However, unlocking this potential is not as easy as it seems. It requires fundamental changes in attitudes, policies and practices as well as investments and willingness to take and implement decisions.

Given the limited water supply for irrigation in the long term, demand management measures should aim at increasing both the productive and allocative efficiency. In future, agriculture is expected to use less water to produce more in order to supply growing demand for food and at the same time to release some of the water it is now consuming. There is a need for more efficient use of water in agriculture, which can come about by more efficient irrigation practices, improving water control at farm levels and by eliminating irrigation on marginally productive lands. This is already taking place in some of the GCC countries as increase in demand for quality food over the past two decades has led to the emergence of a few private farms specialized in high-value agricultural production, using up-to-date technologies and management tools and realizing marginal profit. Economic and technical mechanisms to achieve water use efficiency in agriculture should be analyzed in the specific context of the country.

5. Incentives and water services cost recovery

Recovering costs and setting water service tariffs are essential tools for sustaining reliable services and promoting water conservation. Incentives and service cost recovery constitute the most reliable means for controlling water use in the GCC countries since it is practically difficult to rely on other procedures such as the allocation of water quotas and well metering. Governments in the region need to formulate cost recovery policies and to suggest appropriate water service tariffs under the prevailing conditions. The issue of water service pricing should be addressed in a wider context of the incentive structure facing the farm sector. The current incentive framework adopted in most countries of the region encourages expansion of the irrigated area and water wastage. It should be re-oriented towards promoting water conservation and enhancing productivity.

The context of agriculture and water management in the GCC countries has specific characteristics including: 1) agricultural production relies essentially on groundwater which is difficult to control by nature; 2) farmers are private and have their own wells which they manage with no interference from public institutions; 3) farm owners are entrepreneurs rather than farmers; 4) irrigation labor is essentially foreign. Under this context, the most reliable means of implementing an agriculture and water policy framework is through a set of dissuasive and persuasive measures at the macro-level.

Economic and policy instruments offer a pathway to improving irrigation performance. Although the need for self-financing and cost recovery has been a goal in irrigation development for some time, it was the Dublin International Conference on Water and the Environment in 1992 that established the idea that water was an ‘economic good’.

Principle No. 4 – Water has an economic value in all its competing uses and should be recognized as an economic good. Within this principle, it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price. Past failure to recognize the economic value of water has led to wasteful and environmentally damaging uses of the resource. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resources.

This is now accepted as a ‘keystone’ of the international consensus on future needs for water policy and resource management. Water pricing policy is recognized as a key instrument for improved water allocation, better conservation and quality preservation. It can induce better demand management of water resources and is seen by many as the ultimate solution in water-deficit areas where supply is limited or cannot be augmented. It has led to the current focus on water charging – policies, practical actions and mechanisms required to set a price for water, how charges will be levied and how revenue will be collected.

6. Supply enhancement and alternatives to fresh water

The focus of supply enhancement would center on building sound technical, institutional, and economic criteria for investing in water resources management infrastructure projects. Preparing strategies prioritizing water needs in the short, medium and long range, preferably based on results from decision support models/systems to enhance water allocation decision-making among competitive sectors; and high priority infrastructure requiring rehabilitation and/or nearing completion, with emphasis on improving quality-at-entry of projects by supporting project preparation. A large scope of increasing supply of water for agricultural

use still exists in the GCC countries, but this potential has not received the focus it deserves. Investment priorities should include the following:

1. The use of all treated wastewater, through a review of the current policies to include food crops, setting-up of standards, regulations and monitoring systems, and capacity development for the safe use of these resources. To this end, an International Centre for Research and Technology on Wastewater Treatment and Reuse is under establishment in Kuwait and could benefit the entire GCC region.
2. The use of brackish water, both after desalination and raw. The region is endowed with large quantities of brackish water that is suitable for agricultural production, provided that the appropriate precautionary measures and use practices are applied. The International Centre for Biosaline Agriculture was established in the region to serve for this purpose, but additional commitment by the GCC countries to reap this potential is still needed.
3. The potential of water harvesting and groundwater recharge is very important in the region. Adapted research and pilot testing would open avenues for tapping this potential and identifying the technology and practices adapted to the region.
3. Desalination of brackish water for agricultural production has started in the GCC countries and demonstrated its cost-effectiveness. However, support to lower desalination costs and to pilot test the conditions for up-scaling the practices is still needed.

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