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Water Scarcity Challenges in the Middle East and North Africa (MENA)

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Water Scarcity Challenges in the Middle East and North Africa (MENA)

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1. Introduction – setting out the challenges

Water is scarce in the Middle East and North Africa (MENA) region. As Allan (2002) noted, the region basically "ran out of water in the 70s" and today depends as much on water from outside the region -- in the form of its food imports, for example -- as on its own renewable water resources. Continued water scarcities will affect the region's social and economic potential, increase land vulnerability to salinization and desertification and raise the risk for political conflict around the limited water available.

Groundwater is a hidden problem, since many countries extract more than is being recharged. This puts the region's irrigated agriculture at risk and leads to saltwater intrusion in aquifers close to the seas. Weak environmental legislation leads to groundwater pollution, which further decreases groundwater quality throughout the region. In some cases, laws do not contain specific rules on solid wastes, hazardous chemicals, etc. A disproportionately large share of available freshwater is used in irrigated agriculture, but it is accompanied by an intensive use of fertilizers which also contributes to the water quality degradation through pollution and salinization. The Jordan River, for example, is in poor shape due to overuse of the upper Jordan by Israel and overuse of its tributary, the Yarmouk River, by Syria and Jordan. There is a great need for improved water resources governance, as well as improved water efficiency and productivity in irrigated agriculture.

Population growth together with urbanization and economic development further increases water demand, with serious implications for development and poverty reduction. Even though some of countries in the region are on track to reach the Millennium Development Goal targets on improved water supply and sanitation, ongoing urbanisation will necessitate increased investments in water supply and sanitation. According to the World Bank (2005), the MENA region will have grown to a projected >430 million in 2025 from around 100 million in 1960 and the present 311 million, bringing the per capita water average to extremely worrying levels. This puts ever bigger questions on the present 87 percent of water that is used for irrigated agriculture in the MENA region.

The complexities of managing and sharing common water resources are well-known to the region. Conflicts over water in both intra-national and international settings evolve in complex political and hydrological environments. The MENA region's potential for conflict is increasing because it has one of the highest demographic growth rates of the world at 3-4 percent. The water-intensive agricultural irrigation policies are motivated by the pursuit of national water and food security in countries with burgeoning populations but little economic diversification. Some of the highest demographic concentrations in the world are found in the region, such as in the Gaza Strip.

The water resources are used in an agricultural sector which produces little wealth in the MENA region economies (Beaumont, 2002). It has been suggested that a gradual reallocation of water from irrigated agriculture to other economic uses that can provide a higher economic return (industrial and services) will be a more realistic and long-term sustainable policy option. Such change will not come easy since many people -- the poor, in particular -- have agriculture as their economic mainstay and employment opportunity.

The following sections will address the water resources status, rapid urbanisation and intensifying water competition between urban and rural areas and between nation states in the region. Since irrigated agriculture dominates water use, special attention is paid to water options -- technological, governance and virtual water -- within irrigated agriculture.

2. Intensifying water competition

2.1 Status of water resources

Most countries in the MENA region are experiencing water scarcity combined with low water use efficiency in irrigated agriculture. According to FAO (2003b), water use efficiency is about 40 percent. This is higher than in Latin America but lower than in South Asia. Figures from the World Water Development Report (WWDR, 2003) show that countries like Kuwait, Libya, Bahrain, Jordan and United Arab Emirates are facing extreme situations of water scarcity (see table 1). Out of 182 countries ranked in the WWDR (2003) with regard to the annual per capita total renewable water resources availability, more than half of the countries in the region are ranked in the lowest 10 percent. This has caused almost all renewable water resources to be in use, and many countries have resorted to the use of their non-renewable resources for agricultural, industrial and domestic purposes (FAO, 2003a).

Table 1. Water Availability in the MENA region

Ranking	Country	Total internal renewable water resources (km^3/year)	Groundwater: produced internally (km^3/year)	Surface water: produced internally (km^3/year)	**Water resources: total renewable per capita (m^3/capita year)**
108	Iraq	35.20	1.20	34.00	**3 287**
131	Iran	128.50	49.30	97.30	**1 955**
141	Syria	7.00	4.20	4.80	**1 622**
149	Lebanon	128.50	49.30	97.30	**1 261**
155	Morocco	29.00	10.00	22.00	**971**
156	Egypt	1.80	1.30	0.50	**859**
162	Tunisia	4.15	1.45	3.10	**482**
163	Algeria	13.90	1.70	13.20	**478**
164	Djibouti	0.30	0.02	0.30	**475**
165	Oman	0.99	0.96	0.93	**388**
167	Israel	0.75	0.50	0.25	**276**
168	Yemen	4.10	1.50	4.00	**223**
169	Bahrain	0.004	0.00	0.004	**181**
170	Jordan	0.68	0.50	0.40	**179**
172	Malta	0.05	0.05	0.00	**129**
173	Saudi Arabia	2.40	2.20	2.20	**118**
174	Libya	0.60	0.50	0.20	**113**
176	Qatar	0.05	0.05	0.001	**94**
178	United Arab Emirates	0.15	0.12	0.15	**58**
179	Palestine (Gaza)	0.05	0.05	0.00	**52**
180	Kuwait	0.00	0.00	0.00	**10**

Source: World Water Development Report 2003. (The country selection is based on the World Bank's definition of the MENA region). N.B. The water dependency ration refers to surface water. Many of the countries that have zero water dependency ratio do in fact share transboundary groundwater aquifers with other countries.

According to the FAO Aquastat[2] countries like Jordan and Israel are over-exploiting their water resources by between 10 and 20 percent. As a result water levels are dropping, groundwater resources are being mined, salinization and salt water intrusion are taking place

[2] See: http://www.fao.org/landandwater/aglw/aquastat/main/index.stm

and the domestic water supply does not reach adequate standards of quality. The situation is even worse in many other countries of the region. For example, in Libya, Bahrain, Kuwait, Qatar, Yemen and the United Arab Emirates, fossil groundwater withdrawals for irrigated agriculture far exceed the total renewable resources. Falling groundwater tables and reduced river flows will not only impact the social and economic dynamics of the region but will also "close" river systems and reduce ecosystems goods and services. Due to their extreme water scarcity, most countries in the region will find it difficult to cope with increased water demands from their own growing urban centres as well as from upstream and downstream countries. It will be difficult to maintain current levels of water allocation to irrigated agriculture.

2.2 Urbanisation: Impacting future water choices

MENA has one of the fastest growing populations in the world with an average annual growth rate of 2.1 percent between 1990 and 2003. The population is growing from around 100 million in 1960, through a present 311 million to a projected >430 million in 2025, bringing the average amount of water per capita in the region to far below the scarcity level. Most of this population growth has been in urban areas, where the population share is expected to exceed 70 percent by 2015. The urban growth rate has been around 4 percent annually the last two decades (The World Bank, 2005).

According to UN-Habitat (2004) the region's 25 largest cities have an average annual urban growth forecast of 2.7 percent between 2000 and 2010. Whereas Bahrain, Kuwait and Qatar were already 80 percent urban in the 1970s, the region's lesser urbanized nations all have recently experienced sharp urban population increases – a trend expected to continue.

In 2015, Egypt, Sudan and Yemen will be the only MENA nations which are less than 50 percent urbanized. Around 2030 nine MENA countries will likely be more than 90 percent urban: Bahrain (95.8 percent), Israel (94.5 percent), Kuwait (98.4 percent), Lebanon (93.9 percent), Libya (92.0 percent), Oman (95.2 percent), Qatar (95.9 percent), Saudi Arabia (92.6 percent) and the United Arab Emirates (93.3 percent). For more urbanisation trends in the region see box 1.

A common feature of urban transition in most developing countries is that the relative urban growth is higher in small- and medium-sized urban areas as compared to mega cities. The MENA region is no exception. In 2000, the MENA region had 16 cities of over 1 million inhabitants, with only Cairo, Istanbul and Tehran exceeding 5 million. By 2010, there will be a minimum of 24 cities of over 1 million within the region. It is forecast that by 2015, six cities will be larger than 5 million, with Cairo and Istanbul both exceeding 11 million. Tehran and Baghdad will remain the third and forth largest cities, with 6.9 and 4.8 million (UN-Habitat, 2004). Small- and medium sized cities tend to have lower levels of services compared to bigger cities. It is thus essential that more focus is put on those cities that currently are below or around 1 million inhabitants. Such a focus presents opportunities to apply innovative water technologies and practices more widely and to avoid past mistakes of unplanned development in mega cities.

Box 1: Urbanisation trends in the MENA region

• The 'oil urbanization processes' of the Gulf States started during the 1950s and caused a massive transformation in the urban landscapes, especially in Dubai, Jeddah, Kuwait City, Mecca and Riyadh. Increased oil revenues during the early 1970s allowed for ambitious economic development plans and rapid urbanization.

Whereas in the early 1970s about 26 percent of the Gulf States' population lived in urban centres, it was 73 percent by 1990.

• The Mecca, Riyadh and Jeddah metropolitan areas have expanded into urban agglomerations of 1.3, 5 and 3.2 million inhabitants, respectively.

• The population of MENA's largest agglomeration, the Cairo metropolitan area, has increased from 2.4 million in 1965 to about 10 million today and is predicted to reach 11.5 million by 2015. Population densities within the city are some of the highest in the world and the urban area is now more than 400 square kilometres in extent. Cairo's development into a metropolitan region is largely the result of its location along the Nile River.

• Although Cairo and Alexandria are about 200 kilometres apart, the spread of low-density residential developments south of Alexandria and north of Cairo is well underway. The merging of both cities into a single and huge Nile Delta metropolis is a very real possibility.

• Istanbul, as Turkey's largest city and commercial capital, has for decades been the destination of a continuous national migration process. Istanbul's annual urbanization rates since 1950 have persistently exceeded 3 percent, with a peak of 5.12 percent annually during the 1970–1975 period, making Istanbul Europe's most rapidly growing city. Today, its population exceeds 8 million.

Source: UN-Habitat, 2004.

The increasing population pressure combined with urbanization and economic development will increase water demand, leading to:

- an even greater pressure on the cities and their infrastructure, public services, housing and jobs; and
- an increased claim on water that is presently used for irrigated agriculture.

In the MENA region, 88 percent of the population has access to improved water supply and 75 percent has access to improved sanitation. The variation between countries and urban and rural areas is great. For example in Yemen only some 30 percent of the population has access to basic sanitation and 69 percent of the population has access to improved drinking water. Qatar has close to universal coverage of water supply and sanitation, while in Syria 77 percent of the population got access to improved sanitation and 79 percent to improved drinking water (WHO/UNICEF, 2004a). In most countries of the region those living in urban areas are having better access to improved drinking water supply and sanitation as compared to rural. Another trend in cities like Cairo is that the urban newcomers often end up in informal settlements with limited access to basic services, such as water, energy and transportation.

The demographic transition in the region can lead to tensions between urban and rural settlements. A case of this is found in Jordan. The urbanisation of rural poor in Jordan, from 62 percent of the population 1952 to 22 percent in 2002, has led to increased competition of the scarce natural resources in the expanding urban communities. The use of pumped aquifer water to supply the urban populations of the capital, Amman, and the country's second largest city, Zarqa, has led to reduced availability of water to local farmers and the draining of nearby wetlands (AAAS, 1997). The scarcity of water resources in the country is already severe enough for poor rural farmers to abandon agriculture and livestock as there main source of income (JHDR, 2004). In 2000 Amman hosted a population of 1.1 million (USAID, 2000) and had already in 1992 been withdrawing twice the "safe" extraction volume from the underground aquifer at Azraq Oasis, which supplies the city with almost all of its water (AAAS, 1997).

In Yemen, rural areas are transferring water to urban areas and the farmers in the vicinities of the cities Taiz and Sana now lack a sufficient amount of water for irrigation. The city of Taiz has negotiated with the neighbouring rural area of Habir to extract water from their land. Even though agreement has been reached, the discussions proved difficult and rural residents are obstructing implementation (Ward et al., 2000). (For further information see Case 1 in the annex).

Relating to the urbanisation is the discussion on increased virtual water import (see below). If reliance on virtual water (i. e. water contained in primarily imported foodstuffs) import grows, the number of farmers needing to find other economic livelihood options will increase. This will likely speed up urbanisation in the region, as unemployed farmers look for jobs in other economic sectors.

The new demographic situation in the region presents huge challenges for local and central governments of how to allocate water in a socially acceptable way and for maximum economic benefits.

2.3 What are the options for irrigated agriculture?

According to the World Bank (2002), irrigated agriculture claims 87 percent of the total water withdrawals in MENA and accounts for about 30 percent of total used arable land. Maintenance of irrigation facilities, water pricing, water rights and land tenure, efficiency of water use, and crop pricing and production policies are important issues in most MENA countries.

The agricultural sector contributes 2.5 percent to approximately 25 percent of the GDP, depending on the country (World Bank, 2003). On average some 26 percent of the population in the region is dependent on agriculture for their livelihood. This is a 5 percent drop since 1995 (ILO, 2006). This trend will continue as cities grow. Countries like Yemen, Syria and Egypt are relatively more dependent on agriculture as compared to Jordan, Lebanon and Israel. Even though the agricultural sector uses the greatest amount of water, the amount of land under cultivation is not more than 35 percent for any of the countries, and for Egypt and Yemen 3 and 7 percent, respectively (FAO, Aquastat, 1997-2004). Much of the land in the region is too dry for cultivation or grazing (FAO, 2003a). Rainfall variability between different years is also large and makes the region's population vulnerable to droughts (World Bank, 2004).

There are many different agricultural practices in the region, including pastoralism, rainfed, combinations of rainfed and irrigated, and large-scale irrigated. While most rural livelihoods are earned on rainfed agriculture, irrigated agriculture claims the bulk of water use and a large share of total value of production, especially for high-value and export crops. This will continue to be the case in MENA, but water availability to agriculture in the future is likely to shrink because of competing demands from urban and industrial water uses (see previous section). A main priority for agriculture will be to use the available water at the highest efficiency possible both regarding water use and economic returns, such as through industrial production or high value crops (World Bank, 2002). But considering that agriculture in the region employs a large number of the population, countries will have to decide how to make most efficient use of water, such as for example more "crop per drop", more "economic growth per drop" or more "employment per drop". It is clear that countries will have tough decisions to make. Considering the urban transition, it is clear that more "employment per drop" for agriculture will not be a viable option in the long run.

The choices of how to make use of water resources are heavily influenced by the politics of the region. Most countries in the region will continue to focus on irrigated agriculture for as long as possible, since it is perceived that for political and national security reasons it is important to be food-self sufficient or to maintain the image of striving for self-sufficiency in food production.[3] The special treatment for water use in irrigated agriculture is also linked to domestic politics of safeguarding rural employment and providing cheap food to urban consumers (Tropp et al. 2006). The domestic and regional politics, combined with fairly low social acceptance to price water for irrigation, explain why most countries of the region subsidize water for irrigation. The paradox for the already water-scarce region is that the subsidies provide disincentives for more efficient use of water. In 1995 Israel subsidized water to agriculture by USD 120 million, the second costliest subsidy after those to transportation in the national budget (Cohen and Plaut, 1995). In Jordan farmers paid 26 percent of the real cost of the supplied irrigation water in 1995 (FAO, 1995). In 1996 the irrigation water used for agriculture in Egypt was still free of charge, although there was a limited cost recovery for improvements in the infrastructure (Perry, 1996).

Large-scale irrigated agriculture means that there is a relatively large area being irrigated, although ownership and tenant patterns may be quite varied and include small-holders. The systems are found across the region and include high-value cash/export cropping, intensive vegetable and fruit cropping, and irrigation for cereals and sugar. Efficiency of resource use varies greatly, but often water is not used effectively, and there are major problems linked to falling water tables and rising levels of salinization and alkalinity (World Bank, 2002). FAO (2003b) has estimated that the water use efficiency in the region for irrigated agriculture is barely over 40 percent.

In 1997 the agricultural sector contributed just 13 percent to regional GDP and 19 percent of exports. It did, however, account for approximately 50 percent of overall employment. Whilst agricultural GDP growth has been some 2-5 percent per year, in some countries it has been zero or negative during the 1990s, including Palestine, Morocco and Jordan.[4] How the sector grows in the future will determine key issues of water availability across countries. Much of the agricultural GDP growth has been driven by intensive export-oriented agriculture, which is where future growth is expected. The region accounts for some 15-20 percent of total global food imports and, more specifically, it received 22 percent of all world grain imports from 1996-98.[5] It is evident that the region is not feeding itself, but is relying on food import. In other words, high water use is contributing to a relatively unproductive sector supporting a large proportion of the region's poor. Despite insufficiency in food production, undernourishment is relatively limited. According to FAO approximately 4-6 percent of the total population in many of the region's countries are undernourished. As always, exceptions exist. Almost 35 percent of the population in Yemen is undernourished; in Lebanon, hardly anyone (WWDR, 2003).

2.4 Optimizing the use of water in agriculture – what are the alternatives?

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[3] No country in the region is however food self-sufficient but the domestic discourse on food security in the lion share of the countries in the region is dominated by arguments favouring as high allocations to farmers as possible. This is of course also related to the fact that many people are employed within the agricultural sector. See also case 2 in the Annex.

[4] Nicol, A. Key-note Presentation, Middle East Seminar: Water for Agriculture in the Middle East, Stockholm World Water Week, 2005.

[5] Ibid.

There is a lot of experience in the region of developing alternative water sources. These water supply and demand management practices include, among others, desalination, reuse of waste water, water pricing, water-efficient irrigation technologies, virtual water and water imports. Middle Eastern countries have applied these practices to various degrees of success. Some of the technological, governance and virtual water options are outlined below.

Technological options

A typical supply-led response in the region has been to harness and increase the availability of water through, for example, water diversions, damming and desalination. Increased water diversion from transboundary rivers is a highly sensitive and political issue in the region, since most river and other surface water is already in use. The erratic rainfall and high evapotranspiration makes increased water storage capacity more difficult. The more wealthy countries in the region, the oil-based economies in particular and Israel, are desalinating water mainly for household and industrial uses. Due to high costs of desalinating as well as for the massive investments required for developing the necessary water transportation infrastructure, desalinated water is not an option for irrigated agriculture.[6] Large-scale production of water through desalination, transporting water over large distances, all are worked out to various degrees of implementation. There are plans for importing water from Turkey to Israel, or using the track of the Trans-Arabian Pipeline to transport water from Lebanon to Saudi Arabia. Another plan is the Red Sea - Dead Sea water diversion project. Other types of water demand-led technological responses have been to increase water use efficiency and to reuse wastewater. For example, drip irrigation in combination with bioengineering technologies has been applied. In some places, like in Israel, greywater from households is reused for irrigated agriculture. It has not, however, been scaled up, and mainly supplements conventional irrigation in peri-urban areas.

Since irrigated agriculture in the region accounts for the lion share of water use, there has as of yet been little attention paid to improved rainfed agriculture. The potential of increased food production and productivity through rainfed agriculture and the so called green water (soil moisture) remains to be explored (see for example Tropp et al. 2006, SIWI, 2005 and Allan, 2002).

Water governance options

In general, there is a lack of proper legislation and properly functioning institutions, and unclear water and land rights. The MENA region is perhaps the region in the world that displays the biggest challenges when it comes to developing sound governance systems (See, for example, UNDP's Human Development Report – Arab States, 2005). The region thus faces the double challenge of improving the management of water and environment as well as governance systems. This point is well illustrated in Yemen, where there is a great need for clarifying water rights and improvement in stakeholder participation in decision-making. A clear system for water rights can balance the urban and rural needs and help decrease number of conflicts related to land and water. In 1995 the National Water Resources Authority (NWRA) was formed to plan, monitor and develop new legislation and regulation for the nation's water resources. The new authority will need time to build capacity and acceptance among the users. It is important that new legislation and policy recognise the traditional customs in rural areas to handle water allocation. The government and the NWRA have adopted a new sector policy for urban water use, which include decentralized management

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[6] While desalination is still too expensive to be economically feasible to use for irrigated agriculture the price has gone down to around 50 cent (US) per cubic metre.

and the possibility for individual tariffs for local branches. The government has also begun to involve the private sector in urban water distribution. The government is also looking into the possibility of water markets as a way to allocate the available water between users, both urban and rural (Ward et al., 2000). Such an introduction will be challenging for Yemen as water markets would require the strong regulatory authorities which currently don't exist.

In general farmers lack the capacity to apply appropriate technologies. Many times there is also a lack of economic incentives (see above on subsidies on agricultural water) for farmers to invest in new irrigation or rainfed technologies. More secure land tenure could improve farmers' willingness to invest in improved agricultural practices. Though water saving is highly prioritised in the region, many irrigation farmers receive public subsidies which result in more water withdrawals for irrigation instead of more efficient water use.

Groundwater governance is critical for the region. The protection of groundwater should cover two inter-related folds: quantity and quality. The control of groundwater abstraction is usually organized with a permit system. In Jordan, recent legislation on groundwater control (By-law No 85 of 2002) has set up a clear system prohibiting the use of groundwater without a license prescribing the usage and the extraction quantity among other conditions. According to this by-law, every well owner should install at his own expense a water meter, which will enable the water authority to monitor abstraction. Syria and Lebanon also have regulations for the control of groundwater abstraction. Syria is trying since recently to introduce water meters. In spite of legislative improvements the actual enforcement is poor. For example, in Lebanon and Syria, illegal groundwater pumping is very common. In Jordan, if most of the wells are drilled legally, the terms of the permit are often not respected, and the water meters broken. The regulation and monitoring of groundwater quality are in general poor. In Jordan the by-law prohibits generally the pollution of groundwater, without any specific provision. The new Jordanian law on the Environment Protection (2003) does not give more details. In Syria, provisions for the protection of water against pollution are non-existent, as well as in Lebanon, despite the institution of the Ministry of Environment.

Virtual water option

Trade in food and other goods imply trade in water. The total amount of water that is used to produce a product is referred to as *virtual water*. Using this concept, international food trade has been analysed in terms of virtual water flows.[7] Simply put, the virtual water flow between two nations is equal to the volume of virtual water that results from product trade. This concept provides insight on patterns of water consumption and serves to highlight areas of inefficient and unsustainable water use. Moreover, it illustrates the gains from trade between efficient and inefficient water users. For example, most of the major food exporters have highly productive rainfed agriculture, while most food importers rely on irrigation or low output rain fed systems (see Allan, 1993 and Hoekstra & Hung, 2002). Trade in virtual water can reduce consumptive water use in agriculture, as well as industry, provided that exporters achieve higher water productivity than importers. It can make good sense for countries that are net-importers of virtual water to seriously consider their strategies and policies towards domestic irrigated food production.

Trade in virtual water generates water savings for importing countries - it is estimated that Egypt's maize imports in the year 2000 generated a saving of about 2 700 million cubic metres of water (FAO, 2003a). A striking paradox is that Israel, despite arguments of regional

[7] For a discussion on the virtual water concept see: Allan, 1993 and Hoekstra and Hung, 2002.

dominance of water resources for domestic food security, is a big net importer of virtual water. The annual importation of virtual water by Israel is equivalent to about three times its available internal water resources. Even though Syria holds that they are receiving less than they are entitled to from the upstream Euphrates, they are nevertheless a net virtual water exporter (Phillips et al. 2005, see also table 2). (See cases 1 and 2 for more discussions on virtual water linked to Jordan River Basin riparian countries)

The liberalisation of trade in agriculture will continue to be a priority of future international negotiations. It is therefore important that the linkages between agricultural trade and water resources are identified and analysed to better understand the positive and negative impacts that trade liberalisation will have on the economy, taking into consideration the short and long-term impacts on water resources.

The issue of virtual water sounds in theory appealing and a path that many countries could pursue to "free up" irrigation water to other economic sectors or to other crops that can provide a higher value-added to GDP. Despite that the mainstay of labour in many countries (with exceptions of course such as Israel) is involved in agriculture, the agricultural contribution to GDP is in general low for most countries of the region. Table 2 shows that agriculture is contributing very little to the economies of Israel and Jordan. It also displays that the service sector is the main contributor to GDP in the selected countries. Economic activities linked to industries and services typically take place in urban areas. With the ongoing urbanisation in mind, it is most likely the contribution of industries and services will continue to grow. Table 2 also indicates that countries are not keeping the same pace regarding a transition from a rural-agrarian based economy to an urban-led economy based on industrial production and a big service sector. For example, the GDP of Syria is still fairly dependent on agriculture, even though it is the economic sector that contributes the least to the country's total GDP. As compared to Lebanon, Israel, Palestine and Jordan, the per capita water resources availability in Syria is much higher, which, to some extent, can explain why irrigated agriculture continues to play a more prominent economic role in the country.

Table 2. Virtual water imports and economic indicators for selected countries

	Lebanon	**Syria**	**Israel**	**Palestine**	**Jordan**
Virtual water import.	4,212	-1,176	6,186	n.a.	4,506
Agriculture as percent of GDP	12	25	2.8	9.0	2.4
Industry as percent of GDP	21	31	38	28	26
Services as percent of GDP	67	44	59	63	71

Source: Phillips et al. 2005.

Becoming less dependent on transboundary water can also ease some of the political tensions in the region. On the other hand there are also other economic and politically domestic factors at play. Agriculture still employs a major share of the work force in most countries of the region and there is basically no alternative economic sector that can absorb unemployed farmers in any bigger scale. The countries of the region generally have economies that lack the much needed diversification. The poorer countries would also be hard pressed to raise the foreign capital needed to import foods. Being self-sufficient in food supply has for a long time been a political aim with regard to the overall security situation in the region. In other words, the implementation of virtual water would require great structural adjustments in the economic and political systems of most countries and would at least in the shorter run imply higher burdens of unemployment and economic volatility.

3. Transboundary waters – Source of tension or opportunity for cooperation?

Water is a contested resource in the Middle East region and the water dependency – water from outside a country's borders – is rather high for many countries (see Table 3). For example Kuwait relies entirely on water sources outside its borders and the dependency ratio also runs high in countries like Egypt, Syria, Palestine, Israel and Iraq. Transboundary water issues are in many other developing country contexts focusing on development potentials and poverty reduction, but in the Middle East region the attention has typically revolved around "water conflicts". At times, images of "water wars" have wittingly been promoted by media and parts of contemporary academic writing.

Even though water is made a brick in the turbulent politics of the region, past experiences do not provide any clear evidence that water scarcity directly incites violent conflict and war between nation states (Wolf and Hamner, 2000). But as water scarcities are increasing it will imply higher risks for water conflicts and it is therefore important to remain vigilant of any potentially escalating disputes of shared surface and ground waters in the region. Still, it is shown that arid zones are no less prone to violent conflictual behaviour than states sharing water in water humid zones (Wolf and Hamner, 2000). It seems as though states that are experiencing water-scarce situations in a transboundary context tend to develop strategies to cope (Jägerskog and Phillips, 2006) It is also equally important to continue to build on cooperative efforts that are taking place in the region, such as through the Joint Water Committee (JWC) between Israel and Jordan, Israel and Palestine, and the Nile Basin Initiative. A main issue of the region is: Is it possible to shift the image of "water wars" to a more constructive image, as well as practice, of "water for regional and national development"? There is no denying that water will continue to cause tensions in the region, but political leaders of the region must increasingly realise the benefits of enhanced cooperation.

A key aspect in the transboundary water discussion in the MENA region is connected to the emerging discussion on "hydro-hegemony". A hydro-hegemon maintains a position in a basin in which it receives more than its equitable share of the water. In the Jordan River Basin, Israel is in such a position; in the Nile Basin, Egypt is clearly the hegemon; and in Euphrates-Tigris, Turkey is dominant. The hegemonic position seems not to be related to riparian position but is a reflection of the relative economic and political power in the basin (Zeitoun, 2005). To level the playing field in these basins donors could engage in building capacity of the weaker parties in a basin, thereby enabling them to engage in negotiations and relations with the basin hegemons on more equal terms (Jägerskog and Phillips, 2006).

Much of the water conflict focus in the region has emphasised potential inter-state conflicts, such as between riparian countries of the Jordan River, the Nile and the Euphrates and Tigris. Case 2 in the annex develops the political tensions surrounding the Jordan River Basin. Taking the increasing urbanisation into consideration, the competition for water and related services is increasing both within the urban center itself and between urban and rural water uses. The competition can trigger tension and conflict between various stakeholders, but also inspire cooperation. It is thus high time to also pay more attention to potential intra-state or local water conflicts. A recent urban example of local water riots took place in the Algerian coastal town of El Arrouch in 2002. The chronic drinking water shortage and inefficient supply systems led to violent protests.[8] In general, water supply and sanitation is not considered a main issue for transboundary waters. However, in certain pockets of the region, such as Gaza/West Bank, issues of water supply and sanitation are linked to transboundary ground and surface water. As the water scarcity situation will be increasingly experienced in urban centers such as Gaza City, the frustration might "trickle up"to the transboundary level.

It has been claimed that increased water cooperation among co-riparians will make it possible to have spill-over effects to other policy areas, such as the water cooperation annex in the Israeli-Palestinian Interim Agreement on the West Bank and Gaza Strip, 28 September 1995 (Oslo II). However, it has been argued that such spill-over is difficult to realise since the overall political system is not "attuned" to capitalise on water cooperation (see case 3 in the annex for an example from the Jordan River regarding potential spill-over effects into broader politics of the region).

Table 3. Water dependency ratio[9]

Country	Water Dependency ratio (percent)
Kuwait	100
Egypt	97
Bahrain	97
Syria	80
Palestine	75
Israel	55
Iraq	53
Jordan	23
Tunisia	9
Iran	7
Lebanon	7
Algeria	4
Qatar	4
Morocco	0
Djibouti	0
Oman	0
Yemen	0
Malta	0
Saudi Arabia	0
Libya	0
United Arab Emirates	0

Source: World Water Development Report 2003 and Phillips et al. 2005.

It should be noted that the water dependency ratio in table 3 does not include shared groundwater aquifers. In fact, countries like Libya, Tunisia and Algeria are sharing vast amounts of groundwater. Despite the region's heavy reliance on groundwater, most of the political focus is on the shared surface water. There are some exceptions to this, such as the groundwater between Palestine and Israel. Interesting cases are now emerging where countries have started to cooperate on transboundary groundwater, such as between Tunisia, Algeria and Libya regarding the North Western Sahara Aquifer System. The cooperation has so far been on a technical level, such as jointly defining the boundaries of the aquifer,

[8] See: Algerians riot over water shortages. BBC News 2002-07-14 http://news.bbc.co.uk/1/hi/world/middle_east/2127885.stm

[9] N.B. The water dependency ratio refers to surface water. Many of the countries do in fact share transboundary groundwater aquifers.

identifying areas where the pressure on the groundwater resource is the strongest and developing a common database. The cooperation is now moving into a second phase of establishing joint legal and institutional frameworks: steering committee consisting of the three countries' national water authorities; a joint coordination unit; and an *ad hoc* scientific committee. The framework will manage common databases, establish monitoring indicators and promote information exchange (see case 4 for further information).

There are long-standing traditions in the region of developing small- and large-scale alternatives for both using and producing water. The irrigation-based civilisations that have emerged in the region are of course well known. Less emphasised, however, are the nomadic and pastoralist cultures that for centuries have applied, for example, rainwater harvesting techniques and sustainable ways of using water resources. The more recent water scarcity responses include, among others, desalination, reuse of wastewater, water pricing, modern irrigation technologies and virtual water and water imports. Middle Eastern countries have applied these techniques when they find it necessary and appropriate to gain more supply and/or use the existing limited supply in a more efficient way. So far, these national water policy adjustments have not been reflected in the transboundary water allocation discussions and negotiations. In most cases riparian states do not include various water management options in shaping and changing their very inflexible positions along transboundary water resources.

4. Conclusions: Regional water use at crossroads

There is evidently no blueprint solution to the challenges related to water and irrigated agriculture in the region. Most countries in the region face acute problems related to water scarcity that are amalgamated by the highly complex political map of the region and difficulties to re-think agricultural policies. Many countries in the region are at a crossroads over their future use of water for irrigated agriculture. A critical question for many countries in the region is: Is agriculture an economically viable option? Despite that some countries have managed to shift into more high-value crops, such as fruits and flowers, it is not realistic to perceive that all countries will be able to follow such a path. It is also required to resolve the insufficient provision of drinking water supply and sanitation. Some countries in the region, for example Egypt, seem to be on track to meet the Millennium Development Goals (MDGs) on water supply and sanitation, while Yemen is far off the MDG mark.

The most water-scarce countries in the region will thus have to pose some very serious questions related to irrigated agriculture. Can current levels of irrigated agriculture be maintained in the long run? What are the environmental, social and political costs of maintaining current levels of water allocation? There is increasing evidence that unless countries apply economic policies that shift away from increased water use, water will continue to fuel political tensions between and within countries. It is somewhat hopeful that the much-hyped "water wars" are increasingly being replaced by a new type of thinking: Water for long-term stability in the region. However, much remains to be done before such a way of perceiving shared waters impacts political levels and the practice of politics in the region.

Technological options and improved water governance will continue to provide mechanisms for, at least in the short run, managing water scarcities and alleviate increasing tensions between water users. An area that needs special attention is the governance of groundwater quantity and quality. Interestingly, there is now in some places an emerging realization of the need to cooperate around transboundary groundwater aquifers. It is important that countries in the region closely follow such cooperative efforts to see how it can be applied in their own hydro-political context. For many countries in the region it will not be sufficient to apply improved management and technologies of increased water use efficiency, water reuse and harnessing of water resources – the bottom of the water barrel is basically reached. It will thus become a matter of dramatically changing water allocations and/or seek new ways of improving rainfed agriculture. Opportunities that largely are yet to be explored within rainfed agriculture in the region include the more efficient use of the green water (soil moisture). This is water that is not claimed. A gradual shift from irrigated agriculture to improved rainfed agriculture may also ease the pressure on surface and groundwater water, and reduce conflict potentials.

In developing local and national financing and adaptive strategies to water scarcity and climate variability, the role of virtual water should also be considered. Alternatively, or as a supplementary measure, countries can diversify economies and shift away from water-intensive agriculture and industries to reduce water scarcity as well as drastically reduce investment needs. Structural shifts away from water-intensive irrigated agriculture and industries could decrease economic vulnerability to droughts and land degradation. Equally and sometimes even more important is the shift towards sectors where the country or a community has a comparative advantage in terms of water use efficiency. Relying on trade in virtual water to meet a country's power supply and food needs could drastically reduce unsustainable water use. Furthermore, it could also mitigate the need for diverting national resources as well as foreign direct investment and aid towards costly water supply projects to support water intensive activity in areas that do not have the necessary water resources.

It is noted that when analysing agriculture in the Middle East context it is imperative to do it within its political, social and economic context. Unfortunately, donor agencies and international organizations sometimes see water as separated from other fields. Such an approach will lead to misunderstandings and disappointments about, for example, why support activities do not accomplish the expected results in the estimated time. Furthermore, in the context of transboundary waters and which has been pointed out by Waterbury (2002) in the context of the Nile Basin, the development of water policy with regard to the shared waters of the respective states is a very complex process and is determined by considerations stemming from both the domestic and the international political arenas.

Annex

Case 1. Country examples: Urbanisation and water in the Middle East[10]

Lebanon

Lebanon is one of the most urbanized countries in the Middle East with 90 percent of the population living in urban areas in 2000, compared to the average of 61 percent for the Middle East and North Africa region (MENA) (Earth Trends, 2003), but the agriculture sector is consuming 2/3 of the total water use in the country and only contributing to 12 percent of the GNP (Hoekstra, ed. 2003 and CNRS, 2003). The total area of cultivated land has remained constant during a long time, but the area of irrigated land more than doubled between 1961 and 1999. Increased consumption due to population growth, industrial development and expansion of agricultural irrigation will put the country's water resources under high pressure.

Even so the surface water resources in the country are presently underutilized (CNRS, 2003) and Lebanon is at an advantage when it comes to renewable water resources in the Middle East (Hoekstra, ed. 2003).
Lebanon has a great potential for trading with virtual water, which refers to the volume of water needed to produce a commodity or service. For arid and semi-arid regions this can be a good management strategy to supplement scarce water resources. Lebanon is, in the relationship of its neighbouring countries, expected to be an exporter of virtual water. It has medium water needs, a weak economy with high internal and external debt that would limit ability to import food crops and very low agricultural sectoral water efficiency (Hoekstra ed., 2003).

Instead it is the opposite, between 1997-2001 Lebanon imported crops that would be equivalent of 8-9 times the virtual water export (Hoekstra ed., 2003). The large import of agricultural products to the country is also very costly. In the late 90's the import exceeded the export by about ten times (IRC International, 2000). The large flow of virtual water into the country comes mostly from the import of wheat and rice, crops with high water demand (Hoekstra ed., 2003). Contradicting the hydrological fact description of Lebanon as a country of relative abundance of renewable water resources in the region, local public servants and experts all agree that Lebanon is facing severe water shortage (Brooks and Mehmet ed., 2000) and many farmers are relying on water from private wells as a supplement to irrigation (Aquastat, 1997).

The implication of these facts is that the water use is inefficient and needs to be reformed (Hoekstra ed., 2003). Presently the water user doesn't bear the cost of receiving the water, and increased tariffs and monitoring of the water use would create an incentive to be more efficient with the resource and would generate income for the water authorities to improve water infrastructure (CNRS, 2003). Now the outdated laws and regulations lead to constant disputes over the right to water and thousands of private wells are tapped without any regulations or charges (Aquastat, 1997). In the past the government agencies have been more supportive of expensive large scale programmes for reservoir constructions, but for the future the underutilised surface water could be used for alternative small-scale projects, not requesting large investment programmes (CNRS, 2003).

Jordan

In Jordan the annual urban growth rate is expected to be 3.1 percent 2000-2015, compared to 1 percent in the rural areas. Poverty is as widespread in the urban areas as in the rural, about 12 percent, but the access to water supply and sanitation is not equally distributed throughout the country. In the rural areas 16 percent of the population lacks access to clean water and 2 percent to adequate sanitation. In the cities the equivalent numbers are 0 percent (USAID, 2000). Being one of the most water-scarce countries in the world this is a potential source of conflict between rural and urban areas in the future. The capital, Amman, and the country's second largest city, Zarqa, both uses pumped aquifer water to supply the urban populations and there has already been a reduced availability of water to local farmers and the nearby wetlands are being drained (AAAS, 1997). The scarcity of water resources in the country is already severe enough for poor rural farmers to abandon agriculture and livestock as there main source of income (JHDR, 2004). In 2000 Amman hosted a population of 1.1 million (USAID, 2000) and had already in 1992 been withdrawing twice the "safe" extraction volume from the underground aquifer at Azraq Oasis, which supplies the city with almost all of its water (AAAS, 1997). The

[10] Case compiled by Rebecca Löfgren, Stockholm International Water Institute

rapid urbanisation of rural poor, from 62 percent of the population 1952 to 22 percent in 2002, have led to increased competition of the scarce natural resources in the expanding urban communities. To cope with this new demographic situation local governments and authorities need to be strengthened and have the capacity to allocate resources in an accepted way to the citizens (JHDR, 2004).

Yemen

Yemen is exhausting its groundwater aquifers faster than any other country in the world (Ward et al., 2000). Yemen had a per capita availability of renewable water resources of 133 m^3 in 1994. This is to be compared to the average for the MENA region of 1 250 m^3 and the world average of 7 500 m3. Water consumption is increasing every year and in the two largest urban areas, Taiz and the capital Sana, water resources are extremely limited (IRIN, 2005). If the water use continues at the same rate as today the capital will run out of water within a decade (Ward et al., 2000). In 1994 the extraction was 400 percent more then the renewable share of the aquifer (Ward et al., 2000). The public water delivery system only provides water every 20^{th} day to Sana and every 40^{th} day to Taiz (Ward et al., 2000).

Domestic and agricultural use stands for 90 percent of the consumption in the country, most of this being from aquifers as most regions receive 50-200 mm of rainfall per year (IRIN, 2005). The urban areas are transferring water from the rural areas and the farmers in the vicinities of the Taiz and Sana are now lacking a sufficient amount of water for irrigation. The city of Taiz has negotiated with the neighbouring rural area of Habir to extract water from their land. Even if an agreement is now made the discussions were difficult and the implementation of the agreement is constantly obstructed by rural residents (Ward et al., 2000).
Yemen has also increased its use of water for irrigation and the development of groundwater sources has rapidly increased the irrigated area in the country the last two decades. This has increased the tension between urban and rural water users and a new policy to handle urban-rural water transfer is needed to handle the rising conflicts (Ward et al., 2000).

The water and sanitation delivery system has been neglected in the rural area where only 20 percent of the households have access to safe water (Ward et al., 2000) and 16 percent had access to adequate sanitation in 1997. The same figure for urban areas was 56 percent in 1997 (WHO/UNICEF, 2004b). The percentage with access to safe water was 74 percent in the urban areas in 1995 (Ward et al., 2000). These figures will risk to decline, especially for the capital as the expansion of housing and industry development is too great for the government agencies to keep pace with providing water and sanitation (Ward et al., 2000).
To alleviate some of the water stress that Yemen is experiencing the efficiency of the water use must increase. A need of a clear system for water rights, which can balance the urban and rural needs, could decrease the conflict situations now occurring. In 1995 the National Water Resources Authority (NWRA) was formed given the responsibility of planning, monitoring, and developing new legislation and regulation for the nation's water resources. The new authority will need time to build capacity and acceptance among the users. It is important that new legislation and policy recognise the traditional customs in rural areas to handle water allocation. The government and the NWSA have adopted a new sector policy for urban water use, which include decentralized management and the possibility for individual tariffs for local branches. The government has also begun to involve the private sector in urban water distribution. The government is also looking into the possibility of water markets as a way to allocate the available water between users, both urban and rural (Ward et al., 2000).

Case 2: Water situation in the Jordan River Basin[11]

It is important in any attempt to address the water issue in the Jordan River Basin to have a clear view of the different water management situations and development stages that Israel, Jordan and the West Bank and Gaza are in as well as of the historical development of the respective catchment states or entities.

It is important that for a variety of reasons the parties started to develop their water resources at different times and devoted different resources to this. Over the first decade after its independence, Israel appropriated and developed around 1 billion cubic metres (bcm) of groundwater. Later through the construction of the National Water Carrier in the 1960s another 400 mcm were developed. By 1967 Israel was using 1.6 bcm of water per year, of which 80 percent was used in agriculture (Allan, 1996). In order to be able to develop its water resources in such a way as to cover all of its territory, it chose to nationalize the water. The 1959 Water Law emphasized that the state needed the water so as to be able to serve the needs of its people and the development of the state (Trottier, 1999). In 1985 Israel's consumption of water reached 2 bcm per year, although it declined in the years that followed as a result of droughts and only reached 2 bcm per year again in the mid-1990s (Allan 2001). However, following the droughts of 1998–2001 the Water Commissioners Office in Israel is making drastic cuts and intends to bring down water use considerably (Galnoor, 1980).

Since the establishment of the state, when agriculture was strong, Israel has turned itself into a modern political economy that does not rely on agriculture for its sustainability but rather on its advanced high-technology industry. The share of its gross national product (GNP) accounted for by agriculture has declined continuously (at present it is 2–3 percent) and fewer and fewer people are employed in the sector (a rough estimate today is that around 3–4 percent of the economically active population work in the sector). It is also worth mentioning that Israel is the leading producer of highly advanced irrigation techniques which enable Israeli farmers to be effective water users. This should be compared with the situation in Palestine and Jordan, which suffer from large water losses due to poor technique and management (Lavy, 1997).

The water resources in the West Bank and Gaza were not much developed prior to 1967, and the bulk of the water used there was consumed by agriculture. There are clear problems in obtaining figures on water use in the West Bank and Gaza. It is, nonetheless, generally assumed that the aquifer under Gaza yields around 50 mcm per year. In spite of this, water withdrawal is believed to be around 100–150 mcm per year, which explains the deteriorating quality of that water (Allan, 2001) In 2002 the Palestinians were saying that they used around 270 mcm/year in the West Bank and Gaza together. The West Bank is thought to provide around 850 mcm per year if brackish water is included and 620 if it is excluded. Since the war in 1967 Israel has administered the water of the West Bank and Gaza and all drilling of new wells has to be approved by Israel. From 1967 to 1990 Israel issued only 23 new drilling permits to Palestinians. At the time of the Taba agreement in 1995 (also called the Interim Agreement on the West Bank and Gaza Strip of September 1995) it is estimated that the Israelis were using 82 percent of the water that comes from the West Bank and the Palestinians only 18 percent.

While the Israeli economy has transformed itself the Palestinian economy is still reliant on agriculture to a sizeable extent. At present agriculture accounts for around 15 percent of the GNP of the Palestinian territories and around 15–20 percent of the population work in the sector.[12] Moreover, as the West Bank and Gaza have been and still are under occupation, there has been no ambitious water development plan for these areas. Today, when the Palestinians have self-rule over parts of the occupied territories, they are dependent on the donor community for water projects and will continue to be so for quite some time into the future. The donors grant rather large sums for water development projects in the West Bank and Gaza, and there is a lack of Palestinian institutions that can manage this in an appropriate way. The role of the donors and the extent of interference by them are therefore considerable. This contributes to both ideas and efforts being directed towards putting the greater part of the water management in the hands of the Palestinian 'state in the making', in contrast with the local arrangements that have persisted in many areas of the West Bank throughout the occupation (Trottier, 1999).

For Israel and Jordan the Jordan River Basin (which includes its tributaries) is of immense importance as both states withdraw large percentages of their water from it. For the other riparian states in the basin—Syria and

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[11] Case compiled by Anders Jägerskog, Stockholm International Water Institute. It draws on Jägerskog, Anders, 2003.

[12] The figure of 15–20 percent is high but reflects the fact that since the beginning of the al-Quds Intifada in 2000 more people are involved in agriculture since many are not able to get into Israel for their work.

Lebanon—the Jordan River Basin is not as important as it is for Israel, Jordan and the Palestinian areas since Lebanon gets the greater part of its water from the Litani and Awali rivers while Syria receives most of its water from the Euphrates and the Orontes. Moreover, the quantity of water in the Jordan River is constantly declining along the course of the river because more water is withdrawn from it than is renewed each year. This is especially significant in years of drought. The decline in the flow threatens the quality of the water as saline water can infiltrate and salinize the water, making it impossible to use. Agricultural drainage water, draining into the river from both sides of the river, is accelerating the deterioration of the water quality. Hence, the water problem is not only one of quantity but also of quality (Wolf and Hamner, 2000).

In addition to the dispute over surface water, which is the main issue of dispute between Israel and Jordan, there is the dispute over the groundwater of the mountain aquifer between Israel and the Palestinian territories. The mountain aquifer, which is divided in the western aquifer, which flows from the highest parts of the West Bank westwards, and the north eastern aquifer that flows north-east into Israeli territory and the eastern aquifer that flows east towards the Jordan River.The eastern aquifer is not considered to be a transboundary water resource as its flow is almost entirely within the West Bank (Assaf et al, 1993). These aquifers are recharged through the precipitation that falls over the West Bank. The recharge is subject to major variations as precipitation over the area varies considerably from year to year. These variations obviously complicate the relations among the riparians, and this is particularly evident in years of drought. The variations in water availability are in a sense possible to account for. If the parties could agree to negotiate allocations on the basis of 'reliable' water and include provisions for the allocation of the 'non-reliable' extra water, the problem of allocation in times of drought would be more easily dealt with. These ideas are iterated by Kolars who points out the (rather obvious) fact that data on river flows are multi-year averages and thus not a rational base for yearly allocations. He also points out that the Jordan River Basin is subject to high seasonal and multi-annual variances in precipitation and attendant stream flow (Kolars 2000). Consequently, it would be irrational not to take these features into account.

In the conflict between Israel and the Palestinians a further source of dispute is the Israeli coastal aquifer**,** which runs along the Mediterranean coast and connects from Israel into the Gaza aquifer, which underlies the Gaza Strip. There is a general agreement that the Gaza aquifer is an extension of the coastal aquifer in Israel, although there are different views on the extent to which they are connected (Assaf et al, 1993). Still, there is a general agreement that the flow in the aquifer is predominantly east–west, which seems to indicate that Israeli activities north of the Gaza Strip will not affect the part of the aquifer beneath the Gaza Strip very much, nor will activities in the Gaza strip affect the Israeli coastal aquifer very much (Shapland, 1997).

Having outlined the hydrological features of the region, it is important to view them in their political context. It must be borne in mind that the figures presented by hydrologists from each side as well as international experts are much debated, as they tend to differ. They differ, rather predictably, according to national and political lines (Salameh and Bannayan, 1993, Elmusa, 2000 and Shapland, 1997). In much of the literature on the water resources of the Middle East the focus when discussing water availability is on the *blue water*, which is the water in *surface* resources such as rivers, streams and the groundwater (Falkenmark, 1986). Allan calls this *evident* water. What is overlooked is the *green water*, which is the soil moisture. This water is included in what Allan calls *non-evident* water. Obviously, there are differences between different soil profiles which determine their capacity to hold water. Fine-textured soil holds water better than coarse-textured soil and it is thus easier for the vegetation to intercept the soil water on its way to the groundwater in a fine-textured soil (Allan 2001). The evident water in the region can be seen to consist of surface water, groundwater, reused urban waste water, desalinated water and water imported through pipelines and tankers. The non-evident water is the soil moisture, the reused water and the virtual water, which is the significant amount of water embedded in the foodstuffs that are traded into the region.

Israel, Jordan and the West Bank and Gaza essentially ran out of water a long time ago but they are still coping. This is mainly due to the large proportion of virtual water that is traded into the region, although water-saving technologies and increased use of reused waste-water have also been helpful in this regard.

While the scientific ideas on how to best approach the water problem in the Middle East might be quite clear[13]—to achieve strategic water security the states should strive to secure supplies through importing virtual water—it is a rather different matter to get these ideas adopted in the different national discourses on water. The concept of 'insiders' and 'outsiders' is helpful in this regard. While insider knowledge about water tends to be more determined by politics than by scientific findings, views of outsiders, who are not a part of the politics of the region, tend to be more attuned to scientific understanding. Essentially, the importing of *virtual water* has been an ameliorating factor that has enabled the states of the region to 'solve' their water problems without too much friction. The presence of cheap subsidized grain on the international food market from which the states in the region have covered their water deficits has evidently not created the circumstances in which the insiders take it into account. Why is that? Clearly, it is because politics are at the centre of the discourse.

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[13] These arguments and the societal changes they entail are also discussed in e.g. Lundqvist, Jan et al., *New Dimensions in Water Security: Water, Society and Eco System Services in the 21st Century*, FAO Report (New York: United Nations Food and Agricultural Organization, 2000). See also: Chapagain, A.K. and Hoekstra, A.Y. (2004a). *Water Footprints of Nations. Volume 1: Main Report.* UNESCO-IHE Institute for Water Education, Value of Water Research Report Series No. 16, Delft, the Netherlands and Chapagain, A.K. and Hoekstra, A.Y. (2004b). *Water Footprints of Nations. Volume 2: Appendices.* UNESCO-IHE Institute for Water Education, Value of Water Research Report Series No. 16, Delft, the Netherlands.

Case 3: Spill-over effects of transboundary water co-operation in the Jordan River Basin– reality or wishful thinking?[14]

In the midst of fears of water-related violence and conflict Israel, Jordan and the Palestinians have maintained a basic level of cooperation over their shared waters. Even during the *intifada* that started in September 2000 this is true. Between Israel and Jordan low-level cooperation dates back to the 1950's when, under the auspices of UN, they collectively have chosen to co-ordinate water activities related to the Jordan River. The cooperation was later formalised as part of the Israeli-Jordanian Peace Agreement of 1994 that has created a Joint Water Committee. The Israeli-Palestinian water relations are regulated in a 1995 interim agreement. This is not a full agreement but covers only part of the water issues between the parties such as protection of water and sewage systems. A Joint Water Committee is also in place between Israel and the Palestinians. Given the political stalemate and ongoing violence substantial negotiations on water or other matters are not likely to take place soon. Still, Israel and the Palestinians agree that some form of basic cooperation on their shared water is indispensable.

A key question in this annex is if and if so how, the existing cooperation over transboundary waters can be used to promote cooperation in others spheres, thereby potentially functioning as a conflict prevention mechanism. Increased understanding of the relationship between the technical level (where most of the actual water co-ordination and cooperation takes place) and the political level needs to be analysed. Some questions that will be dwelled upon are: Is it reasonable to argue that there are, or can be, co-operative spill over effects as a result of the existing water cooperation on other political questions and issue-areas in the region? Can the existing cooperation over transboundary water in the Jordan River Basin be used to promote cooperation in others spheres between the parties? Is it indeed feasible to think that water may be a catalyst for increased security and eventually peace?

In an effort to utilise cooperation between riparians over transboundary waters it has been argued that the states (or entities) engaged in the cooperation must be able to *perceive* the potential for a range of benefits that are not only to do with water management *per se.* Sadoff and Grey argue that there are four basic co-operative benefits. The first is *benefits to the river*, which entails a better management of the ecosystems. The second is *benefits from the river* such as increased food and energy production. The third is the *benefit of reduction costs because of the river* since the tensions between riparian states that inevitably will exist over a shared river will be lowered by cooperation in the management thereof. The reduction of tensions will also result in a reduction of costs. The fourth example are the *benefits beyond the river* which cover the positive results that cooperation over a shared river can have in terms of spill-over effects such as increased economic integration between two or more countries. Seemingly the cooperation between states sharing a river is in some cases vast while in other cases not so significant. The perception of potential benefits as well as the materialisation of those from water cooperation seem in any case imperative to a better management of the world's rivers as well as to relations among the riparians sharing a watercourse (Sadoff andGrey 2002).

The economic framework developed by Sadoff and Grey for understanding cooperation and benefit sharing ought to be complemented by an account of the political aspects involved in the joint management of international rivers. In a study commissioned by the Expert Group on Development Issues at the Ministry for Foreign Affairs in Sweden (See Phillips et al, 2006) its authors argue that the key drivers in benefit sharing are security, economic development and the environment. They argue through the use of the INTER-Sede Model that in the Jordan River Basin the basic security dynamics in that particular region is of overriding importance so that it minimizes chances for benefit sharing to occur.

Drawing on the "benefits outlined by Sadoff and Grey: a) *to* the river, b) *from* the river, c) *as a reduction of costs* resulting from river cooperation and d) benefits that goes *beyond* the river the discussion below analyses the different benefits in the Jordan River Basin. Are those benefits possible to discern in the case of Israel and the Palestinians and Israel and Jordan and Israel? And does it matter *who* sees the benefits?

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[14] This annex builds on: Jägerskog, A. (2006) "Functional water co-operation in the Jordan River Basin: Spillover or spillback for political security" (tentativ titel) in Brauch, H. G., Grin, J., Mesjasz, C., Chadha Behera, N., Chourou, B., Oswald Spring, U., Liotta, P.H., Kameri-Mbote, P. (Eds.) *Facing Global Environmental Change – Environmental, Human, Energy, Food, Health and Water Security Concept*, (Berlin, Heidelberg, New York, Hong Kong, London, Milan, Paris, Tokyo: Springer Verlag) (forthcoming)

In terms of benefits to the river it is argued that there are tangible benefits to the parties in terms of a better management of the river system. For example, the canal for storage of Yarmuk water from Jordan in Lake Tiberias that was built after the peace agreement between Israel and Jordan has led to a more sensible (although by no means perfect) way of utilising the water of the Jordan. In the case of Israel and the Palestinians an example of cooperation with benefits *to* the river is the local cross-border cooperation that takes place between the Israeli city Emeq Hefer and Tulkarem on water in spite of being separated by the "green line". The cities have an ambitious programme to manage their shared water resources.[15] In terms of benefits stemming *from* the river the result is more mixed. There are plans between the parties for increased energy production but not much has happened. At present the parties are seeking support for a feasibility study of a Read-Dead Canal, which would aim to mitigate the drying up of the Dead Sea as well as produce hydropower on its way from the Red Sea to the Dead Sea. While the Israeli-Jordanian arrangements for storing of part of the Jordanian share of the River Jordan in the Israeli lake Tiberias during wintertime and the subsequent release of the water to Jordan in summer time when they need it more is a benefit to the river it could also be seen as a benefit from the river. As a result the Jordan is able to optimise the water allocation to its farmers and to its cities. In terms of *reduction of costs* and the related reduction of tension as a result of the cooperation the result is mixed. While in the case of Israel and Jordan the relations are relatively smooth it is highly doubtful whether this has to any large extent to do with the functional water cooperation. Rather, there are strong political factors (such as U.S. pressure, Israeli interest of keeping good relations with Jordan etc) acting as strong forces reinforcing this cooperation. In the case of Israel and the Palestinians it is not apparent that the basic cooperation that is taking place between the water professionals is resulting in cooperation in other political areas. In terms of benefits *beyond* the river (for example economic integration) it is not apparent yet. In the case of Israel and the Palestinians there is on the contrary a sort of disintegration that is taking place.

While visionary leaders such as Shimon Peres in his book *The New Middle East* (Peres 1993) pointed to a possible future of further economic integration and cross-border business parks in the Jordan Valley but this has not happened yet. If an economic integration should eventually take place it is furthermore not reasonable to argue that this would to any significant extent be a result of technical water cooperation between the parties although it should not be neglected as a confidence building measure. Indeed the confidence building has meant that there is a professional understanding across the borders, which have increased water security since the professional people involved have generally been helpful in providing assistance for reparation of water infrastructure even during the latest intifada. In terms of donor thinking around the issue of potential spill-over effects that goes beyond the river much analysis is still needed. Reasonable questions to be asked are: would increased conditionality (demanding or at least linking water cooperation projects to cooperative measures in other political spheres) from the donor side facilitate increased spill-over effects? Drawing on discourse line of reasoning – would increased involvement in bringing in the civil society? – and thereby affecting the "sanctioned discourse" in the society towards a more pro-cooperation stance – facilitate the process of increased cooperation?

For a further understanding of why spill-over effects of cooperative behaviour are hard to find in this case it is useful to bring in a discussion of *perceptions* among the public both on water as well as their neighbours. In order for benefits to be tangible and gain momentum to stir further cooperation in other areas the benefits must be apparent to a broader public. Otherwise it is hard for the policy-makers to take the necessary steps to capitalise on the cooperation that is taking place. While the water professionals and practitioners in the field see the potential benefits in all of the above-mentioned areas their respective generic political system is not so attuned to that, and indeed, have many other interests to weigh in against the water question. And the broader public is even less aware of the cooperation that is taking place and naturally neither aware of its actual and potential benefits. Thus the strong public discourses discussed above largely determine what spill-over of cooperative behaviour is possible.

[15] Nahum Itzkovitz, personal communication, Antalya, Turkey, 2 November 2002; Eran Feitelson, personal communication, Jerusalem, 24 May 2001.

Case 4. A regional approach for the management of transboundary groundwater aquifers: the case of the North Western Sahara Aquifer System (NWSAS)[16]

The NWSAS is a transboundary aquifer system between Algeria, Libya and Tunisia. It contains considerable reserves of non-renewable groundwater. Located in arid and semi-arid areas where surface water is very rare, the three countries rely heavily on their groundwater resources.

During the last thirsty years, the development and exploitation of the system has substantially increased, from 0,6 to 2,5 billion m^3/year (Abdous et al, 2006). This continued exploitation is associated with many risks such as salinization, loss of artesian flow, drying up of outlets and excessive drawdowns in pumping wells. The first signs of deterioration of the state of the groundwater resources can already be observed. The question is therefore how to exploit the NWSAS in a sustainable way, ensuring the best development for the region, without at the same time risking the irreparable and irreversible deterioration of the system. The three countries concerned with the future of the system have to come together and find a way to jointly manage the NWSAS. The first necessary step is to improve the scientific knowledge over the system on its geographic extent and the evaluation of the exploitable reserves and their use. Well aware of the potential risks on the NWSAS, and its importance as a water resource for them, the three countries undertook a joint study of the system under the supervision of the Observatoire du Sahara et du Sahel (OSS); with the support of the Swiss Agency for Development and Cooperation, the International Fund for Agricultural Development (IFAD) and the UN Food and Agriculture Organization (FAO) from 1999 to 2002. The achieved results of this study was an improved knowledge of the basin's hydrogeology, which could lead to the establishment of a common data base between the three countries serving as an exchange information tool, and the design of a model simulating the hydrodynamic behaviour of the aquifer system and making it possible to forecast the impact of abstraction. The results of this study have been enlightening for the decision-makers of the three countries. For instance, the simulations carried out have highlighted the areas where the system appears to be the most vulnerable. It is the sector of the Algerian-Tunisian Chotts where the strongest density in population can be found, and where the pressure on water resources is strong.

In the second phase of the NWSAS project (in progress) the institutional mechanism which has been established is under signature by the three States. The structure of the mechanism is as follows: a steering committee composed of the national water authorities in the three countries, a coordination unit hosted by the OSS, and an ad hoc scientific committee for scientific evaluation and orientation. The mechanism is in charge of managing the tools developed for the NWSAS (a common data base and a model) and the exchange of information, the establishment of monitoring indicators and promoting studies.

The regional approach in the NWSAS has highlighted the necessity of understanding the functioning of the system in its natural conditions and the impact of any development for building an institutional and legal mechanism for cooperation. The results are rather encouraging for the future of the cooperation between the three States. However socio-economic and environmental aspects need now to be considered in the future development of the resource.

[16] Case provided by Raya Marina Stephan, International Hydrological Program, UNESCO.

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