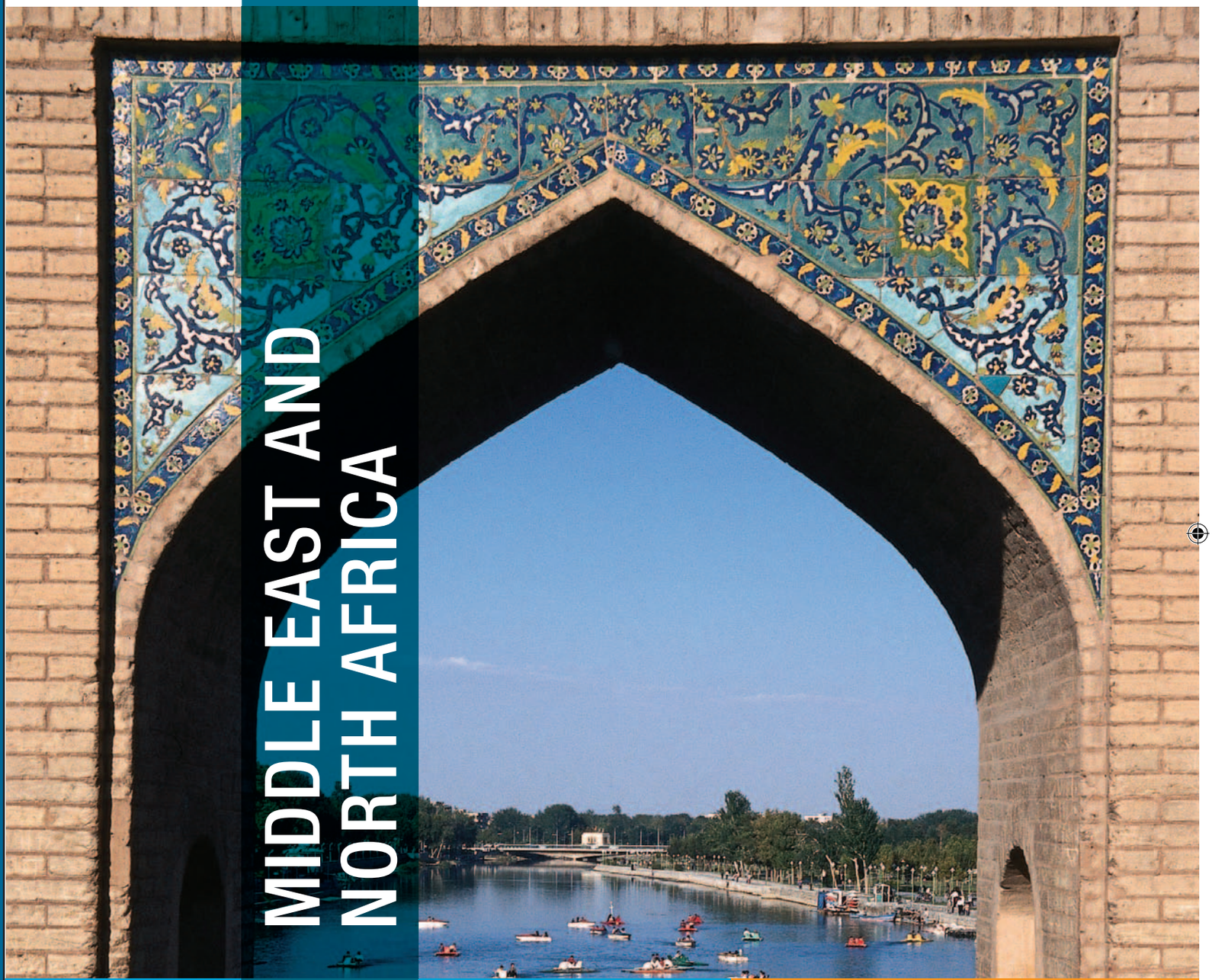
Mexico 2006
4th World Water Forum



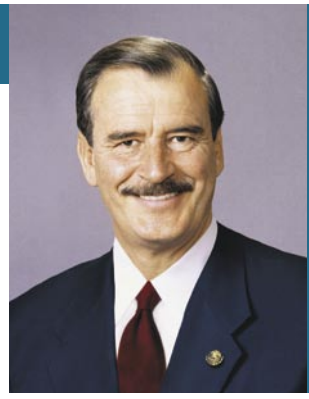
MIDDLE EAST AND NORTH AFRICA

Regional Document

Local Actions for a Global Challenge

CONAGUA
Comisión Nacional del Agua

World Water Council
4th World Water Forum



Vicente Fox Quesada
President of Mexico

People, organizations and nations are more interested in sharing their own experiences and in knowing how effective solutions have been implemented to solve different challenges regarding water issues.

We know that waste and scarcity of this resource might affect social welfare and limit the development.

Therefore, World Water Fora have become one of the most important events at the international level.

The 4th World Water Forum was organized by the National Water Commission of Mexico and the World Water Council. This important event was held in Mexico City on March, 2006.

With the purpose of facilitating the organization of the Forum, the world was divided into the following five regions:

- Africa.
- Americas.
- Asia-Pacific.
- Europe.
- Middle-East and North Africa.

Each Region was organized in a specific way and as part of its important work, they produced a document that shows the main water related problems in the region, that explains the progress made so far in their solution and that evaluates the future perspectives.

These documents are a very important source of knowledge and I am sure that they will become a key reference in the future.

Finally, I would like to reiterate my recognition to the superb job performed by the different specialists, institutions and organizations involved in the regional process. Their professionalism, enthusiasm and commitment have been outstanding.

MIDDLE EAST AND NORTH AFRICA REGIONAL DOCUMENT

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

ACSAD	Arab Center for the Studies of Arid Zones and Dry Lands
AOAD	Arab Organization for Agricultural Development
ARG	Artificial Recharge for Groundwater
AWARENET	Arab Integrated Water Resources Management Network
AWC	Arab Water Council
BOD5	Biochemical Oxygen Demand (5 days)
BOT	Build, Operate and Transfer
CEDARE	Center for Environment and Development for the Arab Region and Europe
COD	Chemical Oxygen Demand
CWRAS	Country Water Resources Assistance Strategy
DAGs	Donor Assistance Groups
DBL	Design-Build-Lease
ENSAP	Eastern Nile Subsidiary Action Program
ESCWA	Economic and Social Commission for Western Asia
FAO	Food and Agricultural Organization
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
IDEN	Integrated Development of the Eastern Nile
IDRC	International Development Research Center
IIIMP	Integrated Irrigation Improvement and Management Project
IRWR	Internal Renewable Water Resources
IWRM	Integrated Water Resources Management
LNFDC	Lake Nasser Flood and Drought Control Project
LWCP	Land and Water Conservation Project
MDGs	Millennium Development Goals
MENA	Middle East and North Africa
MSF	Multi-Stage-Flash
NEL	Nile Equatorial Lakes Region
NELSAP	Nile Equatorial Lakes Region Subsidiary Action Program
NGOs	Non Governmental Organizations
NWP	National Water Plan
PPP	Public Private Partnerships
RBAS	Regional Bureau for Arab States
RO	Reverse Osmosis
SVPs	Shared Vision Programs
UAE	United Arab Emirates
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHO	World Health Organization
WRI	World Resources Institute
WSP	Wastewater Stabilization Pond
WSSD	World Summit for Sustainable Development

EXECUTIVE SUMMARY

Since the dawn of history, the Middle East and North Africa Region (MENA) has been home to some of the greatest civilizations which ever flourished on earth. From 4500 BC, regional nations such as Egypt, Iraq, Yemen, Syria and Iran gave rise to thriving and distinguished societies. All of these societies had one factor in common —their dependence on water and its development.

In the year 2005-2006, countries in the region have joined together to prepare this report reviewing water in MENA in order to share experiences with the rest of the world through the 4th World Water Forum, convened in Mexico —the home of another great civilization.

1. The resource and its uses

The region is the most arid in the world. Of the total area of about 14 million km^2, more than 87 percent is desert. Except for coastal strips in the Maghreb and the East Mediterranean, and the mountains of Northern Iraq and the Arabian peninsula, conditions are predominantly arid to hyper arid. Water resources are consequently very sparse. Total renewable water resources in the region are estimated at about 335 km^3/year, with demand already exceeding 200 km^3/year (about 60% of the renewable resource) and rising fast. It is expected that per capita renewable resources, which in 1950 were an ample 4,000 m^3 each year will drop further from their present level of about 1,060 m^3 each year to as little as 547 m^3 per person per year by 2050. The region also has the highest dependency on external water resources. More than half of the annually renewable resource originates outside the region, largely in the major river systems of the Nile, Euphrates, Tigris and Jordan.

Due to the scarcity of water resources in the region, non-conventional water supplies have been widely adopted in the form of desalination plants for brackish and sea water, wastewater reuse programs, and reuse of agricultural drainage water. Fossil groundwater has also been extensively tapped: for example, in the two major shared aquifer systems of North Africa, the Nubian Sandstone and the North Western Sahara fossil aquifers, which extend from Egypt to Mauritania. In the Arabian peninsula, deep non-renewable aquifers supply more than 80% of total freshwater use. Now, these aquifers are at risk, particularly in the Arabian Peninsula, as volumes withdrawn far exceed natural recharge resulting in a continuous decline in groundwater levels and quality deterioration due to seawater intrusion.

Major investments have been directed to the water supply and sanitation subsector within the region. However, coverage is variable: Libya, Tunisia, and the countries of the Gulf Cooperation Council (GCC) have the highest rate of access to safe drinking water (more than 90%) and also to sanitation services. The lowest access to both services is in Somalia, Mauritania, Palestine and Yemen.

Box 1. Extreme Aridity

- Total rain fall 2148 km^3/yr
- 50% of rain occurring in Sudan
- Evaporation may exceed 4,000 mm/yr
- IRWR = 146.5 km^3/yr
- 70% of the region's IRWR are generated in Iraq, Sudan & Morocco
- Per capita share of IRWR changed from 1911 m^3/cap/y in 1950 to 540 m^3/cap/y in 1998, and is expected to drop to 240 m^3/cap/y in 2050.
- ARWR = 335 km^3/year.
- More than 50% dependence on water resources generated outside the region

Box 2. Water Supply and Sanitation

- To achieve the MDG of reducing by half the people with no access to drinking water by 2015, a further 83 million people in the Arab region need to be supplied with safe water.
- To achieve the MDG of reducing by half the people with no access to proper sanitation by 2015, 96 million more people need to be provided with sanitation services.

2. Challenges and Responses

The principal water management challenges in the region stem from the prevalent aridity and the consequent scarcity of water, and from the nature and quality of supply and demand management responses to that shortage.

Water resource management in MENA has until recently been characterized by an unintegrated supply driven approach in which each water using sector tended to act independently.

The vulnerability that stems from the high rate of dependence on external and shared resources has been exacerbated by the political instability and conflict that has marked some parts of the region.

As use has mounted, environmental problems have emerged, including deterioration of water quality, salinization, and reduction of the yield of heavily exploited aquifers. The decline in water quality has in part been caused by problems related to the fast growth of cities in the region: inefficient wastewater treatment, poor or non-existent solid waste management, and weak pollution control and abatement programs.

Box 3. Population & Water Resources in the Region

- Population growth 3%.
- Population of the MENA region is less than 5% of the world population, but it receives only 1% of the world's renewable water resources.
- Water consumption considerably increases with GDP (744 l/c/d in UAE).

Finally, the truth that "somebody has to pay for quality water services" has been too often overlooked. Institutional structures have paid too little attention to the imperatives of financial sustainability. Both in irrigation and in water supply and sanitation, the quality of service delivery has too often been undermined by inadequate budgets, themselves in part resulting from inadequate cost recovery.

For the future, new or intensified challenges include increased urbanization, less homogeneous societies which reduce the effectiveness of traditional water management institutions, high levels of unemployment leading to reluctance to reduce water diverted to irrigated agriculture on which the poor often depend, increased climate variability, globalization, and increased pressure on agriculture from imports matched by growing but specialized opportunities for agricultural exports.

Policy and institutional responses to these complex challenges have varied between countries in the region, but have in general occurred at three levels, depending on the degree of water scarcity and the extent of water resources development.

At the first level, water scarcity has been felt, but **supply side solutions** exist and scarcity has typically been addressed through supply management and engineering interventions to divert more water or reduce conveyance losses.

At the second level, where classic supply side solutions are no longer practical, countries in the region have invested more in **non-conventional supply solutions** like wastewater recycling or desalination, and have begun to make water use more efficient through user **demand management interventions**. Demand side approaches have proven challenging as they rely on the development of appropriate instruments and institutions to ensure sustainable and high quality water services to farmers and the population, as the counterpart to managing demand to maximize incomes and growth.

At the third level, where institutional reforms have led to enhanced water management within each sub-sector but demand and the needs of a modern economy continue to press on scarce resources, improvements in **overall sector governance** are required. Typically, this stage will include integrated water resources management, decentralization of water service management to locally accountable institutions, and the involvement of users and of civil society in governance structures. This requires difficult political trade-offs and institutional accountability to achieve more value per each drop of water. However, experience has shown that overall integrated management can be achieved, provided that political will is backed up by effective capacity building programs, awareness campaigns, applied research, and adoption of innovative technologies.

While each country of the region is attempting to tackle its water problems according to its local needs, strategies and policies are not always consistent from country to country, or even within countries, nor should they be, since the situations vary greatly. Several countries have already commenced national programs for enhancing irrigation efficiency, minimizing conveyance losses, participatory water management, and protection and improvement of water quality. Drought management and climate variability strategies, groundwater management policies, and wastewater reuse plans have also been adopted by several nations. However, the common need across all countries in the region is to make progress on the complex issues of improving water sector governance.

One governance improvement on which most countries of the region already have developed policies, plans, or strategies is **integrated water resource management.** However, the level of preparation for specific national IWRM plans varies from one country to the other. For example, Egypt, Jordan, Yemen and Palestine have approved national water resources plans, and in the case of Egypt and Yemen, these plans are fully integrated.

Food security issues have long been a preoccupation at decision making levels in the MENA region. The region imports more than 50 percent of its food requirement, and over 80% of regional food production depends on rainfall which is by its nature erratic. As a result, the region is importing a net 80 million tons of food each year, although the quantity may vary significantly with good or bad rainfall years. Available water resources can do little to close this "food gap" – self sufficiency in food would require an extra 235 km^3 of water, more than the entire current water use. There is, however, scope for improving returns to water through greater use efficiency and through a move to higher value crops. To the extent that higher value produce can be exported, this would help to counterbalance the food import bill which is about US$ 23.5 billion annually, dwarfing food exports that total about US$ 4.92 billion each year.

A negative factor for decades in the MENA region has been the scourge of **conflict,** which has caused major socio-economic and environmental problems and increasing pressure on already fragile and scarce water resources. The environmental impacts induced by conflict include physical damage to infrastructure (which is prohibited by international agreements) and serious contamination due to release of potentially hazardous substances from targeted military and industrial infrastructure, which need massive investments for restoration and rehabilitation. The continued failure to resolve long standing political tensions in the region is a major factor in the region limiting effective water management and hence sustainable development.

3. Progress and Innovations in the Region

Investments in water sector services

Driven by the need to make the most of scarce resources, countries in the region have made massive investments in infrastructure to store and divert water, to provide water supply and sanitation services to the population, and to provide irrigation services. For example, in Egypt in the five years 2002-2004, about US$ 2.5 billion was spent on irrigation infrastructure, and about US$ 1.5 billion on the provision of water supply and sanitation services. Over the two decades 1982–2004, Egypt spent a total of US$ 10 billion on investments in potable water supply services, and US$ 16 billion on investment in sanitation services. The investments produced remarkable increases in services. Potable water production increased from 5.8 million m^3/d in 1982 to 18.2 million m^3/d by year 2000. The per-capita share of potable water use increased from 130 l/d in 1981 to 275 l/d in 2000. The capacity of the sanitation system increased from 1.0 million m^3/d in 1982, to 8.3 million m^3/d in 2000, and is planned to reach 20.0 million m^3/d by 2017. About 20% of total government capital expenditures in Egypt are in the water sector.

In a single year, 2002, Saudi Arabia spent 7% of total oil revenues (equivalent to 1.7% of GDP) on water services (about US$ 3.4 billion). In the same year, the countries of the Gulf Cooperation Council (GCC) allocated about US$ 4.9 billion to the provision of water supply services. Other countries have made similarly high levels of investment. However, water services remain inadequate, with rural water supply and sanitation a particular challenge to the whole region.

Regional Integration

Regional cooperation and information exchange on water resources has always been strong, and regional integration will be reinforced by the recent creation of the Arab Water Council (AWC), a non-governmental regional organization dedicated to coordinating the introduction of integrated water resources management in the Arab world in order to maximize the economic, social and environmental benefits. The AWC (see Box) was formally launched on 14 April 2004 in Cairo, Egypt.

Shared Water Resources Cooperation

The high degree of shared water resources in the region has led to several water-sharing agreements and cooperative programs, where the cooperation experience has proved that sharing water resources, partnerships for management or investment, or just technical cooperation on a fair and equitable basis can improve benefits for all concerned and contribute to a peaceful environment on a broader scale. Examples include agreements on cooperative management of the Tigris-Euphrates River Basin between Iraq and Syria, agreements between Lebanon and Syria over the waters of the Orontes and Nahr El Kabir Rivers, bilateral water-sharing agreements over the Jordan River, and the Nile Basin Initiative. Moreover, regional cooperation on the sustainable utilization of the Nubian Sand Stone Aquifer has achieved major progress between Egypt, Libya, Sudan, and Chad. Similarly, Algeria, Tunisia, and Libya have reached prosperous cooperation for the North Western Sahara Aquifer.

The Nile Basin Initiative (NBI) provides an excellent example of fruitful basin-level cooperation. Ten Nile riparian nations have agreed and started implementing a river basin cooperation framework for the development and use of Nile water based on shared benefits and equitable use of water. The Nile Basin Initiative programs aim at: poverty alleviation, improvement of livelihoods, pollution abatement, and sustainable development of all Nile riparian countries. The Secretariat of the NBI was officially established at Entebbe, Uganda in November 2002.

Box 4. The Arab Water Council – Aims and Activities

The Arab Water Council aims to promote better understanding and management of water resources in the Arab states in a multi-disciplinary, non-political, professional and scientific manner; and to disseminate knowledge and enhance sharing of experience and information in order to achieve rational and comprehensive water resources development of the region for the benefits of its inhabitants. In addition, the Council is mandated to represent the views of the Arab states at international and global fora dealing with the political, institutional, legal and financial aspects of water management or about technical topics such as transfer of knowledge, conceptual development of policies, or preparation of strategies and plans of action related to water resources and its uses.

Other objectives of AWC also include advising the public, private and voluntary sectors on aspects of water management, and promoting appropriate participation of the stakeholders in decision-making processes and equitable sharing of the benefits of water development.

Technological Innovations

Several innovations have been adopted by the region and serve as good examples for replication. These include: desalination, bio-saline agriculture, and groundwater assessment and development for arid climates,

Desalination. The region is leading the world in desalination technologies. For more than twenty years, all the GCC countries have supplied the bulk of municipal and industrial water from desalination of sea water, and reliance on this mode of water supply is expected to increase as the population grows. The desalination process primarily used is multi-stage flash (MSF) distillation. The reverse osmosis (RO) process has also been considered a highly viable option for small inland areas. About two-thirds of the world's total desalination capacity is installed in the GCC countries (about 3.2 billion m^3/yr). Saudi Arabia alone accounts for one-quarter of world capacity in desalination. Saudi Arabia, Kuwait and the United Arab Emirates rank first, third, and fourth, respectively, in desalination capacity. They rely on large-scale plants capable of producing up to 500 mm^3 per year (UNU 1997). The largest desalination centre in the world is located in Al-Jubail, in the eastern province of Saudi Arabia. One-third of the desalinated water for Saudi Arabia is produced at this plant.

Bio-Saline Agriculture. To cope with prevailing freshwater scarcity, impressive progress has been witnessed in developing sustainable management systems to irrigate food and forage crops and ornamental plants with saline water. Similar advances have been made in developing salt-tolerant plants for arid and semi-arid regions and salt-affected areas. The effort is led by the International Center for Biosaline Agriculture, Dubai, UAE, which implements research and development programs

addressing: plant production and management systems, genetic resources, information management and capacity building. Several successful projects have been conducted in Oman, Saudi Arabia, and the UAE. In Abu Dhabi, productivity of saline farm land was restored in just three months as a result of salinity reduction (by 80% in some cases) due to the effective implemented interventions.

Groundwater Development for Wadi Systems. Ephemeral wadi systems, common in many Arab countries, have potential for further groundwater exploitation. Periodic flash flood events recharge the shallow aquifers and in desert conditions where extreme water scarcity prevails, every drop of available water becomes highly valuable. Development of shallow wells as part of an integrated approach to water resources in the wadi areas is therefore a high priority. In a project in Egypt's Eastern Desert (see Box 4), Cairo University and the National Water Research Center in Egypt's Eastern Desert developed an integrated methodology for assessing and estimating groundwater quantities, quality and sustainable utilization, and mapped the potential locations for shallow wells in the whole desert. The methodology has good potential for replication in many MENA region countries and several other arid countries around the world.

Institutional Innovations

Countries across the region have been concerned with institutional reform to improve water management and services, including three areas of international best practice: integrated water resources management institutional decentralization, and stakeholder participation.

Several countries have created a **unified institutional structure for integrated resource management.** For example, in the GCC countries and also in Yemen, an independent ministry is now responsible for the management of water resources. Planning, resource management, legislation and regulation are under the responsibility of one ministry that will serve all sectors without being biased towards one sector over the other.

In line with the international movement to delegate water management tasks to the lowest practicable level, a number of countries have started to **decentralize management and services.** In Yemen, for example, there has been a gradual evolution from a focus on infrastructural development to management and institutional development, capacity building and participation of the private sector in water management. Initially, there was resistance to implement institutional reforms, restrictions in terms of providing incentives, and difficulties to apply tariffs which would allow cost recovery. However, with the backing of political commitment, Yemen has been able to decentralize water supply and sanitation to local utilities which are self-accounting autonomous corporations with their own board of directors. Yemen is now in the preparatory phase for including the services of private companies in the water sector. Syria has established independent water directorates at the basin level to promote decentralization and has decentralized responsibility for water supply and sanitation to water authorities and municipalities.

Box 5. Exploiting shallow groundwater in the desert

Through the UNDP/GEF-funded Eastern Desert Project, Cairo University and the National Water Research Center in Egypt initiated a program to develop sustainable water management plans for wadi systems in dry areas. The project applied concepts of wadi hydrology rather than resorting to classic approaches which have been developed more for temperate climates. The project used remote sensing technologies and satellite imagery to collect valuable data for remote uninhabited desert areas. GIS was utilized for data compilation and analysis. Geochemical and isotopic analyses were conducted to determine the renewability and source of groundwater. Advanced modeling techniques were applied for watershed analysis and simulation of surface and groundwater flows. Environmental impact assessments were conducted to predict various impacts. A capacity building program is inherent to the project to provide for a pool of national experts capable of replicating the model.

Combining the philosophy of engineers, the wisdom of geologists, the foresight of environmentalists, and the effectiveness of IT experts, an integrated methodology for assessing and estimating groundwater quantities, quality and sustainable utilization was developed. Potential for replication in arid areas worldwide is strong.

Stakeholder participation has been introduced in many countries, often through the development of irrigation water user associations. For example, since 1999 Egypt has piloted the concept of involving users' organizations in water management at many locations. Now the concepts are ready for broad application to cover the Nile Valley and the Nile Delta and in an adapted form in the areas beyond. Users are organized at three levels: the Mesqa (tertiary canal) level, Branch Canal (secondary canal) level and District level. At the Mesqa the Water Users' Association (WUA) comprises farmers (irrigators) only and deals with the day to day operation and maintenance of the tertiary canal and its pump. The Branch Canal Water User's Association (BCWUA) also involves other water users, such as residents and non-agricultural water users (poultry and dairy farmers, small industries etc.) and deals with water management in a broader sense that includes irrigation, drainage, environmental issues, etc. The District Water Board coincides with the ministerial organizational level; the Irrigation District. Similar innovations are underway in Tunisia and Morocco.

Financial Sustainability and Private Sector Participation

The reality that quality water services have to be paid for through sustainable institutional and financial arrangements has prompted countries in the region to follow a number of different, often innovative approaches to financial sustainability. In some countries, **private sector involvement** is being tested. The UAE, for example, has developed long-term partnerships for water supply between various international companies and the water authorities through BOT projects, supervised by the regulatory authority, the Regulation & Supervision Bureau. Qatar has been applying private sector service provision for a decade. There has been successful experience with public-private partnership approaches in urban water supply and sanitation in Morocco and in Jordan (see Box). Tunisia and Jordan have also developed more effective **cost recovery** schemes for both irrigation and potable water supply. In Egypt, has now been introduced for a variety of projects including irrigation and drainage, and for new lands development, including massive investments like the Toshka project.

Private involvement in development of large scale irrigated agriculture

With the support of the World Bank and IFC, Morocco and Egypt have joined Chile as the first countries in the world to implement major public private partnership (PPP) irrigation projects.

In **Morocco,** the Guerdane project concerned a 10,000 ha irrigation area serving 600 citrus farmers where the groundwater source was running out. Government was prepared to allocate water from the dam complex of Chakoukane-Aoulouz and to co-finance the development of the 60 mile conveyance pipe and distribution structure. In July 2004, the bid was won by a consortium led by Omnium Nord-Africain (ONA), a Moroccan industrial conglomerate, with participation of French and Austrian companies. The consortium will enter into a 30-year concession for the construction, co-financing, and operation and management of the irrigation network. The project will cost an estimated US$ 85 million of which the Moroccan government will provide US$ 50 million, half as loan and half as grant. The water tariff agreed by the consortium is towards the lower limit of the existing cost range of groundwater supply, so farmers will benefit from a cost saving.

The West Delta Irrigation Project in **Egypt** is another major PPP project involving construction and operation of three major canals, and supporting agricultural development in an area of 100,000 ha located to the

Box 6. Two innovative approaches to private sector participation in urban water supply

In Morocco, the provision of water supply, sanitation and electricity in four big cities (Casablanca, Rabat, Tangier and Tetouan) is under the management of private sector companies, with supervision from the National Office for Potable Water (ONEP). In Casablanca, where a private company LYDEC was awarded a 30-year delegated management contract with no transfer of assets, private sector involvement has generally been considered successful by consumers, primarily because of improvements in the service, which now includes uninterrupted supply 24 hours a day, accurate billing, better sanitation, improved responsiveness to customers, etc. This perception of improved services prevails, in spite of the fact that water tariffs were increased three times during the first year. In the last five years, the number of connections has increased considerably —by 27% for water and by 20% for electricity. Private sector involvement has also been helped by a massive investment program in sanitation —Euros 97 million between 1997 and 2001.

In Jordan, a four year water and wastewater management contract for the capital city Amman has been awarded to a private operator. The contract includes management, operation, incentive and investment fees, and seconded civil servants. Among the objectives of the contract are to decrease the unaccounted for water to 25% during the lifetime of the contract, improve the reliability of water supply to the users, repair and replacement the water meters, and improvements in customer services. A project management unit has been established to monitor progress and regulate the performance of the private operator. The contract also provides for 18,000 hrs/ year of staff training, mainly in the areas of technical activities, information systems, customer services, and language. The training programmes are discussed with the regulatory unit and are then adapted accordingly.

west of the Nile delta. The Design-Build-Lease (DBL) option with a capital contribution by the operator and participating farmers was considered as the preferred transaction model for the project area. After constructing the system, the private operator would lease the system, paying a lease fee equivalent to the debt service of the Government, inclusive charges to cover the foreign exchange risk. Several stakeholder meetings have confirmed that farmers are prepared to buy into the project. Water charges will include a flat fee to cover infrastructure cost and a variable fee to cover operation and maintenance cost and operator profit.

Water Conservation and Water Productivity

As water scarcity has become a more pressing concern, countries throughout the region have sought out means of conserving water and improving water use productivity. In addition to institutional mechanisms like water quotas and water charges, countries have modernized irrigation management, and have scaled up the application of conservation and efficiency measures such as water harvesting and supplemental irrigation.

A number of countries in the region have introduced improvements in **irrigation management.** For example, in Egypt, a US$ 300 million project for improving irrigation management covers an area of 211,000 ha, about 10% of the entire Nile Delta. The seven year project will develop a replicable model for command area improvements that integrate physical upgrading to improve water service with institutional changes designed to ensure sustainable and accountable management and financial autonomy (see Box 6).

Water harvesting has always been implemented in this dry region, and there have been innovations to update this classic technology in recent years. The first water harvesting system in history was built in the MENA region over 9000 years ago in the Edom mountains in southern Jordan. In North Africa, rainwater collection and storage are known to have been practiced since the 11th and 12th centuries. These systems have lasted to this day: in Morocco alone, it was estimated in 1990 that there were over 360,000 cisterns throughout the country that still supply domestic water to 10% of the population. Today, terraces are used in Yemen, Lebanon, and Jordon to increase rainfall effectiveness. Contour-ridge terracing in Libya, Syria, and Tunisia is used to conserve water and soil. Cisterns and micro-catchments are applied in Egypt, Libya and Yemen to store harvested water and for domestic

uses. Harvesting techniques have been used effectively to control desertification and rehabilitate land.

Most agriculture in the region is rainfed but productivity can improve enormously with **supplementary irrigation,** the application of limited amounts of irrigation water to rainfed crops at critical periods to improve and stabilize yields when rainfall cannot provide sufficient moisture for the crop. Many MENA countries have innovated in this area and research work at ICARDA in Aleppo has shown great potential for this technique throughout the region. Yields and water productivity substantially increase with little water and at low cost. ICARDA and partners in the national program in Syria have developed a supplemental irrigation package to be transferred to farmers in rain-fed areas. The package includes 1) optimal irrigation scheduling (timing and amount), 2) deficit supplemental irrigation, 3) improved germplasm, and 4) nitrogen fertilization. The package has been tested and proven to improve wheat yields significantly compared with conventional rainfed strategies throughout Syria.

Box 7. Egypt's Integrated Irrigation Improvement Project develops integrated approaches to water management

Improvements will be developed in an integrated fashion through five components that link physical upgrading targeted at improving water service efficiency to institutional and management components designed to increase user participation and agency accountability and to prepare for future financial autonomy: (a) **improved and integrated water management** through the implementation of irrigation and drainage rehabilitation, improvement and modernization works and programs at all levels of the selected command areas; (b) **improved on-farm water management** through land levelling, on-farm water management demonstrations, and irrigation and agricultural advisory services support; (c) **institutional development and capacity building** through establishment, expansion and scaling up of Water User Associations and Water Boards; (d) **coordination, management, and integration;** and (e) **environmental mainstreaming** through implementing an environmental management plan to demonstrate how improvements in water quality can be achieved.

4. Additional Initiatives Needed or Planned

The MENA region has developed most of its economically exploitable water resources, and has made great strides in supply and to a lesser extent in demand management. Nonetheless, most nations in the region have identified the need for substantial further progress, predominantly in two areas: (a) improving the quality of water services to increase living standards, incomes and returns to assets and to raise the water productivity; and (b) improving water resources management through the development of better governance structures. In **water services,** future efforts will include particular attention to:

- Improving the productivity of irrigation water and augmenting value added from irrigation, including changes to higher value and export-oriented cropping patterns. A particular focus will be providing farmers with irrigation water services that are predictable and reliable.
- Enhancing water quality through more investments in sanitation and solid waste, and by controlling industrial pollution
- Improving services supplied by water supply and sanitation utilities through reducing intermittent supply, reducing unaccounted for water, and making utilities less dependent on government.

Amongst future areas of focus for improving governance in **water resources management** are:

- Clarifying irrigation water tenure rules and implementing dispute resolution mechanisms so that farmers can invest confident in their rights.
- Increasing the capacity of institutions at all levels for water management. This involves changing the skills mix, focusing on interdisciplinary knowledge and providing essential training for integrated water management. Establishment of a water management institute for the region is proposed.
- Further decentralization of responsibilities to water users and further involvement of multiple stakeholders in planning related to water, including increasing public awareness. This will involve additional measures to increase transparency, such as development and release of information and measures to empower stakeholders.

- Resolving long standing tensions and political instabilities.
- Integrating regional efforts to initiate a regional macro program similar to the Marshal Plan.

5. Lessons Learned

Water resources development and management

in the region have been driven by the highly specific characteristics of climate, geography and the resource itself. Aridity and water scarcity have created the need for huge investments in hydraulic infrastructure to bring the scant water resources into economic use. The high rate of resource use has driven intensification, technological innovation and institutional experimentation. The same pressures have increased the risks to the resource and driven environmental problems of water quality degradation and groundwater overdraft.

These three factors —aridity, the high level of resource development, and the risks to the resource— have made improved and integrated water resource management a more pressing imperative in the MENA region than elsewhere in the world. Development plans have to be balanced between sustaining proper water supply management, water use efficiency and demand-oriented water management within a sustainable development perspective. Management also has to address allocation of water between competing sectoral needs, institutional and legislative reforms, and financial sustainability.

The region is also characterized by a high rate of dependency on water originating from outside national borders. This has created some areas of tension, but has also given an impulse to regional coordination and cooperation.

Water scarcity has long made the region a net food importer, and national governments have generally been wise to resist targeting food self-sufficiency goals. The priorities are rather in improving returns to scarce water through efficiency gains, and in developing internal and international trade in agricultural products to improve food security through growth in incomes and foreign exchange earnings.

The region is a leader in technological innovation. Many of these innovations are discussed in the report, including hi-tech micro-irrigation, supplementary irrigation techniques, the exploitation of wadi flash floods and shallow groundwater recharge in desert conditions, water quality management, the use of wetlands to clean polluted waters, the application of economic concepts like virtual water to irrigation policy and food security strategy, etc. Further applied and targeted research dealing with the actual problems faced by the region is clearly a priority, as are mechanisms for experimenting with novel technologies and replicating successful experiences across the entire region.

Water management under scarcity conditions depends more and more on the generation and transparent exchange of information and data. The region has made a significant start on improving national and regional data gathering and exchange, and this will be an area for further improvements.

Finally, the contribution of donor funded programs has been considerable. Experience in the region has shown that these programs produce best results when they reflect the physical needs of recipients, when the sense of ownership for policies and interventions is self-developed and not imposed, when effective stakeholders participation is accomplished, and when political will is mobilized.

INTRODUCTION

Beginning with the UN Conference on the Human Environment (Stockholm,1972) the last three and a half decades have been marked by growing concern for the management and protection of the world's precious water resource. Through a series of international and regional conferences (see Annex 1 for details), an agenda has become clear that includes the need for integrated and inter-sectoral management of the resource, the need to include all stakeholders from governments to women and the poor, the role of decentralization as best practice, and the need for demand management through an incentive structure that reflects the true value of water to society.

The three meetings to date of the World Water Forum have explored and deepened this agenda, and have confirmed the primacy of water in development and the need to achieve the Millennium Development Goals of sustainable access to safe drinking water and sanitation.

At the Third World Water Forum meetings in Kyoto, the key debate for the Middle East and North Africa (MENA) region was around the question "from water scarcity to water security", highlighting both the service delivery objectives of reducing poverty and improving living standards, and the governance agenda of capacity building and empowerment of the public and private sectors and of community organizations to fulfill their roles.

At the Third World Water Forum, MENA governments made a commitment to a reform agenda comprising four key strategic actions:

(i) adopting an **integrated water resources management** framework for planning and management of water resources in the country;
(ii) **promoting efficient use of water** through technical instruments and economic incentives, including appropriate pricing and cost recovery mechanisms;
(iii) **mobilizing stakeholders** to advance participatory and decentralized approaches and public-private-partnership; and
(iv) **promoting regional and international partnerships** to foster technical and financial cooperation on water issues.

The 4th World Water Forum being held in Mexico City (March 16th to 23rd, 2006) is to address global water issues under the main topic of "local actions for a global challenge". This topic is broken down into five complementary themes: (1) Water for Growth and Development; (2) Implementing Integrated Water Resources Management; (3) Water Supply and Sanitation for All; (4) Water Management for Food and Environment; and (5) Risk Management. The main objective is to have an impact on the policy agenda. To document experience on the main theme of local actions, the preparatory process for the 4th Forum is designed to be participatory, in order to collect the views and experiences of local stakeholders all around the world.

In preparation for the 4th Forum, the countries of the MENA region have organized themselves to consult stakeholders in order to evaluate progress in the region on the agenda agreed at Kyoto and to prepare a stocktaking assessment in preparation for the 4th Forum. This Regional Report presents the results of this process.

1. PRESENTATION
of the regional report

1.1 Overview

Responsibility for preparing for the 4th World Water Forum. The lead role in MENA in the preparation for the Forum has been taken by the Arab Water Council (AWC). This organization (see Box 1.1) is responsible, together with the World Bank and the Islamic Development Bank, for organizing the MENA session at the Forum in which representatives from different countries in the region will highlight the numerous "local actions" that have proven to be success stories.

Box1.1 The Arab Water Council

The Arab Water Council (AWC) was launched through the initiative of 400 water professionals and scientists gathered in Cairo in April 2004. The AWC is a non-governmental organization set up to promote better understanding and management of water resources in the Arab states in a multi-disciplinary, non-political, professional and scientific manner; to disseminate knowledge, enhance sharing of experience and information for the rational and comprehensive water resources development of the region for the benefits of its inhabitants.

Purpose and coverage of the report. This report presents an overview and analysis of the situation of water resources in the MENA region. It draws on the experience of numerous actions, projects, applied research and studies, awareness-raising campaigns, and policy, legal, and institutional reforms in the region. More than one hundred actions have been collected in this effort, documenting numerous water success stories and suggesting many elements of the water future. This experience together with the strategic priorities and challenges for water in MENA were identified in a series of consultation workshops held in preparation for the 4th Forum (see below). This Report is designed to share this experience with the international water community, as part of an effort to muster the best ideas and support to tackle the pressing water challenges in the region.

1.2 The Preparatory Process

The first preparation workshop. In preparation for the 4th Forum, two regional workshops were organized. A first Consultative Workshop was organized by the AWC, jointly with the World Bank, in Cairo on June 19th – 20th, 2005. The Workshop was attended by 85 participants representing 18 Arab countries, three non-Arab countries, and 11 international and regional organizations including the WB, WWC, and the 4th Forum Secretariat. The workshop briefed the participants on the roles of principal

players and the preparatory process for the 4th Forum. The consultation process allowed an exchange of views and ideas on local actions for sustainable water management and an agreement on a preliminary list of the most important cases to present to the world. Through the use of the participatory process, the workshop identified a large number of key water issues for the region (see Annex 2 for a full list). Through discussion, these issues were synthesized into a list of seven themes and six cross-cutting perspectives of critical importance across the MENA region (see Box 1.2).

Box 1.2 The First Consultative Workshop, Cairo, June, 2005 – Principal theme and perspectives.

The First Consultative Workshop held in preparation for 4th Forum in Cairo in June, 2005 identified the following **principal themes** for the MENA region:

1) Water use efficiency in a basin context
2) Groundwater depletion
3) Climatic variability
4) Inadequate access to clean drinking water supplies in rural areas
5) Transboundary waters
6) Water demand management
7) Development of the use of non-conventional water resources

The Workshop also identified the following **cross-cutting perspectives:**

a) Capacity building
b) Financing water infrastructure
c) Incompatibility of budgetary allocation and present priority needs in the water sector
d) Raising public awareness and the role of media
e) Lack of public participation in the decision making
f) Poor enforcement of laws and regulations for the water sector especially groundwater

The proposed MENA participation in the Forum. The workshop recommended the full participation of the MENA region in the Forum through a series of mechanisms: (1) preparation and presentation of **documents on water issues and actions** in the region; (2) preparation of **case studies on local actions** organized according to the five major themes of the Forum; (3) sponsorship of **special sessions** at the Forum including keynote speakers, cultural events, displays and exhibition; (4) supporting **high level inputs** by ministers at the Forum; and (5) organizing **thematic sessions** addressing and presenting identified key themes and cross cutting issues.

The second preparation workshop. A second consultative workshop was held in Cairo, Egypt on Dec. 18th – 19th, 2005 to review preparation materials and to provide inputs and final consensus on the issues and their presentation. In addition, results of a poll of a wide range of decision makers and water professionals in the region confirmed that there was broad consensus on key items in the regional agenda: 94% of respondents agreed that full recovery of the cost of delivered water was essential; stakeholder participation in water resources management was endorsed by 72%; and 88% of respondents agreed that water quality needs urgent attention in the region, and that legislation and regulation of quality were top priorities (see Annex 3). Respondents also "voted" for their top choice of actions that would do the most to improve water management in the region (see Box1.3).

1.3 The Contributors

The participatory preparation process for the Forum in MENA relied entirely on the voluntary participation of a host of countries, institutions, agencies, organizations and individual professionals. These contributors participated in the workshops, worked on the case studies, and provided invaluable feed back throughout the consultative process. Annex 3 provides a list of the institutions and organizations involved.

Box 1.3 Fourteen priority actions to improve water management in the MENA Region

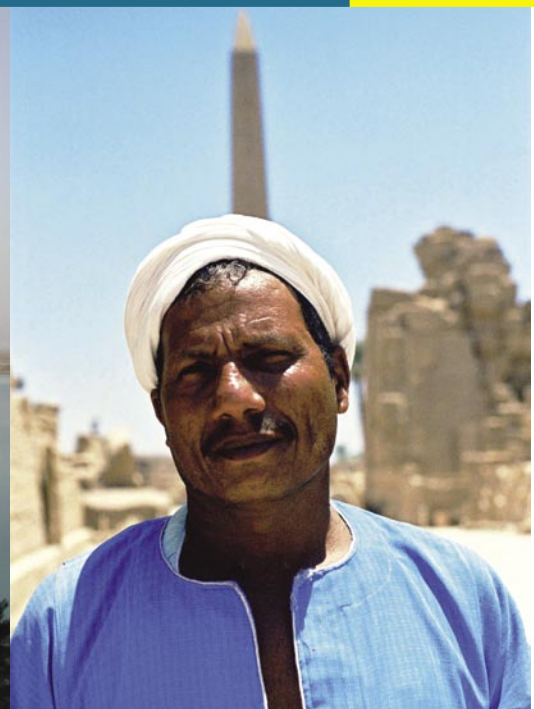
Stakeholders in the region were asked to select from a large pool of suggested actions the ones that in their view would make the most contribution towards achieving regional goals of improved water management. Fourteen actions were selected and are listed below in order of priority:

- Improving water quality
- Policy formulation and legislation enforcement
- Physical interventions
- Promoting water saving
- Capacity building
- Ensuring economic and financial sustainability
- Institutional reform and strengthening
- Enhancing applied research
- Raising awareness for IWRM
- Introducing technologies and information systems
- Developing monitoring and evaluation systems
- Inter-sectoral coordination
- Introducing water valuing mechanisms
- Boosting shared resources cooperation

Workshop preparations also drew on a large number of other water related events during 2005 (see Table below).

Table 1.1 Full list of activities during 2005 to prepare MENA participation in the 4th Forum

Date	Event	Venue
January 2005	AWC Founding Committee Meeting	Dubai
February 2005		
March 2005	Awareness for Efficient Water Use	Cairo
April 2005	Workshop on Seawater Desalination	Sana'a
	Workshop on IWRM from Policy to Action	Cairo
	Int'l Conf. on Global Spatial Data Infrastructure	Cairo
May 2005	Workshop on Wastewater Treatment	Muscat
June 2005	4th Int'l Symposium on Environmental Hydrology	Cairo
	First Regional Consultative Workshop	Cairo
July 2005	Workshop on Virtual Water Technology	Cairo
August 2005	The Water Week	Stockholm
September 2005	CIHEAM Conference	Bari
	ICID Congress	Beijing
	ESCWA Seminar on Water Governance	Beirut
October 2005		
November 2005	Int'l Conf. UNESCO on Hydrology & Research	Cairo
	InWent 1st Capacity Building Forum	Amman
	ESCWA Seminar on Enhancing Agricultural Productivity	Beirut
December 2005	Second Regional Consultative Workshop	Cairo



2. CHARACTERISTICS of the region

2.1 Geographical Features

The MENA region and the Arab countries. The MENA Region comprises eighteen countries, namely; Algeria, Bahrain, Egypt, Iraq, Iran, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates, and Yemen. Except for Iran all countries are Arab countries. For the sake of totality and comprehensiveness, the remaining five Arab countries are added to the analysis. These are Comoros, Djibouti, Mauritania, Somalia, and Sudan as shown in Figure 2.1. The Arab region will be first addressed as one unit, and then Iran will be presented as a specific entity.

Geography of the region. The Arab countries extend between longitude 16.5° West passing through Nouakchott, Mauritania on the African coast of the Atlantic Ocean and longitude 60° East near the city of Masqat, Oman. The Arab region also extends from the equator south crossing the southern Somali border to latitude 37.5° North at the Iraqi-Turkish border. It is bound from the west by the Atlantic Ocean, from the east by the Arabian Gulf and Iran. Central Africa, the Great Lakes Plateau, the Ethiopian, Plateau, and the Gulf of Aden constitute the southern boundaries while the Mediterranean Sea and Turkey constitute the northern borders.

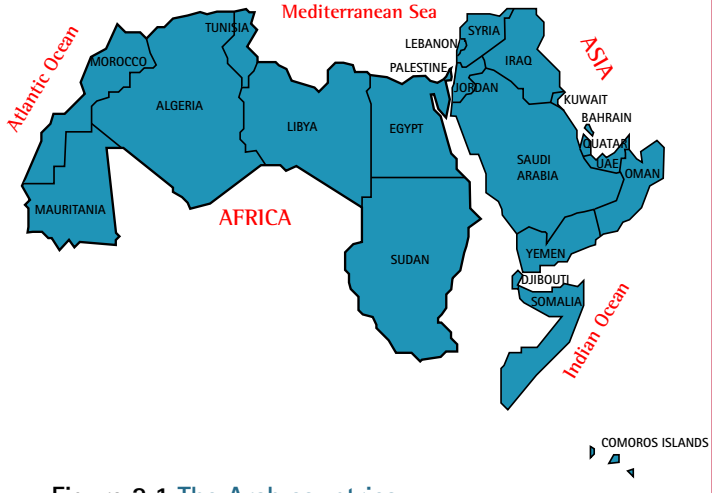


Figure 2.1 The Arab countries

The most arid region in the world. The twenty two Arab countries have a total area of about 14 million square kilometers, of which, more than 86% is desert, making the region the most arid in the world. The region is very poor in water resources and in vegetation cover. Some mountainous ranges are scattered throughout the region. The Atlas Mountains run along the northwestern borders with their highest peak in Morocco (4165 meters). The Lebanon Mountains and the Tebetsy Mountain in Libya reach a height of 3000 meters, and the mountains in Yemen reach of about 3300 m. The region also contains the lowest depression in the world at the Dead Sea in Jordan.

A number of major rivers. A number of major rivers flow through the region, many of them originating outside the region. These include the Nile River and its tributaries (Sudan and Egypt), the Senegal River (Mauritania), the Juba and Shebilli Rivers (Somalia), and the Tigris and Euphrates and their tributaries (Syria and Iraq). Several smaller rivers originating inside the region are shared by more than one country like the Majerda, the Jordan, and the Orantes rivers. A dense network of ephemeral wadis and non perennial streams also exists.

2.2 Renewable Water Resources

Generally low rainfall determines water scarcity. The region is dominated by hyper arid to arid conditions which determine the major physical constraint —water scarcity. Only in the coastal strips of the Maghreb and the East Mediterranean and in the mountains of Northern Iraq and South West Arabia is rainfall relatively high. The average amount of rain received by the region is estimated at 2148 km^3/year, out of which 378 km^3/year occur in the countries of West Asia. About 50% of the rain fall occurs in Sudan. The average annual precipitation for the Arab nations varies considerably between 18 mm/year in Egypt, and 827 mm/year in Lebanon, with a regional average of only 56 mm/year (FAO, 1995, 1997, 2004).

Low and declining per capita water resources. The average annual flow of rivers and recharge to groundwater as a result of endogenous precipitation (commonly known as Internal Renewable Water Resources or IRWR) is estimated at 146.5 Km^3/year, with about 70% generated in just three countries: Iraq, Sudan and

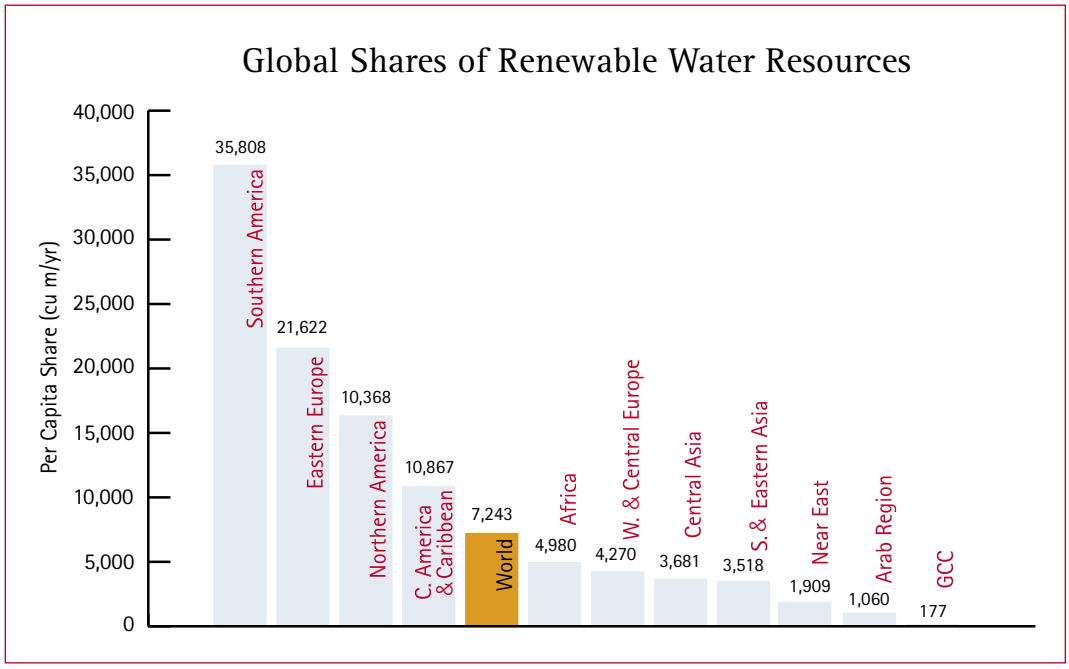


Figure 2.2 Extreme Water Scarcity Experienced by the Arab Region as Compared to Other World Regions

Morocco. Total renewable water resources in the region are estimated at about 335 km^3/year, with demand already exceeding 200 km^3/year (about 60% of the renewable resource) and rising fast. It is expected that per capita renewable resources, which in 1950 were an ample 4,000 m^3 each year will drop further from their present level of about 1,060 m^3 each year to as little as 547 m^3 per person per year by 2050. The available renewable freshwater resources for the Arab region as compared to different regions of the world is projected in Figure 2.2.

Considerable variation in resource availability between countries. Although the region as a whole is dry, there is considerable variation around the average. Kuwait, for example, has just 11 m^3/cap/year of renewable water resources. As of 1998, only seven countries exceeded the threshold of 1000 m^3/cap/year: Iraq, Mauritania, Sudan, Somalia, Lebanon, and Syria, with Morocco barely at the limit. The situation is expected to deteriorate further: by 2050, all the Arab countries except for Mauritania, Iraq and Sudan will be experiencing water stress and water scarcity (Figure 2.3).

More than half of water resources originate outside the region. International river flows make up more than half of the region's renewable water resources (see Box 2.1). Egypt and Mauritania each is dependent on freshwater originating outside the country for more than 97% of water resources, Syria is about 70% dependent, and Sudan and Somalia about 60 % dependent.

Groundwater is an important resource. Renewable groundwater resources are in the form of shallow alluvial aquifers recharged from the main rivers in

Box 2.1 International rivers flowing into the region from outside

- The White Nile (originating from the equatorial lakes) crossing the southern Sudanese border.
- The Blue Nile , Sobat and the Atbara rivers (originating from Ethiopian Plateau) crossing the Sudanese eastern border.
- The Senegal river (originating in Senegal) flowing along the southern border of Mauritania.
- The Shebelli and Juba rivers (originating from Ethiopian Plateau) flowing to the Indian ocean through Somalia.
- The Euphrates river (originating in Turkey) crossing the Syrian northern border.
- The Tigris river (originating in Turkey with some tributaries originating in Iran).

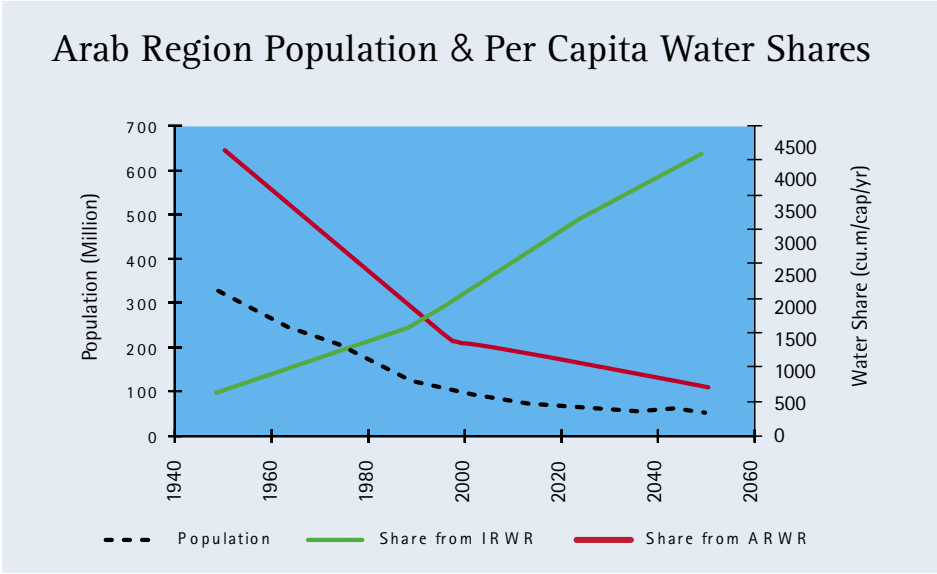


Figure 2.3 Projections for the Arab Region Population and Water Shares

the region or directly from precipitation in limited coastal areas. The main alluvial aquifers are in the Nile valley (all through its course) and Nile Delta, tropical areas in Sudan, the Jezira and Wadi Batin aquifers in Iraq, the Tihama alluvials of Yemen and Saudi Arabia, and scattered strips along the Southern and Eastern Mediterranean coast. Total renewable water resources for different countries are shown in Figure 2.4, following a logarithmic scale (AWC 2005).

Wadis and spate flows. A distinctive characteristic of the region is the complex network of wadi systems. These wadis are subject to flash flooding events where a relatively high intensity precipitation occurs over a short period of time, resulting in sudden and considerable surface runoff. Most of the runoff is lost through evaporation and discharge to nearby seas or oceans. However, at the same time, these events may significantly contribute to recharge groundwater at various locations. Under extreme scarcity conditions, this recharge is a valuable part of the overall water availability.

2.3 Non-Renewable / Non-Conventional Water Resources

A variety of non-renewable and non-conventional sources. Non-renewable and non-conventional water resources in the region consist of fossil groundwater, desalination of sea water and brackish water, waste water reuse, and agricultural drainage reuse. A total of about 30 km^3/year of non renewable and non conventional water supplies are being produced (Figure 2.5)

The use and overuse of fossil groundwater

Fossil aquifers are a particularly important but fragile resource. Fossil groundwater is an important resource throughout the region. Vast reserves underlie the Sahara (see Box 2.2) and the Arabian peninsula. In the Mashreq and Arabia, there are about twenty different aquifer systems, both semi-confined or shallow aquifers, and deep confined aquifer systems of different geological formations, with total reserves estimated at 143.8 km^3. Eight of these aquifers are shared between countries. The Dammam aquifer, the Aruma limestone aquifer, and Umm-er-Radhuma aquifer are among the major aquifers. Although recharge is better in the Mashreq, the deep aquifers underlying the Arabian peninsula have far greater reserves of fossil water. In 1995, Saudi Arabia alone abstracted about 14.66 km^3 from these reserves. Recharge to groundwater is estimated at 4.535 km^3 and 7.515 km^3 for the Arabian Peninsula and the Mashreq sub-regions, respectively.

Depletion of the aquifers. At present, groundwater resources in the region in general, and in the Arabian peninsula in particular, are in critical condition as volumes withdrawn far exceed natural recharge, resulting in a continuous decline in groundwater levels. As reserves shrink, quality deteriorates and there is often saline or seawater intrusion. The use of groundwater in Syria increased by 7% a year between 1989-1993 largely due to the decrease in surface water availability (UNEP/ACSAD, 2000). As a result, there is growing evidence of groundwater depletion, and projections suggest that on

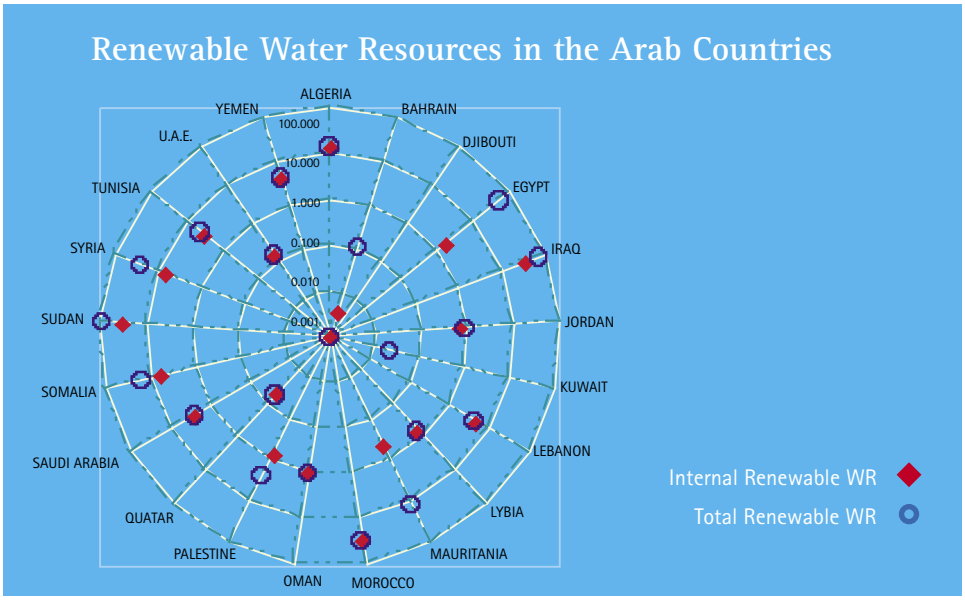


Figure 2.4 Total (Actual) Renewable Water Resources Distribution.

the basis of current rates of increase overall demand will prove to have outstripped supply in 2005 (UNEP/ACSAD, 2000). In the Gaza Strip, it is estimated that the water table is dropping at the rate of 10-20 cm/year.

The consequences of depletion, and possible remedies. If the overdraft of groundwater continues, eventually these resources will be lost due to quality degradation, and the largely agricultural uses that depend on the groundwater would have to be curtailed. Many efforts have been undertaken throughout the region to increase groundwater recharge (e.g. through artificial recharge dams), and to reduce groundwater withdrawal by relying on non-conventional water resources (desalination plants and recycling wastewater), or by water conservation measures in the different consuming sectors (modernizing irrigation methods, reducing subsidies, legislation, public awareness campaigns, etc.)

Non-conventional water sources

Wide application of non-conventional water supplies.

Due to the scarcity of water resources in the region, non-conventional water supplies have been widely adopted, including desalinated water, wastewater reuse programs, and irrigation schemes utilizing mixed agricultural drainage water. In the Arab countries of North Africa, in 1993 figure, an estimated 491 million m^3/year of non-conventional water was used, of which 225 million m^3/year were generated in Egypt and 170 million m^3/year in Libya.

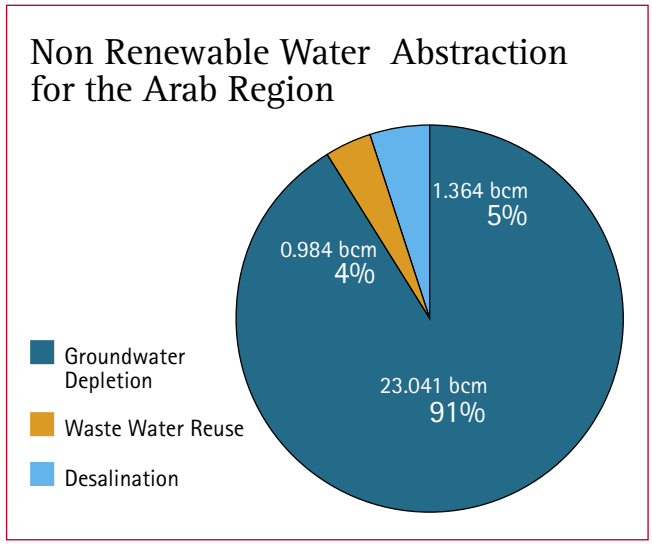


Figure 2.5 Distribution of Non Renewable Water Abstractions (Excluding Agricultural Drainage Re-use)

The Gulf countries are the world's largest producers of desalinated water. All Gulf Cooperation Council (GCC) countries have supplied the bulk of municipal and industrial water from desalination of sea water for the past 20-30 years, and reliance on this mode of water supply is expected to rise as the population grows. The desalination process primarily used is Multi-Stage-Flash (MSF) distillation. Recently, the Reverse Osmosis (RO) process has also been considered a highly viable option for small inland areas. About two-thirds of the world's total desalination capacity is installed in the GCC countries as

Box 2.2 Fossil aquifers of the Sahara

In the Sahara Desert, the major water resources are the Nubian Sandstone and the North Western Sahara non-renewable aquifer systems, which extend from Egypt to Mauritania. The Nubian Sandstone Aquifer is a non-rechargeable reserve that was filled up during the humid periods of the pluvial age 8000 years BC and before. The aquifer is shared by four countries: Egypt, Libya, Sudan, and Chad. Its area covers 2,350 km^2, and it has a maximum reservoir capacity of 150,000 km^3. Geologically, this reservoir is made up of continental sand stones of Mesozoic and Cambro- Ordovician which extends all through the Sahara Desert and the Arab Peninsula (from the Atlantic Ocean to the Arabian Gulf).

shown in Table 2.1. Saudi Arabia alone accounts for one-quarter of world capacity in desalination, and the largest desalination centre in the world is located in Al-Jubail, in the eastern province of Saudi Arabia. One-third of the desalinated water for Saudi Arabia is produced at this plant. Saudi Arabia, Kuwait and the United Arab Emirates rate first, third, and fourth respectively in the world in desalination capacity, relying on large-scale plants capable of producing up to 500 million m^3 a year (UNU 1997, WB 2005). Selected desalination plants are shown in Figure 2.6. The desalination industry, however, creates several environmental impacts which require proper mitigation. These include discharge to the near-shore marine environment of reject hot brine, residual chlorine, trace metals, volatile liquid hydrocarbons, anti-foaming and anti-scaling agents.

Table 2.1 Desalination Capacities in GCC Countries (million m^3 annually)

Country	1990	2000
Bahrain	75	104
Kuwait	318	522
Oman	55	60
Qatar	112	178
Saudi Arabia	950	1278
UAE	502	1081
Total	2012	3223

SOURCE: UNU (1997) modified with country reports.

Jubail, Saudi Artabia 800 mg/d

Al Hidd II, Bahrain

Al Taweelah, UAE

Ras Abu Fontas, Qatar

Figure 2.6 Selected Desalination Plants

In the Mashreq few small desalination plants exist; in Jordan, Lebanon and Syria with a total of 7.5 Mm^3 annual productions.

Drainage water and waste water reuse.

Drainage water reuse is practiced on a very large scale in Egypt, where annually 5,000 million m^3 of agriculture drainage water (equivalent to 10% of the total water resource) is reused after mixing with freshwater. Waste-water reuse is more limited. In the Arabian Peninsula (GCC countries), out of the 0.918 km^3 of treated waste water per annum, only about 0.4 km^3 are being tertiary-treated and used for irrigating non-edible and fodder crops as well as for landscaping. About 60% of the partially treated wastewater is dumped into the sea or low lands. In the Mashreq, about 0.2 km^3 of wastewater is used annually for irrigation purposes. However, it is anticipated that recycled treated wastewater volumes would increase to about 3 km^3/y by the year 2020, to be used mainly as a substitute for groundwater in irrigation in GCC countries.

2.4 Utilization of Water Resources

2.4.1 Sectoral Demand

Water demand in the region is steadily increasing, placing intense pressure on the resource. In the region, abstractions have risen from 182 km^3/y in 1990 to 229 km^3/y in 2000, with about 15% of the total demand satisfied through depletion of fossil water and use of non-

conventional sources. Abstractions are thus about 65% of total renewable resources (336 km^3).

The **Arab countries of North Africa.** For the Arab countries of North Africa (from Morocco to Egypt), the total freshwater withdrawals are estimated at 98 km^3/year, 107% of the internal renewable resources, and 44% of total renewable resources. The lion's share was attributable to Egypt, which withdraws virtually the entire resource each year: 55.1 km^3. Irrigation consumes about 88% of withdrawals, while industry and domestic sectors consume 7% and 5% respectively.

The **Arab countries of Western Asia and the Arabian peninsula.** In the Arab countries of Western Asia and the Arabian peninsula, irrigation use was even more dominant: 91% of withdrawals, with 7% for domestic purposes, and 1.1% for industry (ACSAD, 1997).

2.4.2 Land Use and Water Abstractions

Irrigated lands a small fraction of the total land area in the region. Despite the importance of irrigated agriculture in water abstractions, only 1% of the land area of the region is used for irrigated agriculture. Rainfed agriculture is more important, but even that land use is only 2% of total land use in the region. About 51% of water use is in irrigated agriculture and 44% in rainfed agriculture (Figure 2.9). As discussed above, the vast majority of land in the region (87%) is simply desert.

2.4.3 Water Supply and Waste Water Services

Variable rates of access to water supply and sanitation, with some poor countries having low coverage.

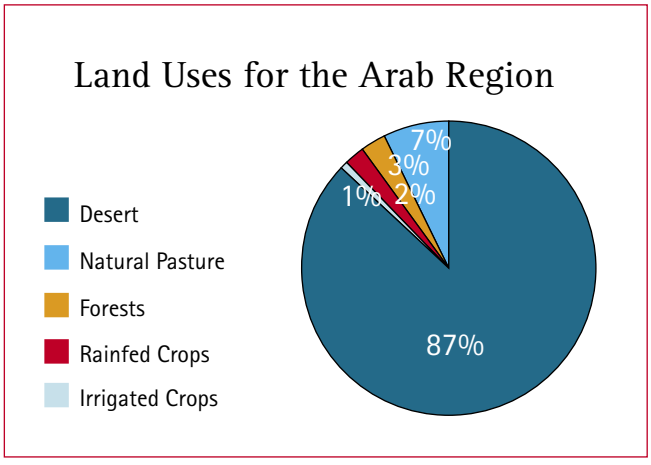


Figure 2.7 Distribution of Major Land Uses for the Arab Region (AWC 2005)

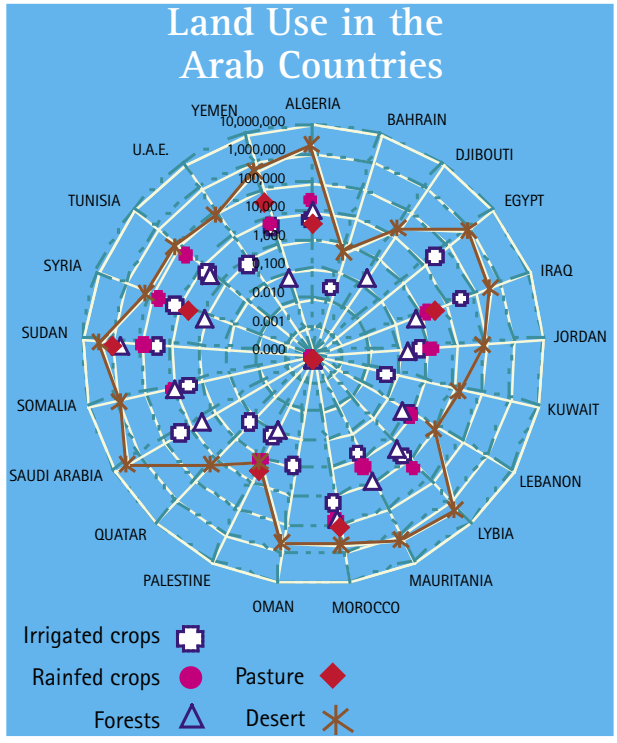
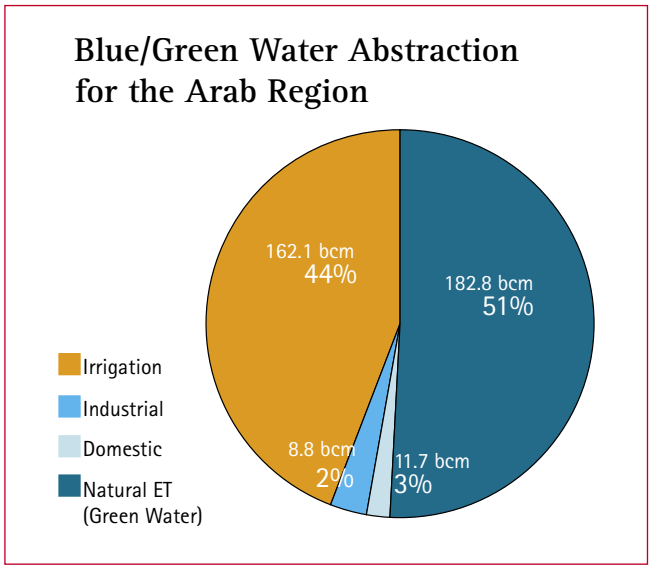


Figure 2.8 Land Uses for the Arab Countries (AWC 2005)

In the region, Libya, Tunisia, and the GCC countries have the highest percentage of population with access to safe drinking water (more than 90%) and also to sanitation services (WRI 1998). The lowest accessibility to both services is encountered in Somalia, Mauritania, Palestine and Yemen. Countries generally have lower rates of access to sanitation, although some regional countries like Egypt have made massive investments in recent years. Environmental problems related to municipal wastewater in rural communities are mainly due to the fact that sanitation services lag behind water supply services by ten years or more. Technology for treatment of sewage has been evolving, first in the 1960s from trickling filters to activated sludge techniques, and subsequently in the 1990s towards stabilization ponds.

The MDGs are a high target in many countries. To achieve the MDG of reducing by half the people with no access to drinking water by 2015, a further 83 million people in Arab region need to be supplied with safe water. To achieve the sanitation targets of the MDG —reducing by half the people with no access to proper sanitation by 2015— an extra 96 million people need to be provided with sanitation services (CEDARE 2005). Figures 2.10 and 2.11 show current rates of population without access to safe drinking water and proper sanitation.



◀ Figure 2.9 Total Abstractions for the Arab Countries Including Green and Blue Water Sources.

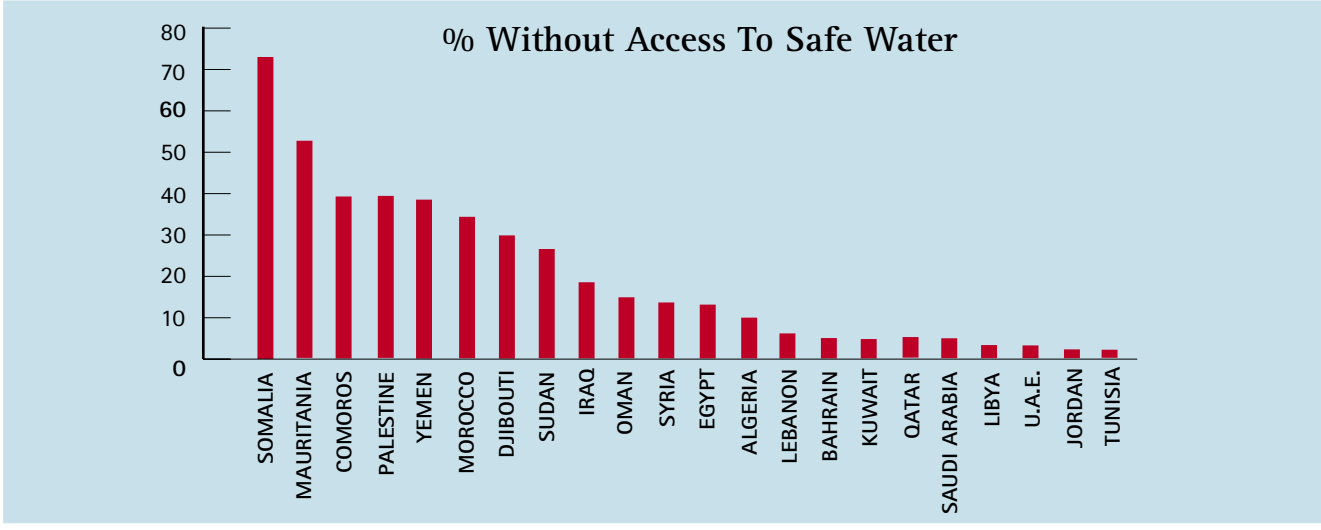


Figure 2.10: Percentage of Arab Countries Population without Access to Safe Drinking Water

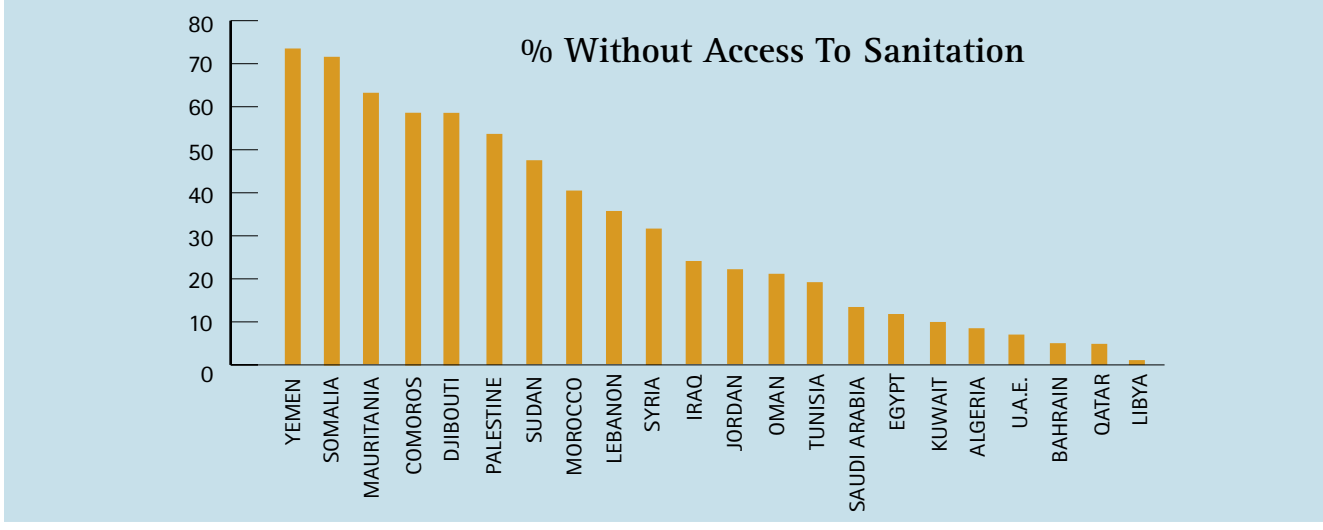


Figure 2.11: Percentage of Arab Countries Population without Access to Proper Sanitation

2.5 Iran

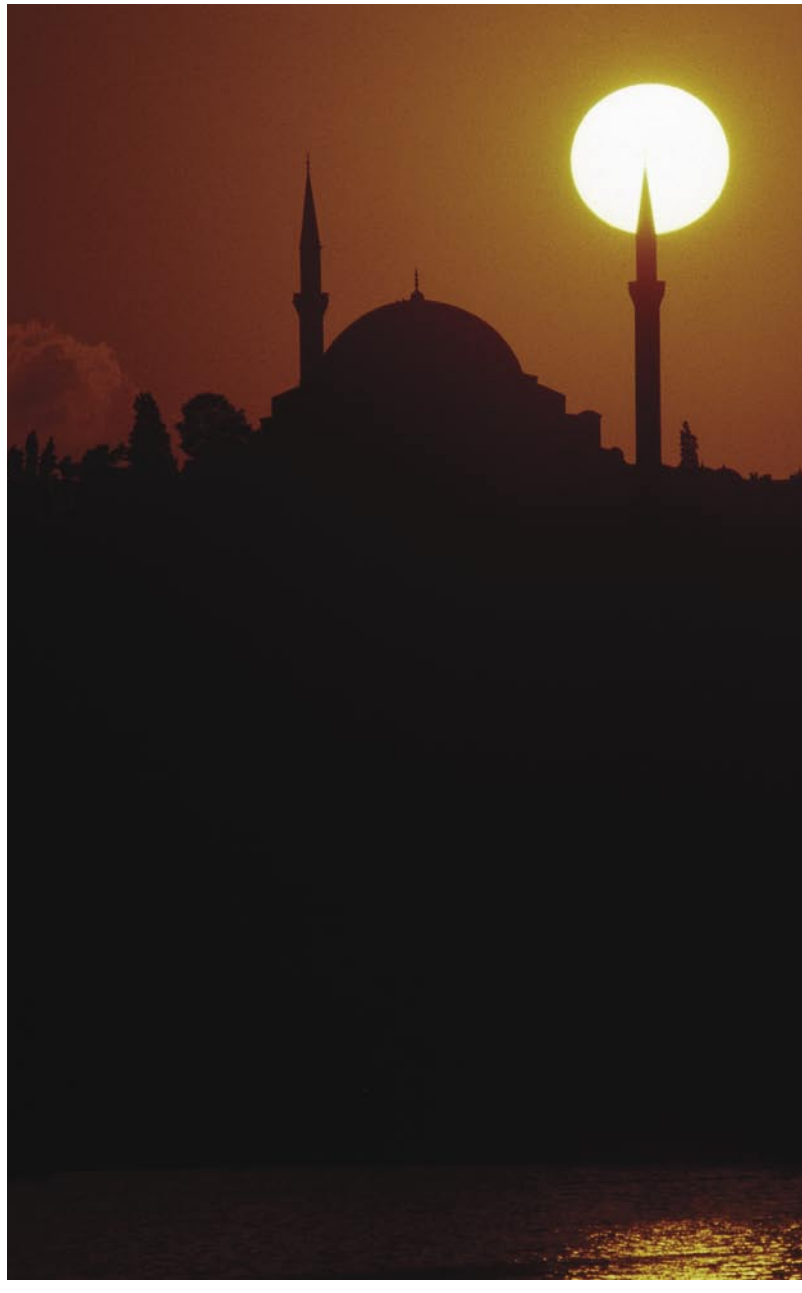
Geography of Iran. The Islamic Republic of Iran, with a total land area of 1,648,195 square kilometers, lies between 25° 00' and 39° 47' N and 44° 02' and 63° 20' E. Thus the southern half of the country is in the subtropical zone and the northern half of the country in the temperate zone with a desert zone in the middle of the country around 30° N (Figure 2.12).

Figure 2.12 The Islamic Republic of Iran

Water is relatively developed by regional standards. Rainfall is on average very low (228 mm), but with wide variations between the sub-tropical and mountain zones and the coastal plains and desert. Total renewable water resources are estimated at 138 km^3 annually, or about 2,020 m^3 per person, double the average of 1,060 m^3 for the Arab countries of the region. About 93% of water resources originate within Iran's territory, a far lower dependency rate than for the Arab countries. Iran has invested considerably in dams and diversion infrastructure, harnessing some 73 km^3 of annual resources, slightly over half of the total resources available. Water use as in the rest of the region is predominantly for irrigation (91%). However, development of irrigation areas has lagged far behind the construction of diversion structures. In addition, many areas suffer from massive groundwater overdraft. Annex 4 shows basic information related to water resources in Iran.

The main highlights of Iran's policy for water include:

- Introduction of integrated water resource; management approaches through basin planning
- A major focus on increasing the coverage and sustainability of potable water and sanitation;
- A shift in investment resources away from a sole focus on dam construction more towards irrigation scheme completion;
- An increase in irrigation efficiency through a combination of technical means such as pressurized irrigation (2 million ha were planned for the year 1995-2000) and institutional means such as decentralizing irrigation management to autonomous self-accounting corporations and increasing user involvement and cost recovery;
- Establishment of a land Bank to provide loans for on-farm development projects;
- A change in water cost recovery and delivery methods;
- Large scale privatization.



3. MAIN WATER-RELATED challenges in the region

Water and civilization are closely linked in the region. In no other region of the world has water availability played such a dominating role in determining human activities, settlement, socio-economic interactions and growth, as it did in the Arab Region. The Nile River hosts one of the greatest early civilizations on Earth, and similarly does the Euphrates and Tigris rivers. The ancient Yemen civilization is closely tied to water resources availability, and its declination is historically related to the destruction of the ancient Maareb Dam. The history of Holy Makka starts with the revelation of Zamzam well to Prophet Ismail, **peace be upon him**. Prophet Moses, **peace be upon him**, had to miraculously reveal twelve natural springs in order for his people to survive.

3.1 Historical Overview

Early hydraulic development. Historically, the first half of the twentieth century marked the colonial control of most of the Arab Region (British, French, and Italian). The colonial regimes directed water management development towards serving its own strategic objectives as expressed, for example, in the suppression of industrialization and expansion of cotton grown areas in Sudan and Egypt along with the associated irrigation measures. Some hydraulic control works were established in that era, for example the old Aswan Dam in Egypt, some channel routing in the Nile basin and the Maghreb, and dredging of the main Egyptian drains.

Phase of rapid expansion. From early 1950s onward, the countries of the region gained their independence. This witnessed a shift towards proper water management which became a pre-requisite for satisfying the ambitious national development plans that targeted enhanced agricultural production, support of industrialization, provision of safe drinking water, sanitation, and other infrastructure services, all of which resulted in an escalating demand for water. Following the discovery of oil in the Gulf countries and Libya, enormous development schemes in agriculture, urbanization and industry sectors were implemented.

Emergence of problems. Nevertheless, rapidly rising **demand**, the rapidly increasing **population**, which doubled in about 30 years, rapid **urbanization**, lack of **financial resources** and external debt in non-oil producing countries, **conflict** and **political instabilities** were major factors impeding proper water management. Unfortunately, recognition of effective **environmental protection and management** lagged behind the main development programs.

Conflict and water. During the last decade, the First and Second Gulf Wars have seriously affected the economy of West Asia. Phased socioeconomic development plans had to be considerably reviewed resulting in reduction or delay in executing water development plans. In addition, severe damage affected the hydraulic and irrigation structures in Iraq, even though these should have been protected under international law. Surface water resources in Syria, Iraq and Palestine were reduced due to the conflicts concerning the

Box 3.1 Population & Water Resouces in the region

- Population growth 3%.
- Population of the MENA region is less than 5% of the world population, but it receives only 1% of the world's renewable water resources.
- Water consumption considerably increases with GDP, (744 l/c/d in UAE).

water allocations of the rivers, and aquifers shared with neighboring countries. This has led to 30-40% postponement of planned agricultural schemes.

Stocktaking of major water issues in the region. After half a century of intensive development in the region, the major water-related problems today can be summarized as:

- Water is naturally scarce in the region and that **scarcity is growing**, exacerbated by growing needs in all water using sectors and by weaknesses in the nature and quality of supply and demand management responses.
- Water resource management in MENA has until recently been characterized by an unintegrated **supply driven approach** in which each water using sector tended to act independently.
- The vulnerability that stemmed from the high rate of dependence on external and shared resources has been exacerbated by the **political instability and conflict** that has marked some parts of the region.
- As use has mounted, **environmental problems** have emerged, including deterioration of water quality, salinization, and reduction of the yield of heavily exploited aquifers. The decline in water quality has in part been caused by problems related to the fast growth of cities in the region: inefficient wastewater treatment, poor or non-existent solid waste management, and weak pollution control and abatement programs.
- Finally, the truth that "somebody has to pay for quality water services" has been too often overlooked. Institutional structures have paid too little attention to the **imperatives of financial sustainability**. Both in irrigation and in water supply and sanitation, the quality of service delivery has too often been undermined by inadequate budgets, themselves in part resulting from inadequate cost recovery.

Emerging stresses. For the future, new or intensified challenges include increased urbanization, less homogeneous societies which reduce the effectiveness of traditional water management institutions, high levels of unemployment leading to reluctance to reduce water diverted to irrigated agriculture on which the poor often depend, increased climate variability, globalization, and increased pressure on agriculture from imports matched by growing but specialized opportunities for agricultural exports.

3.2 Diagnostic Analysis

The deteriorating water balance is the biggest problem. The region is confronting numerous constraints and challenges impeding the achievement of water balance between availability and demands. Although the degree of water imbalance varies from one country to another, the overall picture clearly indicates that the gap between the readily available water supplies and future requirements is continuously deteriorating with time. The water imbalance between water availability and demands, which is ranked on top of the water problems in the region, is a result of a package of numerous constraints and challenges that are considered the driving forces impeding adequate development and management of the water resources. The major challenges and driving forces and their impacts on the water issues are discussed in the following paragraphs.

3.2.1 Population Growth and Declining Share of Water Per Capita

Water scarcity is becoming chronic. The region is witnessing a relatively high rate of population growth amounting to about 3%. The population of the MENA region is less than 5 percent of the world population, but it receives from nature only 1% of the world's renewable water resources. The overall picture indicates that the per capita conventional water resources, under all scenarios are less than 1000 m^3/year, the level below which the countries are likely to experience chronic water scarcity on a scale sufficient to impede development and harm human health. The different sectoral abstractions (along with the source of abstraction) are shown in Figure 3.1, and the per capita shares of withdrawals for 1998 – 2002 for the Arab countries in Figure 3.2 (source is FAO-AQUASTAT 2004).

3.2.2 Challenges Related to the Management and Use of Conventional Water Resources

The principal challenges related to conventional water resource management and use are:

The need for more efficient and cost effective supply side solutions: although more than two thirds of regional resources have been harnessed, there are considerable opportunities for improving supply efficiency (for example in reducing conveyance losses) or —as in the case of Morocco or Iran— for completing downstream irrigation structures which have lagged behind development of the diversion structures. Both financial and institutional solutions need to be explored.

The need to improve water use productivity: with over 90% of the water resource used in agriculture, and that sector contributing a relatively small and declining share of national income, there is scope to improve water productivity within agriculture by technical, economic and institutional means, and also to allow the progressive transfer of water from agriculture to higher value uses in other sectors.

The need for sustainable groundwater management: the nature of groundwater reservoirs implies local planning, under a policy through which scattered localized areas can be safely and sustainably developed. In general, this problem cannot be solved by government regulation alone. It requires government to pursue macroeconomic policies on energy and trade that do not create distorted incentives to overuse of groundwater and to create a regulatory environment in which government and water users at the local level can collaborate together in the common interest of sustainable use, or at least a phased depletion.

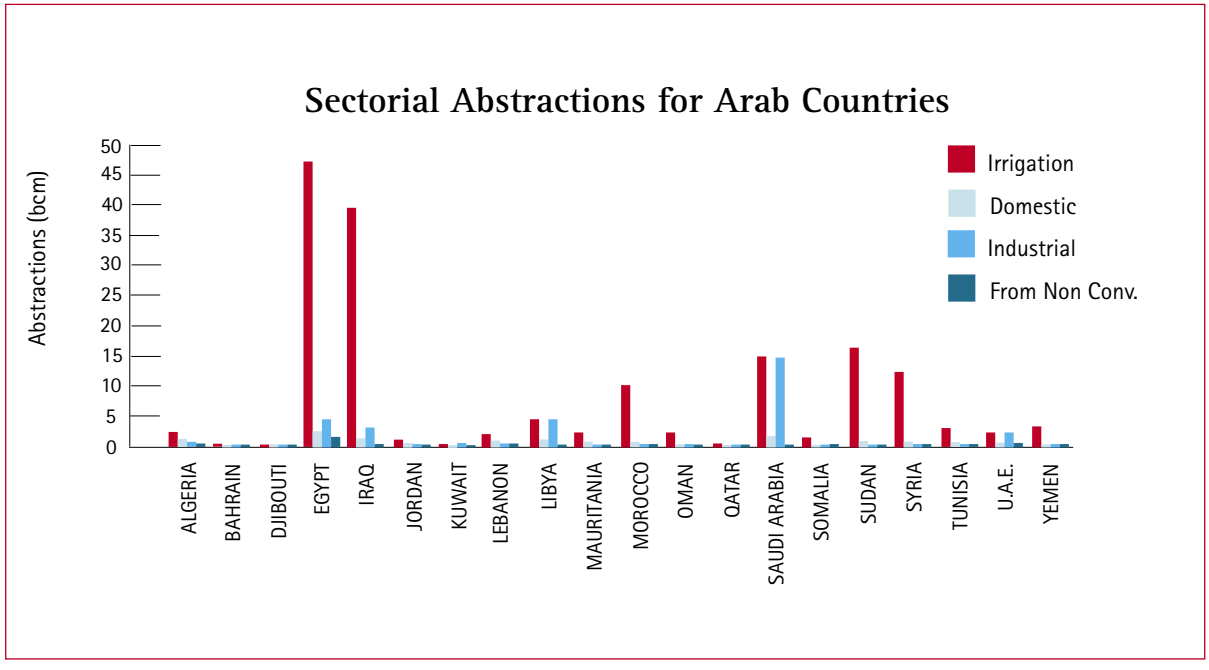
The need to work on controlling pollution and improving water quality: the insufficiency of sanitation services in both urban and rural areas of the region affect both groundwater and surface water. Also, due to the high rates of urban growth in most of the Arab countries, with continuous migration from rural areas to urban centers, waste management cannot be adequately controlled. In addition, the growth of industrial activities has created hazards from solid and liquid wastes. Finally, agricultural drainage and run off waters containing high levels of fertilizers and pesticides are a huge threat to water quality throughout the region.

The need to improve data and information on available water resources: most countries in the region give inadequate attention to establishing efficient monitoring systems. As a result of this, the available data and information on water resources are scanty and sporadic.

3.2.3 Challenges Related to Non-Conventional Water Sources Usage and Practices

The importance of non-conventional water is growing. In view of the scarcity of the available conventional surface and groundwater resources, non-conventional water sources are becoming more valuable than ever. As discussed in Chapter 2, these resources include: reuse of agricultural drainage water; treatment and reuse of sanitary wastewater; and desalination of salt and brackish water. The extent to which these resources can be used in an environmentally safe and economically sound fashion is debatable, despite the fact that these are widely used at a rather accelerating rate. The sustainability in using these resources is still governed by certain features and criteria discussed in the following paragraphs.

Figure 3.1 Sectoral Abstractions for Different Arab Countries



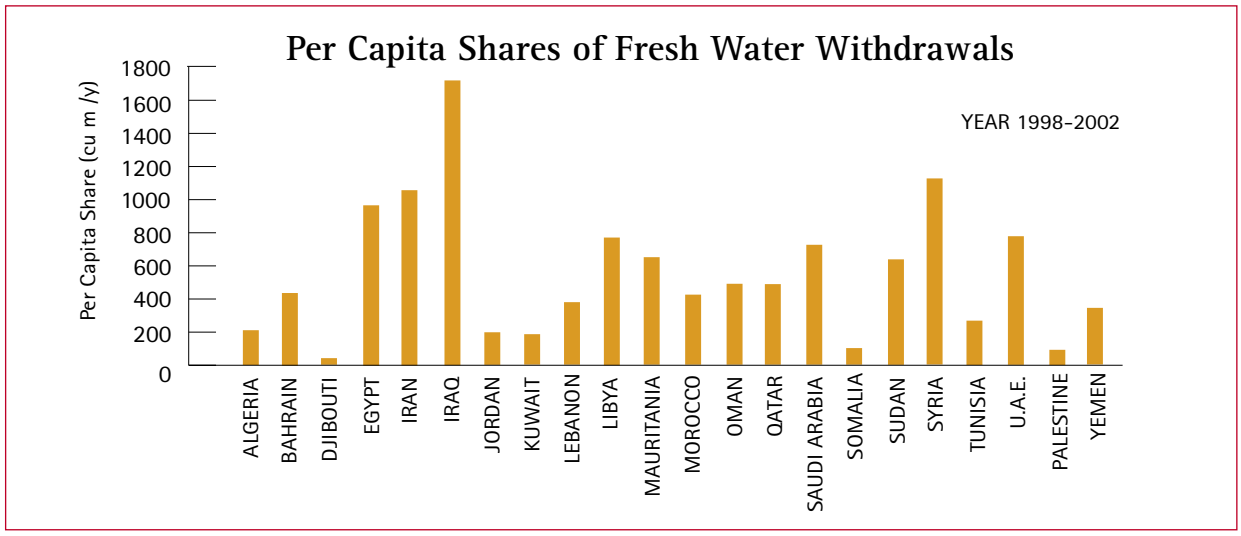


Figure 3.2 Per capita Shares for Fresh Water Withdrawals for Different Arab Countries
Source FAO AQUASTAT

1) Reuse of Agricultural Drainage Water

Reuse is a sound policy but quality and quantity are problems. Drainage water is reused mainly in countries that adopt regular irrigation systems (Egypt, Syria and Iraq). Although the practice is expected to increase, it is constrained by two main problems. First, the **quality**, which is affected by the frequently high salt content of the drainage water and to the prevailing high rate of pollution in the agricultural drains particularly in rural areas void of sanitary facilities, and/or those crossing industrial zones with inadequate waste water recycling plants. Unless these pollutants are mitigated, the ratio of mixing the drainage water with fresh clean water, as currently practiced, will be too small. This feature diminishes the value anticipated in using this source, along with the impacts on both soils and plants when using such type of water. The second problem, the **quantity**, is caused by the increasing adoption of modern irrigation systems (sprinkler, drip), whose very efficiency reduces the volume of return flows.

2) Desalination

Desalination is an essential technology for some countries but attended by problems. Desalination of both sea and brackish water is extensively used in the Arab region, particularly in the Gulf countries where desalination, despite its high cost, is likely to continue to be the most reliable and competitive water supply sources for drinking water. However, desalination is still faced by a number of constraints, including the following:

- **High cost** of water production both in capital investment and energy requirements.
- Dependence of all techniques on **non-renewable energy sources.**
- Absence or unavailability of **stand-by water source** to replace any eventual or sudden breakdown of the plant.
- Release of considerable amount of hot brine with **detrimental impacts on the surrounding environment** both inland and offshore.
- Lack of sufficient financial allocation and investment for **research and training** of manpower in the field of desalination techniques.

3) Sanitary and Industrial Waste Water

Although this type of wastewater is widely used throughout the region (see Chapter 2), it should be used in accordance with specific norms and standards and for specific purposes. For example, there will be restrictions on crops that can be grown using wastewater according to the standard of treatment. If these restrictions are not respected there can be major problems. The technologies of wastewater treatment are becoming factors of growing importance to the environment as well as to the industry. Several technologies are being innovated at present, and are expected to develop further in the future (see Box).

Box 3.2 Wastewater treatment for reuse

Wastewater for reuse normally undergoes prior treatment before usage. In addition to the removal of all solids and floating liquids, there are three main levels of treatment:

- primary treatment for the removal of organic and non-organic materials through natural sedimentary basins
- secondary treatment (or biological treatment) for removal of organic matters through oxidation processes
- tertiary treatment for the removal of all remaining organic matters and suspended dissolved chemicals through various processes depending on the anticipated use of the sanitary water.

3.2.4 Challenges Related to River Riparian Countries

Many transboundary waters in the region are not the subject of an agreement. As discussed in Chapter 2, many major rivers of the region are shared between countries both within and outside of the region. Although a number of agreements have been reached —e.g. Nile River (Egypt-Sudan, 1959), Euphrates River (Syria - Turkey, 1987), Euphrates River (Syria - Iraq, 1987) and Yarmouk River (Syria - Jordan, 1987)— there are other riparian countries that have not developed firm agreements for the entire basins. Lack of agreement or at least of a cooperative framework makes it hard to optimize development at the basin level: each country tends to go ahead with its separate projects, water flows tend to decline for downstream riparians, and unpredictability makes the planning of investment and the day to day management of hydropower, irrigation and other abstractions difficult. In addition, water quality can be affected, for example by irrigation drainage water or uncontrolled disposal of wastes in the upper reaches, and downstream environmental flows or wetlands can be impaired. The case of the Euphrates amply illustrates many of these risks.

3.2.5 Challenges Related to Institutional Framework

The overall water related institutional setup in the region, which includes operational, development and management organizations, research institutions and financing agencies, is subject to numerous constraints and challenges, of which the most important are:

1) Multiplicity and overlap of water sector institutions

Most of the water authorities in the region, in respect to development, management and control, are characterized by overlapping and conflicting functions. This issue constitutes a major impediment to achieving appropriate balance between the water supplies from the various sources and the demands for the various users.

2) Lack of good quality research work

Despite the presence of numerous research institutes dealing with a variety of water related aspects, too few results are available to solve the prevailing crucial water problems in the region.

3) Shortage of skills and need for capacity building

Despite the presence of highly qualified personnel in most of the Arab countries, they are too few to manage the increasingly challenging problems of the sector, and their organizations need overall capacity building.

4) Rising costs and budgetary constraints.

As water scarcity increases, costs are rising everywhere. Where infrastructure is the priority, the costs are extremely high (MENA irrigation development costs are the highest in the world). Where management is the priority, this requires costly and long term investment in institutional development, for example in water user associations or the development of basin management organizations. The costs of a water master plan in the more complex hydraulic economies of the region can easily run into tens of millions of dollars.

3.2.6 Need for More Comprehensive National Water Policies

In view of the above-mentioned aspects, coupled with the prevailing scarcity of water resources in the region, national water policies, although they exist on paper in most countries of the region, are mostly not comprehensive enough and do not adequately reflect the need for integrated approaches. Water problems are therefore likely to exacerbate with time, unless governments and all stakeholders can follow structured

and participatory processes to work out national policies and strategies to get the best out of the available water.

3.2.7 Inadequacy of the Current Legislation, Rules and Regulations

The legal and regulatory framework is generally weak. The capacity of most of the prevailing legislation, rules and regulations in the region to control, protect and sustain the overall aspects related to the water sector qualitatively and quantitatively needs enhancement. The following most important water issues can be cited:

1) Water rights

This particular concept is obviously ill defined and in particular in respect to groundwater. Yet unclear or absent water rights are a major cause of farmer risk aversion: farmers will not invest without security of tenure. Lack of groundwater rights also drives farmers to overuse the resource: if one farmer does not use the water, another will —unless there is a workable framework of rights that will motivate farmers to conserve. Water rights are essential too to underpin equitable inter-sectoral transfer of water and the development of water markets.

2) Environmental water standards

With the rapid development in environmental awareness, and continued progress in the technological and applied sciences, environmental standards for water are becoming more complex and more demanding. Also, requirements are continuously subject to modification. The setting of environmental standards in the water sector should be based on sound logical, economical and scientific grounds, taking into consideration local environmental conditions and economic settings prevailing in the country. Copying and transferring water standards from the industrially developed countries and international organizations should not be done blindly: the standards should be adapted as appropriate to meet local conditions, prior to endorsement and enforcement.

3) Aquifer management

In many countries in the region, regulations require permits for drilling water wells. Yet often these are issued based on rules of thumb such as a pre-fixed distance between wells. Although this approach has served well in the past, pressure on groundwater demands a more scientific approach. A comprehensive water resources assessment of the groundwater basin or aquifer potentialities should be conducted to provide the basis for issuing permits. Only in this way can stakeholders be sure that groundwater is exploited within the safe yield of each particular basin. However, it has proved very hard to manage groundwater based on regulatory approaches alone: Jordan, where the number of wells is limited and governance relatively strong, has had some measure of success, but other countries —Syria and Yemen, for example— have not. As discussed above, participatory and partnership approaches with a self-management approach are the most promising in lower governance situations.

3.2.8 Lack of Public Awareness

Lack of public awareness reduces participation and weakens water sector governance. Public awareness constitutes an important activity complementary to other technical means for improving the governance of water resources. Yet in most countries of the region, public awareness has not received the attention it deserves. Thus, the majority of the population in the region, particularly in rural areas, is not well-informed of the challenges and constraints related to water resources. In view of this, no sensible level of participation could be expected from the public, and the risks of traditional or unplanned water management at the user level are hard to measure and control. On the other hand, a well-informed

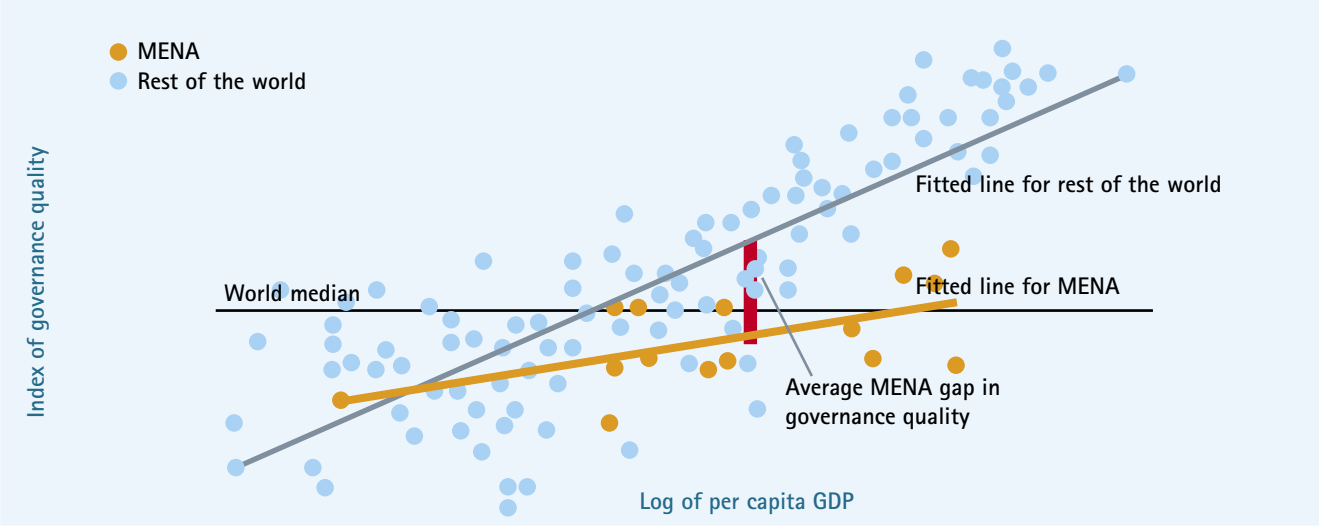
population can appreciate the need for sustainable water management and that appropriate water conservation, utilization and protection practices are the means to achieve it. What is required is effective public awareness campaigns, targeted at specific water management objectives. These campaigns need to be well prepared and the medium adopted (print, radio, television etc) adapted to the target audience. In addition, water planners have to understand that participation is not simply a means of changing people's water management behaviour: it is also an empowerment, allowing water users a say in the national dialogue on water and a stake in the water governance system and influence over accountable water management institutions. Planners need not only to inform the public but also to listen to and empower them.

3.2.9 Water Governance

Fast development of infrastructure —but institutions have not developed as fast. In the past few decades the region has seen major changes, which have impacted how water is managed in the region. Economic growth, massive population growth, urbanization and technical transformation have all affected how water is stored, exploited and delivered. The region has made impressive investments to increase water storage and improve delivery to users. However, institutions (government, societal and legislative arrangements) to manage that storage, exploitation and delivery have not been able to change as rapidly. It is important to expand the current efforts to consider economic, social and environmental factors, how they affect particular interest groups, and how they in turn influence the politics of decision making.

Figure 3.3 shows a plot for a governance quality index as a function of the per capita GDP for various countries around the world (World Bank 2006). In general, higher values of per capita GDP correspond to higher degrees of governance. However, the rate of governance enhancement with GDP for the MENA Region is lower than the corresponding rate for the rest of the world. Despite the fact that such index may be subjected to wide dispute, yet the essence of the message remains valid; **water sector governance in the MENA region require elaborate reinforcement.**

Figure 3.3 The MENA Region Governance Map



Source: "MENA Development Report on Water" World Bank Report (2006)[1] .

[1] Presentation by Ms. Julia Bucknall, WB on the "AWC 2nd Regional Consultation for the 4th World Water Forum", December 14 – 16, 2005, Cairo, Egypt

4. STRATEGIES

that have been implemented to solve water-related problems

Water scarcity creates the need for well thought out policies and strategies. While each country of the region is attempting to tackle its water management challenges according to its local needs, all face the necessity of formulating national water policies in line with international best practice as a matter of national priority. Strategies and policies are not always consistent from country to country, or even within countries, nor should they be, since the situations vary greatly.

Integrated water plans that make effective use of a river basin and its local resources and take account of different factor prices and constraints has been introduced in the different countries of the region. In these plans, the role of **irrigation** is key, as it is far and away the main water consumer in the MENA region. Vigorous constituencies pay close and active attention to issues affecting it, such as those related to crop production, efficiency, modernization of systems, cost for water services, allocation of water, and protection of the environment from the serious consequences of the continual interventions in natural hydrological cycles.

4.1 Integrated Water Resources Management

The Integrated Water Resources Management (IWRM) approach is recognized and adopted to varying degrees in the region. Countries in the region have begun to recognize the importance of an integrated approach to water management and, following the Johannesburg WSSD meetings, made a commitment to develop integrated plans by 2005. Political will and commitment that are triggered with enough awareness and backed with sufficient capacity building are key elements that determine the capabilities of governments to formulate integrated water resources management plans and to further implement them. Most countries in the region have developed water policies, plans or strategies that serve as steps towards full IWRM plans. However, the level of preparation for a specific national IWRM plan varies from one country to the other.

Some Arab countries including Egypt, Jordan, and Palestine have approved national water resources plans. Egypt and Yemen have already finalized Integrated Water Resources Management Plans. Other countries have developed frameworks, which contain elements of policy, in the form of strategy or master plans. However, most of these policies, plans or strategies are inadequate to satisfy all the requirements for IWRM plans. Countries including Algeria, Bahrain and Lebanon have announced their

Table 4.1 Status of IWRM Plans in the Arab Region

Country	Plans/Strategies/Policies/Documents towards IWRM	Status of IWRM Plans Development			
		1*	2*	3*	4*
Algeria				X	
Bahrain	**National Strategy for Environmental Protection of Water Sector**; Bahrain Water Sector, 2003.		X		
Comoros					X
Djibouti	**Strategy for Reducing Water Poverty** **Water Law** **Water Action Plan for City of Djibouti**				
Egypt	**Integrated Water Resources Management Plan**; Ministry of Water Resources & Irrigation, 2005. **National Water Resources Plan;** Ministry of Water Resources & Irrigation, 2004. **Main Features for the Water Policy towards Year 2017;** Ministry of Water Resources & Irrigation, 2000.	X			

Country	Plans/Strategies/Policies/Documents towards IWRM	Status of IWRM Plans Development			
		1*	2*	3*	4*
Iraq				X	
Jordan	**Water Strategy** & **Water Policies in Jordan;** Ministry of Water & Irrigation. **The National Water Master Plan**; Ministry of Water & Irrigation, 2003.	X			
Kuwait				X	
Lebanon	**Work Plan for Ministry of Hydraulic and Electric Resources, Years 2000–2009;** Ministry of Water and Electricity, 1999.		X		
Libya	**National Strategy for Water Resources Management, 2000–2025**; 1999.		X		
Mauritania					X
Morocco	**Water Law,** 1995.	X			
Oman				X	
Palestine	**National Water Plan (NWP)**; Palestine National Council, 2000. **Water Law 3/2002** **IWRM Plan** 2003 **Water Tariff System**	X			
Qatar				X	
Saudi Arabia	**Phase I: Water Sector Strategy and Action Plan**; Ministry of Water and Electricity, 2004.		X		
Somalia					X
Sudan	**Sudan National Water Policy.**		X		
Syria	**Water Sector Analysis in Syria**; Ministry of Irrigation, 2000.		X		
Tunisia	**The Long Term Strategy for the Water Sector in Tunisia**; Ministry of Agriculture, 2003.	X			
UAE			X		
Yemen	**Country Water Resources Assistance Strategy (CWRAS)** Ministry of Water and Environment, 2005. **National Water Strategy** & **Investment Program**, Ministry of Water and Environment, 2004. **Law 23 for Year 2002 Regarding Water**, Ministry of Legal Affairs, 2002.	X			

Explanation of Columns 1–4:

1 *Countries having national water plans, strategies, or policies that incorporate most elements and requirements of an IWRM plan. These countries have on-going committees and/or projects advancing on finalizing their IWRM plans.*

2 *Countries having water plans, strategies, or policies (not necessarily on a national level) that require major enhancements to satisfy the requirements of an IWRM plan. These countries posses the awareness of the WSSD target for developing IWRM plans and are currently progressing to develop their own IWRM plans.*

3 *Countries that may not have developed national water plans, strategies, or policies. However, considering the advanced level of country awareness of WSSD target for developing IWRM plans, country water capacity, and national economical standard, these countries are likely to have an on-going attempt to develop their IWRM plans.*

4 *Countries that may not have developed national water plans, strategies, or policies. However, considering the lagging level of country awareness of WSSD target for developing IWRM plans, country water capacity, and national economical standard, these countries are not likely to have an on-going attempt to develop their IWRM plans.*

intention to develop national IWRM plans but have not yet specified a timetable or action plan. Other countries have not yet made a commitment to develop an IWRM plan due to lack of resources, capabilities, and awareness. Table 4.1 presents the situation, listing the available documents that are seen by their respective countries as policies, strategies, or master plans towards an IWRM plan.

Several institutions are supporting IWRM planning but the experience is mixed. Most of the countries of the region are progressing in different phases and speeds towards developing national strategic water plans (see, for example, CEDARE/AWC/UNDP 2005). However, awareness of formulation, development, and implementation of IWRM plans to meet the target date of 2005 is lagging and in several cases lacking. The following are the principal problems or "gaps":

1. Experience and information are not easily shared among Arab countries.
2. Mobilizing the political will and awareness on the need to achieve the WSSD IWRM target of 2005 and other water related MDGs are lacking.
3. Capacity building is required for IWRM plans development.
4. Capacity building is required for IWRM plans implementation.
5. Shortage of water resources professionals exists in development agencies including UNDP COs.
6. Several countries need to strengthen their capabilities in reporting "State of the Water" and assessing their own water resources.
7. Coordination among the donor community in the water sector is required to avoid duplication and assure streamlining of water related activities towards IWRM plans development and implementation.

AWC has worked with UNDP in a partnership agreement to develop an action plan to close these "gaps". The actions concerned are discussed in the following paragraphs.

4.1.1 Institutional Strengthening of the Arab Water Council.

The AWC will be strengthened and will become the regional focal point for IWRM plans. The UNDP can assist in institutional strengthening of the Arab Water Council to become a "center for excellence in water resources", similar to institutions in Pakistan, the USA and elsewhere. The AWC will act as a knowledge hub for capacity building in the Arab region and will provide technical assistance for Arab countries to develop IWRM plans, and technical means for implementing such plans. The AWC will thus become an effective tool for executing Goal 1 of the UNDP/AWC partnership objectives: capacity building for Arab countries to achieve water related targets (see Annex 5 for details). This entry point can bridge the "gaps" numbers 1 and 2 mentioned above.

4.1.2 IWRM Plans Development Program

AWC with UNDP assistance can support Arab countries in developing IWRM plans and so meet the commitments made. What is needed is to bridge the gap between the existing water strategies/laws in each country and specific requirements for IWRM plans. The UNDP/AWC partnership can assist in providing the required expertise, similar examples, and guidance in developing national IWRM plans. This effort will have to be integrated with other initiatives within the region. This entry point can bridge the previously identified "gap" number 3.

4.1.3 IWRM Plans Implementation Program

The UNDP/AWC partnership can assist countries in identifying the bottlenecks for implementing IWRM plans in their region. The partnership can also assist in identifying the financial means and administrative requirements for effective implementation. Again, this effort will have to be integrated with similar initiatives within the Region. This entry point can bridge the previously identified "gap" number 4.

4.1.4 Regional Program for Water MDGs in the Arab Region

A regional coordination unit will be established to monitor and evaluate progress towards the MDGs for water. A regional coordination unit will be set up within AWC to work with national task forces for the water MDGs in the region to standardize the assessment criteria for monitoring progress. The unit will also help mobilize the political will for achieving the water MDGs, raise public awareness on them, help assess budget requirements, etc. Specifically on IWRM, the proposed unit will agree action plans for each Arab country to develop IWRM plan by the target date and will also follow up in the implementation phase. This entry point can bridge the previously identified "gap" number 2.

4.1.5 IWRM Capacity Building Program for Governments & Civil Societies

AWC with UNDP support can help improve capacity building efforts in the region, identifying available capabilities and successful implementation experience in the water sector. The partnership will design a specific capacity building program for various countries, with a particular focus on groundwater management and wastewater reuse. Regional organizations (for example: CEDARE, ESCWA, FAO RNE, UNDP RBAS, UNEP ROWA, UNESCO ROSTAS, ACSAD, etc.) can be major players in capacity building and training, and AWC will help coordinate their activities within national plans to avoid overlap and waste of resources. This entry point can bridge the previously identified "gaps" numbers 3 and 4.

4.1.6 Arab Water Facility

The Arab Water Facility will assist in establishing national Donor Assistance Groups (DAGs) for donor agencies to coordinate their activities in the Water Sector on the national level. Based on country needs assessments, the Arab Water Facility will also identify the priority projects in the water sector and coordinate the communication with potentially interested donor agencies to fund and implement these projects. Subsequently, the AWF will mobilize funds for soft and infrastructure water projects. The AWF will prioritize programs for funding, set criteria for accepting projects, and define guidelines for considering water-related project proposals. This entry point can bridge the previously identified gaps numbers 5 and 7.

4.1.7 State of the Water Report in the Arab Region

On the same lines as the global **World Water Development Report,** it is proposed to prepare a **State of the Water Report in the Arab Region**, which will periodically present a look at freshwater resources in the Arab region, discuss topical issues and document relevant experience from within the region and around the world.

4.2 Food Security

Food security issues have long been a preoccupation at decision making levels in the MENA region. However, food security does not mean self-sufficiency. Food security is determined by the ability of a country to ensure that all people at all times have both physical and economic access to fulfill basic food needs. There are this four dimensions to food security: **food availability** either from domestic production or imports; **stability of food** supply within season and between seasons; **accessibility** to all segments of the population through distribution systems and reasonable prices; and **affordability.**

The region imports more than 50% of its food requirement, including cereals, sugar, vegetable oil, meat and dairy products (A. Goueli, 2005). The average annual food import quantity for the period (2001 – 2003) is estimated at 95 million tons, of which 68 million tons are of plant origin, while 27 million tons are attributed to animal protein. The virtual water content of these imports is estimated at about 292 km^3, which already exceeds the existing available water resources for the region. Over 80% of regional food production depends on rainfall which is by its nature erratic. Thus imports may vary significantly with good or bad rainfall years.

Available water resources can do little to close the "food gap". The agricultural trade balance for the region is shown in Figures 4.1 to 4.4. The total annual food exports from the region averaged 15.5 million tons for 2001 -2003 (AOAD , 2004). The total deficit in the agricultural trade balance is thus estimated at about 80 million tons (the "food gap"). To close this gap through regional production, about 235 km^3 would be needed, more than the entire current water use.

There is, however, scope for improving returns to water through greater use efficiency and through a move to higher value crops. To the extent that higher value produce can be exported, this would help to counterbalance the food import bill which is about US$ 23.5 billion annually, dwarfing food exports that total only about US$ 4.9 billion each year.

It is worth noting that while animal protein contributes about one quarter of the total deficit (in terms of quantity in tons), it makes up about two thirds of the imported virtual water and about 29% of the food import bill.

The region is already pursuing a rational policy of importing cheap grains and concentrating domestic production increasingly towards higher value produce. About 60% of the deficit in the agricultural trade balance is attributed to grains and flour. An average of 50 million tons of grains and flour is being imported by the region while exporting only 2.4 million tons. Sugar and vegetable oils rank second and third with respect to quantities of food of plant origin which contribute to the total deficit. Dairy products constitute about 11.5% of the total deficit. In depth investigation by Goueli (2005) and comparative

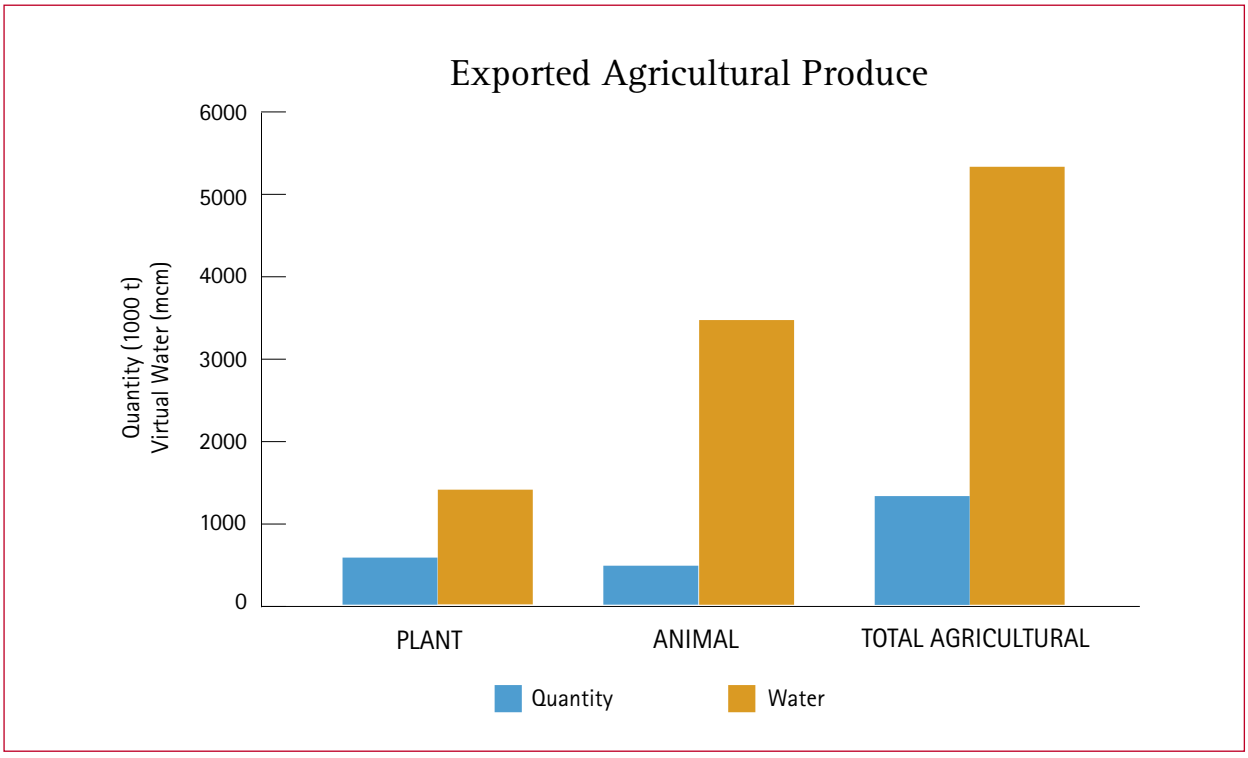


Figure 4.1 The Agricultural Produce Exports for the Arab Region

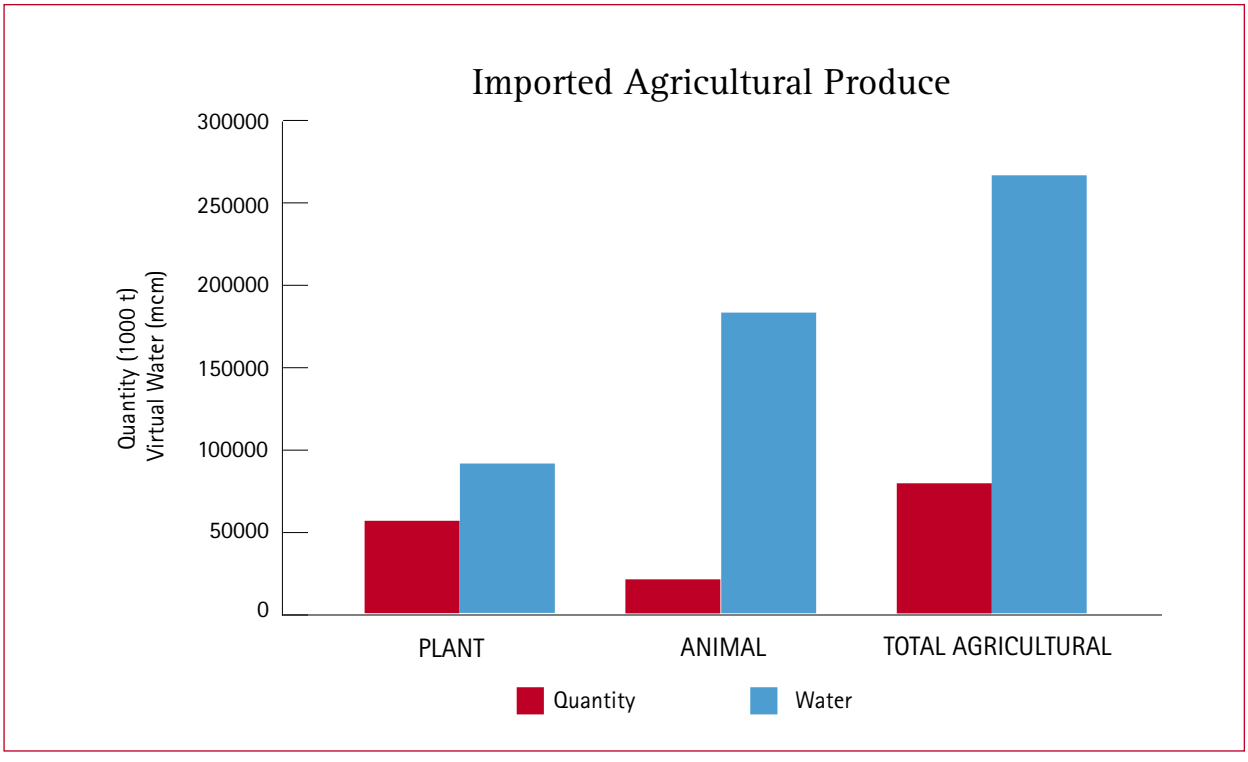


Figure 4.2 The Agricultural Produce Imports for the Arab Region

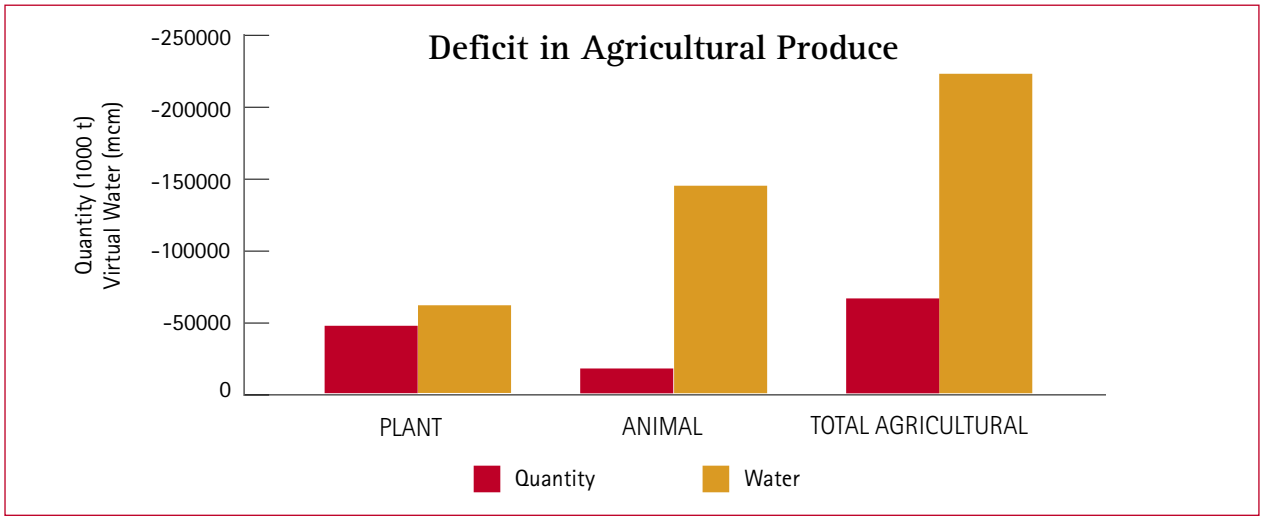


Figure 4.3 The Deficit in Food Production for the Arab Region

analysis of water productivity and economic return of produce per drop generally recommends expansion in the production of potatoes, vegetables, fruits, fish, eggs, and poultry.

Egypt, for example, is pursuing a policy of exporting high value goods and importing low value ones, adding value from its management of "virtual water". The agricultural trade balance for Egypt is shown in Figures 4.5, together with the area required to produce the exported (and imported) food is also added[2].

The virtual water required for the production of different categories of agricultural produce (exports, imports, deficit and surplus) is projected in Figure 4.6 and the economic return per unit of water for different categories is depicted in Figure 4.7.

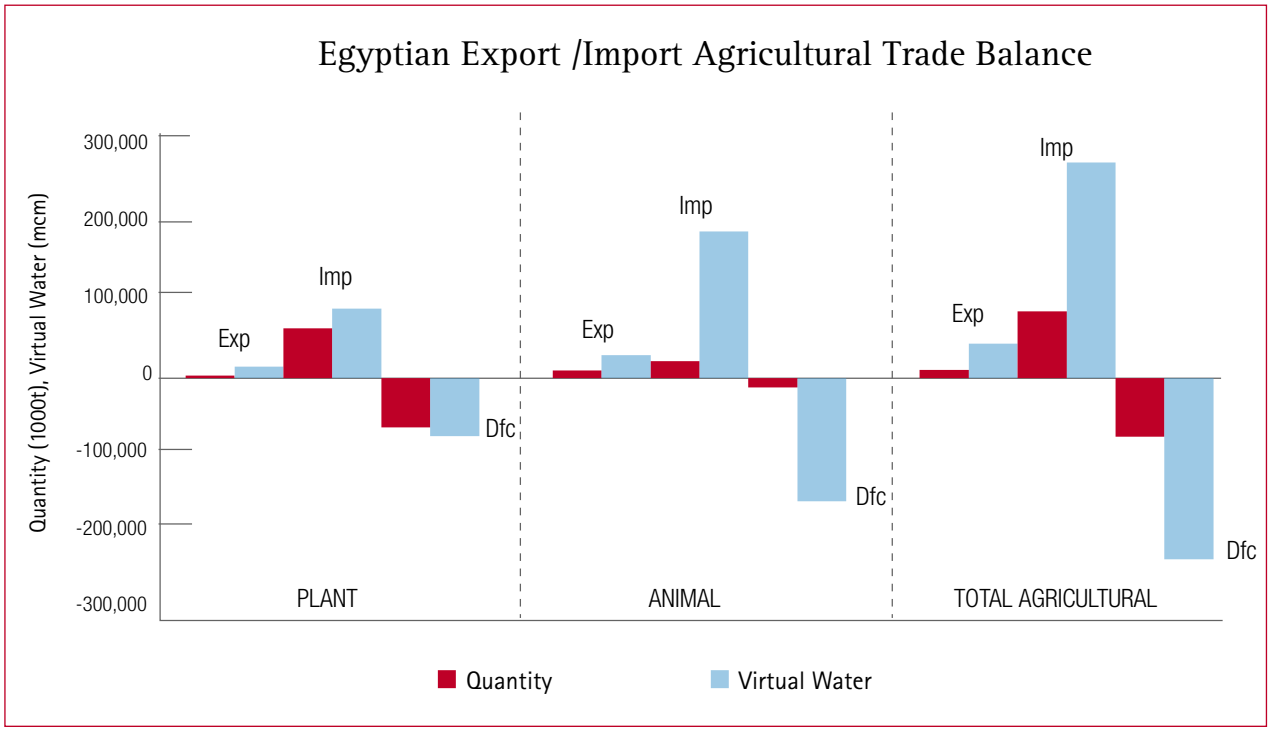


Figure 4.4 The Food Production Balance for the Arab Region in terms of Quantity and Associated Water Requirements Averaged over the Period 2001 – 2003. (Sources: Goueli 2005, AOAD 2004)

[2] One feddan is equivalent to 4200m²

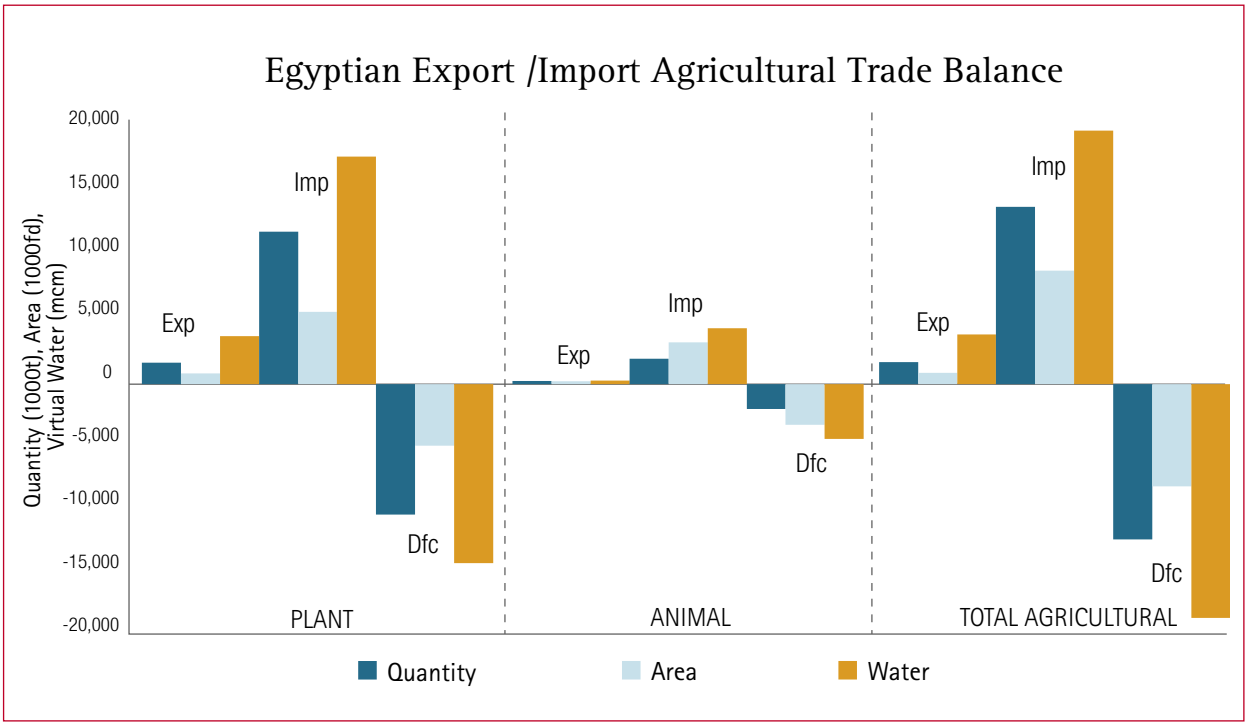


Figure 4.5 The Food Production Balance for Egypt in terms of Quantity, Associated Area and Water Requirements Averaged over the Period 2001 – 2003 (Sources: Goueli & Abdel-Monem 2005)

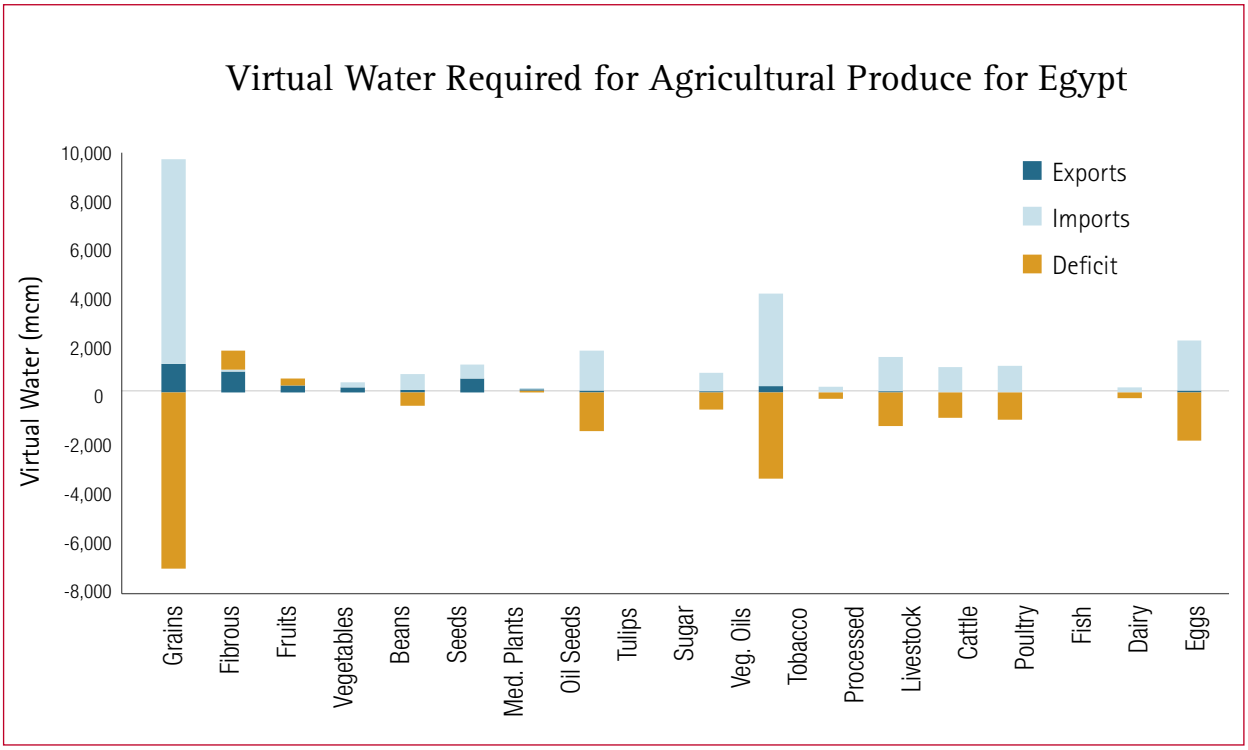


Figure 4.6 Virtual Water for Agricultural Produce in Egypt

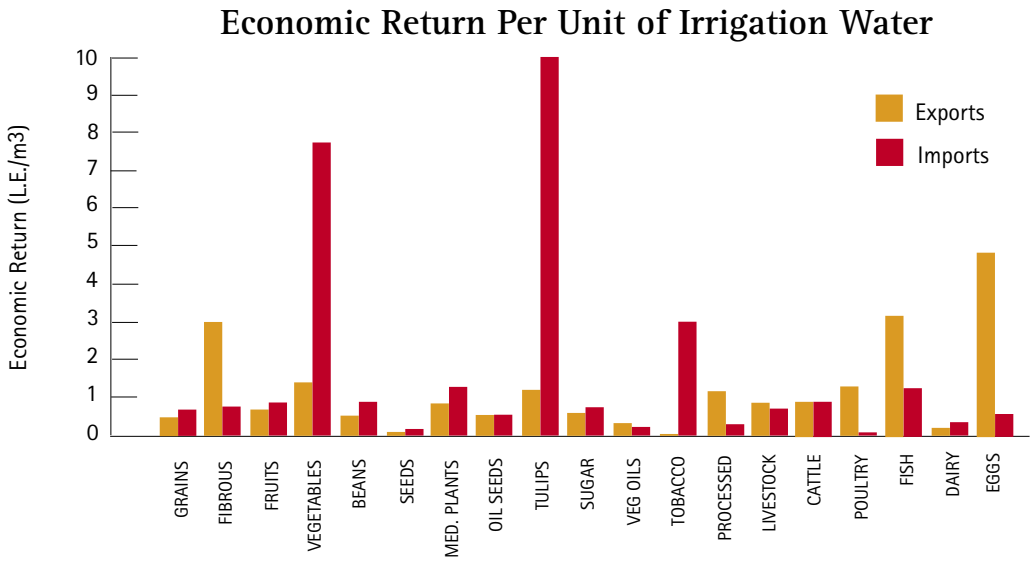


Figure 4.7 Economic Return Per Unit of Irrigation Water in Egypt

4.3 Impacts of Political Instabilities

The special case of conflict-affected areas. A negative factor for decades in the MENA region has been the scourge of conflict, which has caused major socio-economic and environmental problems and increasing pressure on already fragile and scarce water resources. The environmental impacts induced by conflict include physical damage to infrastructure (which is prohibited by international agreements) and serious contamination due to release of potentially hazardous substances from targeted military and industrial infrastructure, which need massive investments for restoration and rehabilitation. The continued failure to resolve long standing political tensions in the region is a major factor in the region limiting effective water management and hence sustainable development.

4.3.1 Impacts of Political Instability on the Palestinian Water Sector

Years of Israeli border closures and control of water resources has placed a great hardship on the Palestinian population (ESCWA, 2005). The prevailing tension is exacerbated by the inequity in accessing safe drinking water between Israelis and Palestinians. The situation is further complicated by the repeated disruptions in water and wastewater services. Water diversion projects implemented by Israel and water retaining structures reduced the normal flow in the Jordan river from 1227 mm^3/year to 114 mm^3/year, thus significantly diminishing the Palestinian share of the resources of the river.

The World Bank approved a grant of US$ 7.8 million to the Palestinian Authority to deal with the impending public health threat and the environmental hazards resulting from the lack of proper wastewater treatment in North Gaza. Although 64% of the wastewater is collected in Gaza, most of it is not properly treated, contributing significantly to contamination of the coastal aquifer and shorelines.

4.3.2 Impacts of Political Instability on the Water Sector in Iraq

Consecutive wars and years of sanctions in Iraq have left devastating impacts on the water situation, with disruption of the electricity and water supplies and destruction of wastewater treatment facilities. Oil spills, toxic chemical releases and depleted uranium have gravely polluted surface and groundwater resources. According to WHO and UNEP, the country has suffered several cholera and other water borne diseases outbreaks. The Iraqi population, notably women, elderly, children and poor people are facing tremendous hardship due to the destruction of water and wastewater treatment plants. It is estimated that the Iraqi water sector needs up to 15 billion US$ to repair a dilapidated water system crippled

by war and neglect. More than two years after the fall of the regime, the country of the Euphrates and the Tigris is struggling with recurrent water shortages in Baghdad and other large cities, poor sanitation and a shattered irrigation network. Iraq's water and sewage system has also been severely disrupted by conflicts. In rural areas, particularly in the south, water sources for domestic use are unreliable and pose a serious pubic health threat[3].

4.4 Wastewater Treatment and Reuse

Treating wastewater can be a low cost source of water.

Under prevailing water scarcity, treated wastewater reuse constitutes an attractive tool to relieve water stress. First, it preserves the high quality, expensive fresh water for the highest value purposes, primarily for drinking. The cost of secondary-level treatment for domestic wastewater in MENA, an average of $US 0.5/$m^3$, is in most cases cheaper than developing new supplies in the region (WB, 2000). Second, collecting and treating wastewater protects existing sources of valuable fresh water, the environment in general and public health, and can supplement them through aquifer recharge. If the latter is correctly factored into economic analyses, wastewater collection, treatment and reuse becomes one of the highest priorities for scarce public and development funds. Third, if managed properly, treated wastewater can sometimes be a superior source for agriculture, than some fresh water sources. It is a constant water source, and nitrogen and phosphorus in the wastewater may result in higher yields than freshwater irrigation, without additional fertilizer application (IDRC, 2002)[4]. Research projects in Tunisia and Saudi Arabia have demonstrated that treated effluent had superior non-microbiological chemical characteristics than groundwater, for irrigation and the treated wastewater has lower salinity levels.

Countries in the region which practice wastewater treatment and reuse include Kuwait, Saudi Arabia, Oman, UAE, Syria, and Egypt. Tunisia and Jordan practice wastewater treatment and reuse as an integral component of their water management and environmental protection strategies.

4.4.1 The Jordanian Experience

In Jordan, in the year 2001 about 63% of urban population and 53% of the total population were provided with wastewater collection and treatment systems, most of the remaining population (44%) being served by on-site treatment systems (cesspits and septic tanks), and only 3% of the population mainly in remote and agricultural areas lacking access to sanitary facilities, CEHA (2003)[5]. The quantity of treated wastewater (effluent) in year 2000 was 72 million m^3, with an effluent to influent ratio of 0.9 thus constituting about one third of the total potable water supply. About 75% of treated wastewater and 85% of reused treated wastewater is attributed to Al Samra Treatment plant.

The Al Samra Wastewater Stabilization Pond (WSP) System was commissioned in May 1985 and by 1986 was receiving approximately 57,000 m^3/d of domestic wastewater and sewage from the Metropolitan Area of Greater Amman, Jordan. In addition to the WSP facility, which is about 40 kilometres northeast of Amman, the system comprises a sewage receiving and pre-treatment installation, an inverted siphon 38.6 kilometres long and a raw wastewater pumping station. A typical composition of the sewage is 1600 mg/l BOD_5, 5700 mg/l COD and 2600 mg/l Suspended Solids. Al Samra ponds were highly efficient, removing 80% and 91% of the incoming BOD_5 on the basis of unfiltered and filtered final effluent samples, respectively.

Treated wastewater contributes to about 12% of irrigation water and about 16 km^2 of restricted agriculture and about 100 km^2 of unrestricted agriculture after blending with freshwater. Olives, barley, and acacia are commonly grown crops and trees.

Wastewater Treatment and Reuse Policy:

- Treatment of wastewater shall be targeted towards producing effluent fit for reuse in irrigation in accordance to WHO and FAO Guidelines as minimum.
- The use of treated wastewater in irrigation shall be given the highest priority and shall be pursued with care.
- Effluent quality standards shall be defined based on the best attainable treatment technologies calibrated to support or improve the ambient receiving conditions.
- Treatment technologies shall be selected with due consideration to operation and maintenance and energy savings.

[3] ESCWA (2005), http://webworldbank.org/WBSITE/external/NE
[4] "First WDM Forum on Wastewater Reuse", 26 -27 March 2002, Rabat, Morocco
[5] "Regional Consultation to Review National Priorities and Action Plans for Wastewater Reuse and Management" Amman 20-22 October, 2003. Jordan Country Paper by Saleh Malkaw, Water Authority of Jordon

- Jordanian standards are benchmarks against which treatment and reuse were evaluated. They should be reviewed and modified to reflect special ambient conditions or end use.
- "Polluter pays" principal shall be established.

Wastewater Management Policy:

- The role of the government is fine-tuned, and its involvement shall be reduced to be regulatory, and the private sector role shall expand with management contracts, BOT, BOO and other forms of private sector participation.

4.4.2 The Tunisian Experience

In Tunisia, the volume of treated wastewater available in the year 2000 exceeded 125 million m^3 (IDRC 2002), and by 2002 had reached 170 million m^3 (CEDARE 2004[6]). Use of treated effluents is seasonal in Tunisia (spring and summer) and the effluent is often mixed with groundwater before being applied to irrigate citrus and olive trees, forage crops, cotton, golf courses and hotel lawns. Irrigation with wastewater of vegetables that might be consumed raw is prohibited by the National Water Law (Code des Eaux). The Regional Departments for Agricultural Development (CRDA) supervise all irrigation water distribution systems and enforce the law.

Treatment methods include tertiary treatment for 4.8% of wastewater including de-phosphation and de-nitrification. Secondary treatment follows medium charge activated sludge for 46.9% of the volume, low charge activated sludge for 31.8% of the volume, storing water in lagoons 16.2% of the volume, percolating filters 0.7% of the volume. Primary treatment consists of coarse filtration and sedimentation which may be aerated or not. The type of treatment such as storing water in lagoons affects the concentration of salts and therefore, salinity of treated water differs from one plant to the other from 1 – 6 gm/l.

Agriculture is the main user of treated sewage. More than 6600 hectares are currently irrigated with treated sewage. Projected discharge of treated sewage is 215 million m^3 by the year 2006 which will be sufficient for the irrigation of 20,000 ha that is 5% of the irrigable lands in the country (CEDARE 2004). Preventive health measures for the employees responsible for the maintenance of the networks and conveyance of water are taken by vaccination and regular analysis.

The national strategy for wastewater reuse includes technical aspects (additional treatment, less restrictive reuse, increase of reuse options...etc), institutional aspects (improving co-ordination between different water sectors, increasing private sector involvement, cost recovery on equitable and fair distribution of cost), social aspects (participation of public and awareness, communication and education) and environmental aspects (reduce negative impacts, adequate and reliable treatment, health control).

4.5 Shared Water Resources and Multinational Cooperation

Some good practice examples of cooperation on shared water show the feasibility and the benefits.

The high degree of shared water resources in the region has led to several water-sharing agreements and cooperative programs, where the cooperation experience has proved that sharing water resources, partnerships for management or investment, or just technical cooperation on a fair and equitable basis, can improve benefits for all concerned and contribute to a peaceful environment on a broader scale. Examples include agreements on cooperative management of the Tigris-Euphrates River Basin between Iraq and Syria, negotiations between Lebanon and Syria over the waters of the Orontes and Nahr El Kabir Rivers that produced two agreements, bilateral water-sharing agreements over the Jordan River, and the Nile Basin Initiative. Moreover, regional

Box 4.1 Shared Water Resources Cooperation

The Nile Basin Initiative provides an excellent example of fruitful basin-level cooperation. Ten Nile riparian nations have agreed and started implementing a river basin cooperation framework for the development and use of Nile water based on shared benefits and equitable use of water. The Nile Basin Initiative programs aim at: poverty alleviation, improvement of livelihoods, pollution abatement, and sustainable development of all Nile riparian countries. The Secretariat of the NBI was officially established at Entebbe, Uganda in November 2002.

[6] "Wastewater Management and Reuse Assessment for the Mediterranean", El-Quosy, CEDARE, Report WRM-Jn2004

cooperation on the sustainable utilization of the Nubian Sand Stone Aquifer has achieved major progress between Egypt, Libya, Sudan, and Chad. Similarly, Algeria, Tunisia, and Libya have reached prosperous cooperation for the North Western Sahara Aquifer.

4.5.1 The Lebanese-Syrian Water Cooperation on Nahr El Kabir Case[7]

The Nahr El Kabir river rises in part within Lebanese territory and constitutes the country's northern border with the Syrian Arab Republic. Its mean yearly incoming flow is around 150 million m^3. On June 11, 2002, the decree No. 8005 was promulgated, forwarding a bill to the Lebanese parliament to allow the government to negotiate an agreement with the Syrian Arab Republic regarding the distribution of Nahr el Kabir basin waters, and, the construction of a joint dam on the main river course. The Agreement was framed in line with international laws, particularly the 1997 UN's "Convention on Using International Water Courses for Non Navigational Purposes". This Convention, which has been ratified by both Lebanon and Syria, constitutes a sound basis for equitable sharing and management of international rivers. With this basis, a joint Lebanese-Syrian committee agreed on the distribution of the Nahr el Kabir waters and on the construction of a dam in the location of Idlin —Noura el Tahta with a storage capacity of 70 million m^3. The agreement provided for sharing the total annual flow of the Nahr el Kabir at the dam site 60:40 between Syria and Lebanon. The shares remain fixed in all conditions, whether in a wet or normal or dry year.

4.5.2 Enhanced Cooperation between Jordan and Syria on Water Issues

Two important sub regional agreements have been reached between Jordan and Syria on water issues. First, Syria agreed to provide Jordan with 60 million cubic meters of water annually (ESCWA 2005) and second, the two countries are embarking on the construction of Wehdeh Dam on the Yarmouk river in the north of Jordan, which had been halted since 1987 due to Israel's rejection. The dam is currently under construction under a three year contract expected to be completed in late 2005. The Yarmouk forms part of the northern boundaries of Jordan with Syria, about 120 km from Amman. The total storage capacity would be about 110 million m^3. The second stage is to raise the dam, in the future, to a total storage capacity of about 225 million m^3. The dam will capture the floods and available base flow in the Yarmouk basin, providing about 30 million m^3 of water to irrigate 31,000 dunum[8] (3,100 ha) of cultivated land; supply Amman and its vicinity with about 50 million m^3 of potable water annually; and, after completion of the second stage, generate about 18,800 Megawatt/hr of electricity annually.

Cost and time for construction of the dam is remarkably low. It is estimated that the expected cost of the first stage of construction is about 66 million Jordan Dinars. The Arab Fund for Economic and Social Development is financing 80% of the total cost of the project, 10% is provided by Abu Dhabi Fund for Development and the remaining 10% by the Government of Jordan.

4.5.3 Kuwait – Iran Cooperation

An agreement has been reached with Iran to transport to Kuwait about 200 million gallons of water daily via pipelines through Gulf. The project will be implemented by private sector by BOT (ESCWA 2005).

[7] Source: National paper presented by Lebanon at the Workshop on Enhancing Negotiation Skills On Shared Water Issues for Palestine, Dead Sea, December 2003
[8] 1 dunum = 1000 m^2

5. SUCCESSFUL **local actions**

5.1 Introduction

In line with the overall theme of the 4th World Water Forum, **Local Actions for a Global Challenge**, this concluding chapter of the report is devoted to consideration of successful local actions in the MENA region. Initial sections discuss policy and governance initiatives, and the report concludes with twenty nine case studies of successful actions which have been conducted in the region.

Types of successful action considered. The most common type of action is a project but some of the "actions" documented in this report are actually plans, and sometimes only strategies, that are expected to lead to concrete actions in the near future. Where these strategies and plans appear fairly definite, and where they represent a new approach —within the concerned country— to managing water, then they have been included as "actions". In summary, the most common types of actions discussed are:

- projects that go beyond "business as usual";
- policy reforms and institutional changes that are innovatory;
- governance initiatives like campaigns to raise awareness or build capacity;
- water planning and strategy formulation beyond normal practice;
- action-oriented research that has produced new approaches;
- innovative technologies.

The actions have been implemented by a wide variety of institutions. To reflect the broad range of actors who have innovated in the region, the case studies are drawn from experience of a broad range of governmental and non-governmental organizations, including:

- **governments** that enact laws and policies;
- **public sector agencies** that implement policies;
- **research institutes** involved in applied "action" studies;
- **non-governmental organizations** with water-related missions;
- **water user groups** (including watershed, irrigation, water supply associations);
- **private companies**, including banks, that pursue business opportunities;
- **donor agencies** that finance projects and promote certain policies.

Often small scale actions teach the richest lessons. Each of these organizational types can be found at various levels, ranging from local, grass-roots (village government, local water user association or self-help group, etc.) to international body (the UN, World Bank, international research institutes, etc.). One of the challenges in preparing this report is to capture the many small-scale actions taking place at the local level, financed by local NGOs or local government bodies. While local actions are sometimes coordinated into larger programs, it is often the independent actions taken at the micro-level that are most innovative, and can enrich our understanding of how to improve water management.

5.2 Policies and Water Governance

Countries in the region have been actively reviewing their policies and many different innovations are underway. Several countries have reconsidered their current water policies and are focusing on the rationalization of available water resources, in parallel to on-going investments to increase water production. Bahrain for example has prepared a water plan for 2006-2020 and reassessed all available resources and future water demands. This reassessment exercise helped in drawing up water policies to manage this vital sector and identify gaps in legislation related to the development and protection of water resources. In Saudi Arabia the ministry is preparing a national strategy and action plan for the water sector that includes an assessment of the current water management practices (developed in 2005), development of strategic water policies (in progress) and development of an action plan to execute the water strategy (expected in 2008). Qatar is currently reviewing and modernizing its legal framework to apply IWRM guidelines and concepts, while the United Arab Emirates

has adopted a legal framework, which regulated the management of water supply and sanitation sector (Law enacted in 2002), building on its successful experience in public-private-partnership in providing water and sanitation services.

Several countries have created new integrated institutional structures for water resources management. The GCC countries also reformed their institutional frameworks, whereby an independent ministry is now responsible for the management of water resources. Planning, management and enforcing legislation are under the responsibility of one ministry that in turn will serve all sectors without being biased towards one sector over the other. This type of institutional and legal set-up facilitates public–private partnership in the provision of water and sanitation services, where these countries have a good record and considerable experience in efficient customer services. Iraq has also established a new ministry for water resources to integrate all water using sectors.

Private sector involvement. At the level of developing and applying management tools, the GCC countries have a good record of partnership with the private sector, particularly in terms of water desalination and water reuse treatments. The UAE for example started to formulate a long-term privatization plans through BOO projects for the provision of water between various international companies and different water authorities, and regulated by the Regulation & Supervision Bureau. In Saudi Arabia, several attempts were made to enhance the participation of the private sector, thus motivating the ministry of water and energy to improve and develop the management of this sector. In this respect, a two-phase managerial plan was developed. Phase one focused on implementing demand management measures which include installing water meters, invoicing and collecting revenues. Phase two focused on a general reform of the water sector with emphasis on new operational and legal frameworks and a thorough review of tariffs.

The decentralization agenda. Syria has established independent water directorates at the basin level to promote decentralization and has decentralized responsibility for water supply and sanitation to water authorities and municipalities. In Lebanon, the water ministry was given new responsibilities and some 21 water authorities were consolidated into four to provide water supply and sanitation. In Oman, the Ministry of Regional Municipalities, Environment and Water Resources is entrusted to implement a decentralization strategy. Within this ministry, the general directory for water issues implements water development projects and works on modernizing and improving its services. Moreover, Oman has managed to provide fresh water supplies to numerous rural areas through the support of Aflaj system at the community level, an indigenous technology of applying IWRM concepts. A database is established for all existing wells and aflaj (The National Wells-Aflaj Inventory Project).

Other areas of progress. In Egypt, Morocco, Tunisia, Jordan, and Palestine major progress is noted in establishing the **legal framework** to regulate water quality, to protect the environment, and to control water use. All these countries have followed a policy of establishing **local water supply and sanitation "utilities",** local and sub-regional water authorities to manage water and sanitation services in their respective areas. They have also increased **stakeholder involvement:** preparation of national strategies, for example, has been based on stakeholder consultations through workshops and town hall meetings involving decision makers, water users associations, related ministries, private sector and local communities. Moreover, significant **public private partnerships (PPP)** have been developed during the last decade in Morocco and Egypt especially for major agricultural development projects. Efficient **drought management** strategies and action plans have been formulated in Morocco in cope with climate variability and cyclic droughts.

5.3 Regional Integration: the Arab Water Council

Creation of the AWC. Regional cooperation and information exchange on water resources has always been strong, and these steps towards regional integration will be reinforced by the recent creation of the Arab Water Council (AWC), a non-governmental regional organization dedicated to coordinate the introduction of integrated water resources management in the Arab world in order to maximize the economic, social and environmental benefits. The AWC (see Box) was formally launched on 14 April 2004 in Cairo, Egypt in the presence of more than 400 water experts representing 17 Arab states, regional and international organizations, leading universities, research centers, and private sector.

The AWC to date. The AWC has already prepared a review of the current water situation in all Arab states and

Box 5.1 The Arab Water Council - Aims and Activities

Objectives: the Arab Water Council aims to promote better understanding and management of water resources in the Arab states in a multi-disciplinary, non-political, professional and scientific manner; and to disseminate knowledge and enhance sharing of experience and information in order to achieve rational and comprehensive water resources development of the region for the benefits of its inhabitants. In addition, the Council is mandated to represent the views of the Arab states at international and global fora dealing with the political, institutional, legal and financial aspects of water management or about technical topics such as transfer of knowledge, conceptual development of policies, or preparation of strategies and plans of action related to water resources and its uses.

Advocacy and advisory role: other objectives of AWC also include advising the public, private and voluntary sectors on aspects of water management, and promoting appropriate participation of the stakeholders in decision-making processes and equitable sharing of the benefits of water development.

a review of the status of IWRM plans in the region. The AWC has also led the efforts to present the experiences of the MENA region for the 4th World Water Forum. The AWC is also launching various regional initiatives, and is formulating a proposal for a Regional Water Management Institute.

5.4 Basin-Level Cooperation; Case of The Nile Basin Initiative

The Nile Basin Initiative aims at mutual benefits for all riparians, optimizing within an integrated planning framework. The Nile Basin Initiative provides an excellent example of fruitful basin-level cooperation. Ten Nile riparian nations have agreed and started implementing a river basin cooperation framework for the development and use of Nile water based on shared benefits and equitable use of water. The Nile Basin Initiative programs aim at: poverty alleviation, improvement of livelihoods, pollution abatement, and sustainable development of all Nile riparian countries. The Secretariat of the NBI was officially established at Entebbe, Uganda in November 2002. Among the Shared Vision Programs (SVPs) agreed within the IWRM framework are: (1) the Nile Basin Transboundary Environmental Action Program; (2) the

Table 5.1 Overview of Nile Basin Initiative Programs

PROGRAM	COMPONENT
Shared Vision Program (SVP)	1. Nile Basin Transboundary Environmental Action 2. Nile Basin Regional Power Trade 3. Efficient Water Use for Agricultural Production 4. Water Resources Planning and Management 5. Confidence Building & Stakeholder involvement (Communication) 6. Applied Training 7. Socio-Economic Development and Benefit-Sharing
Subsidiary Action Programs (SAP)	Nile Equatorial Lakes (NELSAP) Eastern Nile (ENSAP)
NBI Facilitation & Program Management	On-going support to facilitate NBI progress and development SVP Program coordination, quality assurance, and monitoring

Water Resources Planning and Management program; (3) the Applied Training program; and (4) the Socio-Economic Development and Benefit-Sharing program. A list of SVPs with their implementation status is presented in the Table 5.1.

5.4.1 The Eastern Nile Subsidiary Action Program (ENSAP):

Win-win projects bundled together within a multi-purpose program. The Eastern Nile Subsidiary Action Program (ENSAP) currently includes the countries of Egypt, Ethiopia, and Sudan. The Eastern Nile riparians recognize that potential investments need to be assessed within a regional context and that benefits of a win-win nature are most likely to be found in the bundling of projects within a multi-purpose context. The Integrated Development of the Eastern Nile (IDEN) Project includes seven short term sub-projects. Most of these projects have been launched already and the remainder will be launched very shortly. IDEN sub-projects are:

- Eastern Nile Planning Model Sub-Project
- Baro-Akobo Multi-purpose Water Resources Development Sub-Project
- Flood Preparedness and Early Warning Sub-Project
- Ethiopia-Sudan Transmission Interconnection Sub-Project
- Eastern Nile Power Trade Investment Program
- Irrigation and Drainage Sub-Project
- Watershed Management Sub-Project

5.4.2 The Nile Equatorial Lakes Region Subsidiary Action Program (NELSAP):

The mutual benefit of integrated development optimized at the basin or sub-basin level drives the cooperation in these programs. The Nile Equatorial Lakes Region (NEL) includes the six countries in the southern portion of the Nile Basin —Burundi, DRC, Kenya, Rwanda, Tanzania and Uganda— as well as the downstream riparians Egypt and Sudan. The objectives of NELSAP are to contribute to the eradication of poverty, promote economic growth, and reverse environmental degradation. NELSAP sub-projects are expected to be implemented in the short term. Twelve NELSAP projects (see Box) have been identified by the Nile Equatorial Lakes riparians in a consultative manner, targeting investments in agricultural development, fisheries development, water resources management, water hyacinth control, and hydropower development and transmission interconnection.

Box 5.2 The Nile Equatorial Lakes Region Subsidiary Action Program (NELSAP): Projects Identified

Natural Resources Management

1. Enhanced Agriculture Productivity through Rainwater Harvesting, Small Scale Irrigation and Livestock Management.
2. Fisheries Project for Lake Albert and Lake Edward.
3. Development of a Framework for Cooperative Management of the Water Resources of the Mara River Basin.
4. Kagera River Basin Integrated Water Resources Management.
5. Development of a Framework for Cooperative Management of the Water Resources of the Malakisi-Malaba-Sio River Basins.
6. Water Hyacinth Abatement in the Kagera River Basin.

Hydropower Development and Power Trade

1. Rusumo Falls Hydro-Electric Power (HEP) Development.
2. Ranking and Feasibility Study of HEPs in the NEL Region.
3. Interconnection between Kenya and Uganda.
4. Interconnection between Burundi, DRC, and Rwanda.
5. Interconnection between Burundi and Rwanda.
6. Interconnection between Rwanda and Uganda.

5.5 Selected Local Actions

Out of over a hundred local action identified throughout the consultative preparation process, twenty nine actions have been selected for detailed analysis in this chapter. Table 5.2 shows how these 29 actions correspond to the World Water Forum's themes and cross cutting perspectives. Each action is then separately presented.

Table 5.2 Local Actions according to the Forum's Themes and Cross-Cutting Perspectives

	FRAMEWORK THEMES	
CROSS CUTTING PERSPECTIVES	**1. Water for Growth and Development**	**2. Implementing Integrated Water Resources Management**
A. New Models for Financing Local Water Initiatives	1. Public Private Partnership Scheme in Irrigation: the case of the Morocco Guerdane Project	7. Inclusive Vision on Public Private Partnerships (PPP) in Egypt's Water Sector and Introduction to a PPP Model in the West Nile Delta
B. Institutional Development and Political Processes	2. Improving Water's Contribution to Growth and Development in the MENA region - WB 3. Yemen Land and Water Conservation Project	8. Groundwater Management in the MENA region 9. The Role of Civil Society on IWRM in the Arab Region
C. Capacity-building and Social Learning	4. Millennium Development Goals (MDG) Capacity Strengthening project in the Middle East	10. Arab Integrated Water Resources Management (AWARE NET) 11. Arab Regional Session for the 4th World Water Forum
D. Application of Science, Technology and Knowledge	5. Gareh Bygone Plain Project	12. Integration of climate change into the national water plan of Egypt 13. Integrated Irrigation Improvement and Management Project (IIIMP) 14. Closed loop sanitation in Syria: Pilot implementation of a constructed wetland
E. Targeting, Monitoring and Implementing Knowledge	6. Shaping Water Po1icy in Egypt: Egyptian Youth take Local Message from the Nile Valley to World Water Forum	15. Assessment of the status of Integrated Water Resources Management (IWRM) Plans in the Arab Region

	3. Water Supply and Sanitation for All	4. Water Management for Food and the Environment	5. Risk Management
		18. Integrated and participatory approaches to irrigation and drainage planning	25. EMWIS
		19. Capacity Building in the MENA Region (INWENT) 20. Water User Organizations: Partners in Integrated Water Resources Management	26. Water Sector Capacity Building in Palestine
	16. Application of Novel Demisters in MSF 17. An Optimal High Recovery, Energy Efficient, Dual NanoFiltration (NF) Seawater RO Process	21. Reclamation of salt-affected and waterlogged areas 22. Potentials for improving on-farm water use efficiency and the use of Non-conventional Water Resources in irrigated agriculture in MENA Region 23. Supplemental irrigation for improved rainfed wheat yield and water productivity in Syria	27. Methodology for assessment of the development potential for groundwater in Wadi Systems
		24. A Study on Virtual Water in Egypt	28. Management of Water Quality in Mashreq and Maghreb Countries 29. Re-use of Oilfield Wastewater for Agro Forestry using Natural Wetland Treatment Systems in Oman

1. Public Private Partnership Scheme in Irrigation: the case of the Morocco Guerdane Project

The Guerdane perimeter in the Souss-Massa region, near Agadir in Morocco, is suffering from overexploited aquifers and farmers are facing a severe shortage of water resources for their crops (Citrus). Private wells are the only source of irrigation water. 600 medium to large scale farms are privately owned. Due to over-exploitation, the groundwater table level is diminishing by 2.5 meters per year on average and several farms are abandoned every year as wells dry up or water pumping costs become unaffordable. In order to reduce the over-abstraction of groundwater resources, an annual volume of 45 million cubic meters from the Chakoukane-Aoulouz dam complex will be brought to the Guerdane perimeter through 70 kilometer-long gravity-based buried pipes. An estimated 300 kilometer-long irrigation network that will distribute irrigation water to farmers within the Guerdane perimeter will be constructed.

Delegating to the private sector and a partnership with farmers. Farmers have accepted the Government suggestion to delegate this public service to a private operator, beyond users' association schemes. Farmers would pay tariffs equivalent to the pumping cost. Through a Build-Transfer-Operate (BTO) scheme, the private sector will be responsible for the construction (including its financing) of the operation; upon completion, the infrastructure is transferred to the state and the operation of infrastructure is delegated to private sector. The bid for the Guerdane PPP irrigation project was won by a consortium led by Omnium Nord-Africain (ONA), a Moroccan industrial conglomerate, thus creating Morocco's first ever domestic private infrastructure operator. The tariff structure is significantly lower than the price for irrigated groundwater supplies.

Benefits to Morocco – an innovative PPP in the irrigation sector. By bringing in the private sector, Morocco will benefit from the integration of capital and management expertise from the private operator, which should produce cost-reducing efficiency in this public-private partnership. The Guerdane project is quite an innovative project in the irrigation sector. The success of the bidding process for the Guerdane PPP irrigation project sets a worldwide precedent for future irrigation investments in a difficult global environment.

2. Improving Water's Contribution to Growth and Development in the MENA region

A study makes the case for a holistic approach. A detailed diagnostic analysis is undertaken to demonstrate that **water challenges cannot be successfully addressed in isolation and with technical solutions only.** Rather, a **holistic approach** that looks at the interaction between the water sector and the wider economic, social and political environment is necessary. The analysis attempts to reveal why, in the face of so much evidence of the consequences of current practices, many countries in the MENA region frequently continue managing water resources as usual. Amidst this backdrop, there are **windows of opportunity** to encourage change in the region. **Drivers of reform** include increased budgetary rigor and ongoing challenges of providing better quality water and sanitation services to the region's population. **Bottom-up approaches to water service management,** pressures to switch out of agriculture, climate change, information and communication technologies, population growth, tourism and liberalization of agricultural trade policy can make water reforms politically attractive.

3. Yemen: IWRM and Land and Water Conservation Project (LWCP)

Yemen is facing an alarming crisis in its water sector. Attempts to address the groundwater depletion issue through a combination of top-down (regulations and law enforcement) and bottom-up (community awareness and participation) approaches are being promoted and serve as examples for other arid countries facing severe groundwater shortages. The local action of the LWCP, which is supported by the World Bank, highlights the benefits of cooperation between farmers and water saving through a combination of cost effective measures and appropriate technology.

In the course of the project, Yemen went through an important process of elaborating sound policies on water resources and the building of institutions capable of managing this strategic resource. Its key achievements include the establishment of the Ministry of Water and Environment (MWE) and National Water Resources Authority (NWRA), the formulation of a national water strategy and an irrigation policy. The LWCP comprises three major elements: (i) a water management component primarily for reducing water losses in groundwater irrigated agriculture; (ii) a forest and land management component; and (iii) institution strengthening through

consultancy assistance and training. **The LWCP was the first project in Yemen that focused on water resources management, pioneering new techniques for conserving irrigation groundwater.**

The project introduced new irrigation technologies such as **bubbler and drip. PVC and GI pipes** were also constructed in helping reduce irrigation water losses. According to project data, LWCP and farmers invested together on average about US$ 250 per hectare to achieve water savings of about 2,300 m^3 per hectare each year. The investment costs are thus about US$ 0.11 per cubic meter of annual water saving. Savings in pumping costs amount to US$ 0.06 per m^3 on average, so that the investment cost is recouped by farmers in just two years, without taking into account the value of water saved in the aquifer. Increasingly important is the implication of **diesel fuel subsidy reduction** by the Government of Yemen on water saving. Prior to this major policy change, the low cost of fuel rendered water more affordable to farmers who practice cash crops such as qat. The reduction in subsidies has, in effect, necessitated with greater urgency, continued water savings to the extent possible.

The project successfully demonstrates **the benefits of combined top down and bottom up approach in arresting the rapid rate of groundwater depletion**. The top down approach includes the new water law, regulating the excavation of new wells and drillings rigs through the branch offices of NWRA. The bottom up approach has involved greater community participation in water saving initiatives. The innovative nature of the project has also been in its demand driven approach. This has been demonstrated by the desire of farmers to use their own resources to invest in advanced irrigation technologies. In this context, a cost sharing arrangement was devised where every farmer had to deposit a cash contribution on the project's Bank account before receiving technical advice and equipment under the project.

4. Millennium Development Goals (MDG) Capacity Strengthening project in the Middle East

The urgent need to **strengthen the human capacity to reach the MDGs** is widely accepted by both bi-lateral and multi-lateral technical assistance and funding agencies. The number of professionals in MENA to tackle the current problems concerning water and sanitation needs to be increased dramatically in the coming years.
Unesco-IHE is currently supervising 2 Masters researchers from the Middle East as part of this MDG capacity strengthening project: 1 from Yemen and 1 from Palestine investigating: (i) Optimization of Desalination Plants, Yemen, and (ii) Coastal Zone Management of the Gaza Strip, Palestine The UNESCO-IHE researchers are from local and national government agencies, universities, commercial and non-profit organizations. While the objective of the research is to study the problem in its own particular context, it will be analyzed with a theoretical framework that is based on relevant international scientific literature. **The research will study trends and seeks to understand causal relationships**, lifting the subject to a higher plain of relevance, where possible solutions can be applied at a wider national or even international scale, in terms of theory, methodology, but also in terms of technological solutions and innovative institutional arrangements. Key boundary conditions are efficient water use, environmental sustainability, conflict resolution and the MDGs.

5. Gareh Bygone Plain Project

Groundwater supplies about 60% of Iran's water requirements during periods with normal precipitation and a higher percentage during droughts. Survival depends on groundwater resources. Rapid population growth and the use of inappropriate technology (cable tool and rotary drilling machines and powerful pumps) in the last 50 years have caused recession of water tables throughout Iran. Thus, replenishing overexploited groundwater and managing it prudently are essential. Floodwater harvesting for the Artificial Recharge for Groundwater (ARG) is a strategic alternative. The ARG is a low technology initiative, which can be implemented with a minimum of equipment and tools. Desertification control through the ARG is a paradigm-based technology that can be employed in other contexts.

The forced sedentarization of transhumant pastoralists in the 1930s in the Gareh Bygone Plain (GBP), a sandy expanse in southern I.R.Iran (28° 35′ N, 53° 53′ E, 1140-m above mean sea level), with the mean annual precipitation (MAP) of 243-mm and Class A pan evaporation of 3,200-mm, initiated a desertification process that produced upwards of 500 environmental refugees. Overgrazing, fuel wood collection, senseless hunting, and the worst of all, the application of inappropriate technologies, moldboard plows and pumps, devastated this 6000-ha scrubland that teemed with wildlife. Water table receded 10-m in 12 years, very close to the bedrock. Saltwater intrusion

into the aquifer compounded the water shortage problem. Soil salinization was the outcome of irrigation with saline waters. Migration of the inhabitants of 4 villages had reduced the GBP to a few souls where the remaining women and children had to walk up to 6-km a day to fetch water.

Results of the ongoing applied studies in this research and development project are available. By replacing Eucalyptus camaldulensis Dehnh. with less water consuming trees, water is conserved. As the sandy soils of sedimentation basins are being covered with finer deposits, more arable fields are available. The capacity of the ARG systems is being optimized to gain the most out of a unit of diverted water. Strategic plans are being prepared for the crops to be grown and the number of people to be re-settled.

6. Shaping Water Policy in Egypt: Egyptian Youth take the Local Message from the Nile Valley to the World Water Forum

The aim of the activity is to ensure that a two-fold message is conveyed to the global audience: one, that youth are agents of change, and with sufficient capacity, are able to influence policy and practices on key water issues. Two, policy-makers and Ministers must provide the opportunity to listen to youth and address their concerns in terms of enabling sustainability of water resources.

Ten children from Egypt between the ages of 11 to 16 are selected to visit up to five different ecosystems in Egypt where different water problems exist.

Following their discussions with the communities of these ecosystems, the children will spend time with scientists and specialists to explore simple solutions to these water problems. They will then return to the communities to share their findings. The children will prepare a synthesis of their findings and a multi-media presentation to present to policy-makers at the 4th Forum. The activity will culminate with a dialogue between youth and policy-makers at the 4th Forum.

The action is funded and led by IDRC, through in collaboration with WESC, an Egyptian NGO with experience in environmental education, the Egyptian Water Partnership (EWP), the Arab Water Council (AWC) and the Ministry of Water Resources and Irrigation (MWRI). The local action entails working closely with several governmental, non-governmental, and civil society organizations to promote awareness among children to facilitate action on water related issues. The above activity provides the opportunity to enhance communication and learning between current and future leaders in the water sector.

IMPLEMENTING INTEGRATED WATER RESOURCE MANAGEMENT

7. Inclusive Vision on Public Private Partnerships (PPP) in Egypt's Water Sector and Introduction to a PPP Model in the West Nile Delta

Almost all agriculture lands in Egypt takes place in some 8 million feddans (33,600 $km^{2,}$ or about 3.4% of Egypt's territory) of fertile soil in the Nile Valley and Delta. The Delta Regions (East, Middle, and West) alone contributes to about 80% of all cultivable land in the country. Despite the extremely limited land available for agriculture, urbanization of these lands is growing. To compensate for the loss of agricultural land in the Delta, and to provide opportunities to generate new jobs, increase production, and widen the development base the Government of Egypt (GOE) has supported commercial farmers in reclaiming desert lands since the late 1960s. In this context, the GOE has identified an area of about 255,000 feddans (equivalent to 100,000 ha), located approximately 60 kilometers North of Cairo to the West of the Nile Delta, which has experienced noticeable agricultural growth through exploitation of groundwater resources.

The Government of Egypt seeks to augment direct and indirect investments by the private sector, being one of the pillars towards maintaining sustainable growth. While the government will continue to finance and operate most of the major water infrastructure, many end users and stakeholders are petitioned to promote participation of the private sector in financing, developing and operating the system especially at the local level. Egypt's Ministry of Water Resources and Irrigation is, with the assistance of the World Bank, implementing a major project in the West Delta area for PPP in irrigation, involving construction and operation of three major canals.

The Government has been reviewing options to replace groundwater with a surface water for irrigation system at the selected location. The goal is to minimize if not totally halt the depletion of the groundwater resource. However, there are a number of complexities in achieving this, since realistically the growers cannot be forced to connect to a new surface water system, particularly if they are expected

to pay for the cost of service. It is the Government's intent to fully recover the cost of the system and to introduce volumetric tariffs to ensure correct incentives to conserve and utilize water more efficiently.

Moreover, beyond its objective to achieve full cost recovery, the Government also wishes to identify practical ways of involving the private sector in the design, operation and even financing of the new system. While the Government fully endorses the project, it is also keen to transfer as much of the related risks and to assign maximum responsibilities of the operations, maintenance and loan amortization to a private operator. **The Design-Build-Lease (DBL) option with a capital contribution by the operator and participating farmers is considered as the preferred transaction model for the project area.** After constructing the system, the private operator would lease the system, paying a lease fee equivalent to the debt service of the Government, inclusive of fees charges for taking up the foreign exchange risk. Farmers are expected to buy into the project, knowing that amount of irrigation water used will in part be the basis for water conveyance fees. It is anticipated that a two part tariff structure will be imposed on connecting farmers which will further minimize demand risks and continued use of groundwater reserves: (i) a minimum flat fee per feddan that will fully recover the amortization cost of the infrastructure; and (ii) charge for the amount of irrigation water used that will recover the O&M and other variable costs of the operator in fulfilling his operational responsibilities.

Together with Chile and Morocco, Egypt will be one of three countries worldwide that adopt such a PPP initiative. Beneficiaries range from small holders to large land owners and investors, and have exhibited a predisposition to share costs of the new infrastructures, and pay tariffs at market rates for the private operator.

8. Groundwater Management in the MENA region

The Groundwater Management experiences in the MENA region possess unique successful elements from community-based water management and private sector involvement to affordable technology application as follows:

(i) **Yemeni Case:** Faced with the problem of rapid aquifer depletion in many parts of Yemen, the country has been tackling water management both from the top and the bottom. The GOY has legislated a new Water Law, strengthened institutions and reduced diesel subsidies. It also introduced a cost sharing program for helping farmers install an advanced irrigation system. Building on the successes of the project, the country is improving net water savings in aquifers and agricultural income per unit of water.

(ii) **Moroccan Case**: The case illustrates how groundwater irrigation can be profitable by producing high value crops for exports. However, it needs a sound management program for preventing rapid aquifer depletion. The private sector came in to rescue the operation by providing surface water from a dam along with the government. The PPP scheme is rather unique in the irrigation sector and contributes to good governance, transparency and information sharing among users, government and private sector.

(iii) **Egyptian Case:** The case presents a comprehensive groundwater resource assessment as well as monitoring and evaluation with the aid of state-of-the-art technologies such as satellite image analysis, web-based GIS database, geological survey and modeling. The approach illustrates the importance of data collection and sharing among stakeholders

for efficient groundwater management. The program also includes intensive capacity building and training programs for those in charge of groundwater management.

The key recommendations of these experiences would be (i) to strengthen the partnership approach for groundwater management including top-down and bottom-up measures, and involve key stakeholders from politicians to poor local farmers in water resources management, (ii) to increase agriculture value added per drop of water and promote private sector participation for irrigation sector along with the right incentives and mechanisms for water management, and (iii) to enhance groundwater assessment and M&E with the aid of advanced hydro-geological monitoring technologies and promote information sharing among stakeholders as well as strong capacity building programs.

9. The Role of Civil Society on IWRM in the Arab Region

A **number of civil society initiatives have made a contribution to IWRM approaches.** Mubarak industrial city, Quesna, Munofeya Governorate in Egypt was selected by the Egyptian Water Partnership (EWP) as an industrial area in which water resources are polluted by industrial, sewage, and solid wastes that of course have impacts on surface and groundwater resources. Planning and implementation started in November 2003. Improvement of the existing conditions of the water resources in the area was expected through water pollution prevention and abatement. Noweira village in Beni Suef governorate was selected for the low cost sanitation service coverage where 40 households of the poorest segment of the community had no sanitation coverage. The action was accomplished in March 2005. The technique of plant life to treat dirty drainage water heavily polluted with sewage, which then flows into the agriculture drainage was implemented. Demonstration of "plant-gravel-channel" as a low-cost and efficient method of treating large bodies of water in rural areas has been successfully achieved.

A second initiative was a national awareness campaign directed to the children about water issues, accompanied on ground action. The campaign started on 22 March 2005. And it was predictable to design and print awareness material directed to children ranged from 6 to 12 years old carrying the main objectives of the campaign to increase the children awareness and knowledge on Egypt's water resources, water scarcity and means for water conservation and water pollution and means for water quality protection.

One of the major difficulties is coordinating between different stakeholders including the Governor, relevant ministries, private sectors, local administration authorities, etc also searching for a financial aid was an obstacle, as we have to negotiate with different public and private donors to accomplish the local action. A cooperation protocol between EWP, Monofia Governorate, Ministry of Water Resources and Irrigation, Ministry of State for Environmental Affairs and Ministry of Youth, was signed, in which the partners agreed upon regular solid waste collection at the selected locations, Garbage bins were purchased and installed in the selected locations and plastic bags were purchased to be changed on daily basis.

Another cooperation protocol was signed between EWP and the Community Development Association of Noweira village, in which EWP developed a mechanism in a pilot area in the Noweira village for providing sanitation services that, produces effluents that comply with standards set for sewage disposal in agricultural drains. It includes a septic tank consisting of three chambers, chamber for anaerobic treatment and two filters. In addition, installing a pipe network for sanitation to connect the houses to the septic tank and to construct a pipe to connect to a "plant gravel channel" where it drains to "Gohar" drain thus providing low cost sanitation services. In the mean time, it drains good quality sewage into the agriculture drainage network, thus reducing the pollution load on the drains in the area.

10. Arab Integrated Water Resources Management (AWARE NET)

ESCWA and its partner organizations recognized the need to promote awareness about the importance of implementing IWRM and strengthening knowledge on the subject among water professionals and technical personnel in water-related ministries and public authorities. This was the basic idea behind the establishment of AWARENET (Arab Integrated Water Resources Management Network), which serves as a vehicle for promoting the implementation of IWRM on a wider scale and in a more systematic way throughout the ESCWA region. As a network of research and training institutions, AWARENET works on promoting principles of IWRM in the countries of the Arab region.

A regional network of stakeholders has also many advantages, namely:

- Identify and consolidate thinly spread regional knowledge and capacity;
- Effectively and efficiently disseminate knowledge and build synergy of action among stakeholders or network members, which is an empowering process;
- Stimulate regional communication and co-operation, which is a vital objective for ensuring a sustainable development process in the Arab region.

Since its establishment in March 2002, a constitution for the network was developed and membership has expanded to include 60 research and training institutions from 14 different Arab countries (Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Oman, Palestine, Saudi Arabia, Sudan, Syria, United Arab Emirates and Yemen). Several training and research programs have been initiated through AWARENET and are at different stages of implementation. Therefore, it could be said that the network serves as an effective vehicle for sharing knowledge, skills, experience and lessons learned related to sustainable water management among members.

11. Arab Regional Session for the 4th Forum

The AWC Regional Session will include diverse mediums, including poster exhibitions, creative performances, social and youth activities and cultural expressions on water themes in the MENA Region. The activities for this session seek to create awareness and provide a space for reflection of the Arab tradition and life. In addition, the MENA Regional Session will include opening remarks from the Ministers (from Vision to Action) that highlights the development needs based on water and lessons learnt from local actions in the MENA Region. This will also foster the interaction among stakeholders participating in the Forum. Finally, a dialogue among Ministers and Youth will be conducted to build channels of understanding, trust, and information transfer among the youth and the senior officials/ministers in the water sector nationwide.

The major objectives of the session are:

- To showcase actions that promote water demand management as an alternative to supply management, and push it higher on the agenda of policy-makers and stakeholders.
- To provide a platform for policy-makers to synthesize effective local actions for better management of water resources in the MENA region.
- To promote alternative mediums for communication and awareness-raising through performances, cultural expressions, posters and creative mechanisms.
- To open channels of communication, understanding and trust for improved knowledge exchange between youth and policy-makers.

12. Integration of climate change into the national water plan of Egypt

Quantitative information on water supply, demand and quality is needed for water resources planning. The natural boundary conditions typically determine the water supply and availability, while the socio-economical developments determine changes in water demand. The Lake Nasser Flood and Drought Control Project (LNFDC) is carried out at the Planning Sector of the Ministry of Water Resources and Irrigation of Egypt focusing on water management in Egypt and the water supply from upstream Lake Nasser. A complete chain of modeling tools has been brought together at one location, the Nile Forecasting Centre, which can be used for an integrated assessment of various changes in water supply and demand in the Entire Nile Basin. It helps in building up future scenarios to manage effects of foreseen changes in rainfall and evaporation patterns due to climate changes in the Nile basin as well as effects of upstream developments such as water saving projects and irrigation schemes.

The project is expected to define the risk margin that may be posed by climate change uncertainty, minimize flood and drought risks and water shortages, improve agriculture production and maintain infrastructure system. The project will contribute to knowledge sharing through organizing training courses either to the internal staff or to other staff within the ministry to build capacity and increase awareness.

13. Integrated Irrigation Improvement and Management Project (IIIMP)

Egypt is facing increasing challenges in the water sector which require the following three most critical tasks: (1) to increase the productivity of agriculture and the incomes of the rural poor in a sustainable manner; (2) to manage the looming water scarcity with the related water quality issues due to water-logging, salinity and degradation by pollution; and (3) to have a more systematic approach to the development of agricultural exports. Egypt recognizes that better water management is essential for maintaining

a viable agricultural sector while facing ever-increasing demands from other sectors of the economy.

The approach of water management is best improved by an integrated package of services and technical assistance that respond to user's demand. The components of the projects are: (1) preparation and implementation of IWRM plans in the selected command areas; (2) institutional development and capacity building through the proper establishment, expansion and scaling up of water user organizations, that function at the proper hydraulic units and establishment and mainstreaming of integrated water management organizations; (3) improvement and modernization of irrigation and drainage infrastructure; (4) environmental mainstreaming and implementation of environmental management plan to demonstrate how improvements in water quality can be achieved; and (5) improved on-farm water management. These activities will be implemented in two command areas of about 500,000 fed. in Lower Egypt, Nile Delta, (in Alexandria, Behira, Kafr El-Shiekh, and Gharbeia Governorates).

Expected results as presented in the feasibility studies of the project from an **economic** perspective are: (1) water savings (10%-30%); (2) increases in crop yields (up to 20%); (3) shift to more profitable cash crops; and (4) high returns, with the ERR=20.5% and NPV=U$ 141 million. From the **social** perspective: (1) farmers recognize the benefits of Mesqa improvements; (2) reducing the disputes among farmers throughout WUOs; and (3) improving the conditions of rural communities. From the **environmental** perspective, the overall environmental impact of the IIIMP is expected to be positive, leading to improved land and water management in the Nile delta.

The rehabilitation of the irrigation and drainage infrastructure will help maintain the water table at a low level, prevent water logging and soil salinization, and increase overall water use efficiency. The on-farm irrigation component will lead to more efficient and productive use of irrigation water, as well as to increased yields, evolving from the introduction of "continuous flow (on-demand)" irrigation at the tertiary canal and branch canal levels. The integration of water resources planning and management within the MWRI and the development of WBs and WUAs at the district, branch canal and tertiary canal levels will strengthen overall water and land management at the local level.

14. Closed loop sanitation in Syria: Pilot implementation of a constructed wetland

The construction of the pilot constructed wetland (Reed bed system) started in April 1999 and came into operation in November 2000. The pilot plant serves the village of Haran Al-Awamied, in the Governorate of Rif Damascus, Syria. The village is located 40 km south east of Damascus. It has a semiarid climate, with 185 mm rainfall per year, falling within a four month period. This place fulfilled all the criteria such as disposal channels, wastewater quantity and enough room for building and expanding the project. Before the installation of the constructed wetland, wastewater was collected by a network of gravity sewers and used untreated for irrigation.

The concerns of local authorities about introducing a new technology represented an initial difficulty, as did protests from local farmers who believed they would be deprived of the untreated wastewater for irrigation. The plant involved the installation of a combined public sewer system in Haran Al-Awamied for the collection of rain and wastewater. This water is transported to a wastewater treatment plant, which has the capacity to treat the wastewater of 7000 inhabitants. The plant consists of:

- Pre-treatment (bar screens, primary sedimentation tank)
- 2-reed beds (68 m x 22 m x 1.5 m) for wastewater treatment
- A reed bed (20 m x 10 m x 1.8 m) for sludge treatment
- A 150 m^3 collection tank for treated water for irrigation purposes.
- Total Project Scale: 7000 inhabitants (80% connected) 300 m^3/d housing wastewater
- Specific reed bed surface per inhabitant: 0,5 m

Each of the reed beds for wastewater treatment is 68m long, 22 m wide and 1.5 m deep. They are clad with PVC plastic seal foil 1 mm, and are filled with layers of gravel and sand, with gravel forming the upper and lower layers. The wastewater is distributed onto the upper gravel layer and collected through drainage in the lower layer. The treatment plant reaches a good efficiency after reed had grown.

The target value for the design of the wastewater disposal system was 42 l per person and day. It operates at a capacity of 300 m^3/d and the treated wastewater fulfilled the irrigation water quality set according to the Syrian Arab Organization for Standardization and Metrology (SASMO) data line "based on the WHO data line".

The treated water is collected in a tank and pumped to irrigate the agriculture near the plant. Thus the effluent from the wetlands is still used by the farmers. To avoid salinization of the soil, the use of mineral fertilizers is strictly controlled. The farmers were instructed to use fresh water and treated wastewater alternately for irrigation.

15. Assessment of the status of the Integrated Water Resources Management (IWRM) Plans in the Arab Region

Responding to the World Summit on Sustainable Development held in Johannesburg in 2002 that called for developing integrated water resources management (IWRM) and water efficiency plans for all countries by 2005, with support to developing countries, the United Nations Development Programme (UNDP) is conducting through its comprehensive programme in water governance together with the Arab Water Council (AWC) and CEDARE, a review to constitute the mandatory first step(s) to further design, develop and implement such plans in the Arab region.

Some Arab countries including Egypt, Jordan, Yemen, and Palestine have approved national water resources plans. Other countries have developed frameworks, which contain elements of policy, in the form of strategy or master plan. In general, Arab countries are beginning to recognize the importance of an integrated approach to water management. Political will and commitment that are motivated with enough awareness and backed with sufficient capacity building are key elements that determine the capabilities of governments to formulate integrated water resources management plans by 2005 and to further implement them.

In most of the Arab countries awareness of formulation, development, and implementation of IWRM plans as required by WSSD target is lagging and in several cases lacking. The following strategic entry points have been identified to address the water challenges in the region:

- Institutional Strengthening of the Arab Water Council.
- IWRM Plans Development Program.
- IWRM Plans Implementation Program.
- Regional Program for Water MDGs in the Arab Region.
- IWRM Capacity Building Program for Governments & Civil Societies.
- IWRM Capacity Building Programs for UNDP COs.
- Arab Water Facility.
- State of the Water Report in the Arab Region.

WATER SUPPLY AND SANITATION FOR ALL

16. Application of Novel Demisters in MSF

Demisters scaling was faced after 3 to 4 months in the MSF units commissioned in 1999 in Al-Khobar Desalination Plant in Saudi Arabia, Eastern Region. This problem was understood and there were several case studies to eliminate or reduce the scaling. Most of the trials were failed, a new type of demister was tried for the first time in desalination industry which gives an impressive result. The results revealed that the demister scaling was reduced tremendously. This enabled the unit to be operated for a long period of time i.e. more than 2 years with good quality of water production eliminating unit shutdowns and reducing demister acid cleaning. This influenced operation and maintenance costs.

17. An Optimal High Recovery, Energy Efficient, Dual NanoFiltration (NF) Seawater RO Process

The pioneering work done at Saline Water Conservation Corporation (SWCC) R&D Center of coupling NF membrane pretreatment with conventional seawater desalination processes (thermal, membrane) led to development of new,

high efficiency di-and tri-seawater desalination hybrid processes, and made it possible to operate conventional desalination processes at higher efficiency than was feasible prior to this award winning, patented invention. The NF membrane pretreatment overcomes the major problems encountered by the various conventional seawater desalination processes membrane or thermal, since it: (1) prevented SWRO membrane fouling by the removal of turbidity and bacteria, (2) prevented plant scaling by removal of scale-forming hardness ions and (3) significantly lowered required pressure and energy to operate the SWRO plant by reducing TDS of seawater feed, performing primary desalination step. Results of this pioneering applied research program lead to increasing the recovery ratio of SWRO membranes as well as reducing the water production cost to competitive levels.

The calculated results reveal that operation of SWRO plants at different recovery ratios induce significant change in their energy consumption, e.g., compare energy consumption of Jubail SWRO plant at recovery ratios of 28 and 35%. Operation of the NF-SWRO hybrids reduces the energy consumption from 6.87 and 5.5 KWh/m^3 when Jubail SWRO plant is operated with ERD reverse pump to 4.63 and 3.75 KWh/m^3 in the hybrid NF2 – SWRO1 and NF2 – SWRO2, respectively.

WATER MANAGEMENT FOR FOOD AND THE ENVIRONMENT

18. Integrated and participatory approaches to irrigation and drainage planning

Irrigation and drainage are facing several challenges that are reflected in the declining trend of investments in the sector by the governments and the financing institutions during the past two decades. This may lead to serious consequences on the future demands of the world's population for food and fiber. One of the main challenges is the lack of an integrated perspective in planning and management. Another challenge is the need for significant institutional reform of the sector towards decentralization, participation, financial sustainability, and inter-sectoral coordination. The World Bank developed a framework for integrated planning known as DRAINFRAME. Although it was formulated from a drainage perspective, the approach applies to any water management interventions targeting integration of resources management and was used for preparing some recent projects in Egypt and a master drainage plan in Pakistan during the past three years. The objective was to carry out a comprehensive analysis of the effects and impacts of the proposed interventions on the functions of the resource systems at basin level and engage the stakeholders in a discussion of benefits, costs, and tradeoffs.

The main difficulty in applying an integrated approach is the lack of institutional arrangements and multidisciplinary capacity which can support the concept of integration. The concept of integration with its technological, institutional, and legal dimensions is still unclear in the mind of many of the involved stakeholder. A methodology that could put the concept into practical application is needed. Implementation of integrated planning approach helps in identifying the boundaries of the region or basin in which effects and impacts are expected. It also identifies many functions (other than agricultural production) and their stakeholders within the basin who can be affected positively or negatively by the project. It shows how stakeholders value those impacts and give them the opportunity to share the cost and benefits. It further identifies the institutional gaps in the existing arrangements.

The action took place within the framework of the following activities:

- **Rapid Assessment**: The feasibility studies of the integrated irrigation improvement and management project in the Mahmoudiya Command Area (120,000 ha), Egypt.
- **Rapid Assessment**: The preparation of drainage improvement and relate water management plan, Kotri Left Drainage Basin, Sindh Province, Pakistan.
- **Complete analyses**: The planning of the water conservation and irrigation rehabilitation project (116,000 ha), West Delta, Egypt.

The local action reported is the one carried out within the framework of the West Delta Project where the application of the approach was considered as integral part of the project preparation process. The project itself is promoted as a public-private partnership based on full cost recovery of the capital cost and operation and maintenance. It will be managed by private operator who will charge the users on volumetric basis. The conceptual design of the project is based on a Build-Design-Lease (BDL) transaction model. The implementation of DRAINFRAME approach lead to the following outcomes:

- problems and opportunities identified with and without the proposed intervention;
- project alternatives which could maximize the economic and social outcomes, while protecting key ecological functions in the basin are considered;
- consultation with stakeholders about the impact of the proposed interventions on the functions of the natural resource systems both "on-site" and "off-site" the project area;
- necessary mitigation or compensation measures for any identified residual impacts are identified;
- review the existing institutional arrangements and identify reform actions towards reliable service delivery; and
- provide input for preparing for further project preparation.

The study identified the social, economic and environmental impacts on the downstream areas as well as in the old lands (areas currently irrigated by the Nile water in the Delta) which could be affected by the diversion or reallocation of surface water. The study showed that short and long term plans to make the required water supplies available for the project area should be timely implemented otherwise the project could have negative impacts on other lands outside the project area and their stakeholders (e.g. salinization of soils, loss of crop yield, loss of jobs and income, etc). Analyses showed that conjunctive use of surface and groundwater has several advantages over the strategy of designing a surface system. These advantages include a lower average tariff for surface water, higher overall economic benefits, and more job opportunities. It also showed that phasing the implementation of the project into smaller areas rather than doing it all at once could provide time to GoE to implement the necessary water saving measures elsewhere in the Nile irrigation system to secure the project supplies.

19. Capacity Building in the MENA Region (INWENT)

Reform of the water sector requires not only the adoption of an Integrated Water Resources Management and of modern water policy guidelines, but the promotion of regional and international cooperation as well. Participation of all stakeholders concerned is another core element for keeping the region's waters flowing. This includes capacity building and empowerment of the public and private sectors as well as community organizations to realize and fulfill their roles .

InWEnt-Capacity Building International, acting on behalf of the German Federal Ministry for Economic Cooperation and Development, has formulated a four-year Program on Capacity Building in the Water Sector for the MENA Region, focusing on eight countries: Egypt, Morocco, Algeria, Tunisia, Jordan, Palestine, Syria and Yemen, to contribute to water sector performance improvement by providing widespread capacity building measures. Altogether about 40 activities are planned. The total financial volume will be 7,2 Mio. Euro. The objective is to support reform processes which make a significant contribution to a sustainable use of water resources and to combat poverty. In order to achieve this objective, we strengthen technical and methodical competence and aim at building platforms for regional cooperation. Our target is to connect experts and decision-makers working on different levels and actors of civil society through the **establishment of lively networks**. Thus, we encourage further dissemination and public awareness on water issues in the region.

The outputs of the program will include the improvement of human and organizational performance of the water sectors concerned, the awareness of policy-makers of the priority issues involved, and a **functional regional network within the MENA Region.** These outputs should be achieved by a regional and systemic capacity building approach. Being complementary to each other, the training components continuously strengthen and broaden the stream of knowledge. Starting point is the improvement of knowledge (component 1 – **technical knowledge**), which component 2 **"methodological competence"** prepares to anchor methodically. Component 3 **"regional cooperation"** is the platform to exchange knowledge on a regional level, whereas component 4 on **"needs assessment"** is the base for evaluation and modification of the capacity building offer from a regional and international point of view. Component 5 **"public relation and awareness"** relies on the former components and disseminates knowledge for the public on a local level, which component 6 **"best practices"** does for professionals of the international water community.

20. Water User Organizations: Partners in Integrated Water Resources Management in Egypt

Among the various measures undertaken by the Ministry of Water Resources and Irrigation in Egypt to meet the water scarcity challenges is the activity to decentralize water management and actively promote users' involvement in water management. Although traditional forms of user involvement in water management have always been present in Egypt, the formal incorporation of the concept in the Government's policy is new. Since 1999 the MWRI has piloted the concept of involving users' organizations in water management at many locations. Now the concepts are ready for broad application and the activity covers the Nile Valley and the Nile Delta and in an adapted form in the areas beyond.

Users are organized at three levels: the Mesqa (tertiary canal) level, Branch Canal (secondary canal) level en District level. At the Mesqa the Water Users' Association (WUA) involves farmers (irrigators) only and deals with the day to day operation and maintenance of the tertiary canal and its pump. The Branch Canal Water User's Association (BCWUA) also involves other water users, such as residents and non-agricultural water users (poultry and dairy farmers, small industries etc.) and deals with water management in a broader sense that includes irrigation, drainage, environmental issues, etc. The District Water Board coincides with the lowest MWRI organizational level, the Irrigation District.

The challenges that are faced while introducing the concepts of user participation in water management are:

- History of centralized water management by the MWRI;
- No local experience on community mobilization for common action;
- Limited availability of capacity for community mobilization;
- Inadequate legal framework for water users' rganizations;
- The interdependency of the low-level systems through the single source of water (Aswan Dam and River Nile) because of which the various user organizations can never hope to achieve full autonomy.

Nevertheless, the pilots for user involvement in water management clearly indicate the potential for reducing wastage of water, improving the equity in water distribution, reduction of water pollution, and increasing the efficiency of O&M expenditures. In all, user involvement is proving to contribute to improving living conditions in rural Egypt.

21. Reclamation of salt-affected and waterlogged areas in Abu Dhabi

Salinity and waterlogging affect many agricultural coastal areas in Abu Dhabi. Lack of rainfall combined with absence of natural drainage resulted in accumulation of brackish irrigation water in natural depressions and subsequent rise of soil salinity. In some areas, these problems appeared in just two years of operation, and agriculture was abandoned in severely affected farms. Owing to the success of the reclamation activities in a 55 ha pilot area in another agricultural area, Abu Dhabi Municipality requested the International Center for Biosaline Agriculture (ICBA) to perform a hydrogeology investigation and develop concept designs for two additional farming areas, Al Nahda and Al Shahama.

The Concept design developed by ICBA was implemented and contracting activities were completed in 2004. Drainage water outflow was diverted for re-use. Salinity monitoring conducted by a third party revealed that drainage water salinity dropped from 12 dS/m to 2.5 dS/m. The productivity of affected farms was restored in just three months. The hydrogeology investigation and concept design developed by ICBA helped reduce the cost significantly, while maintaining the effectiveness of the system. The affected areas were brought back into production.

The same principles were adopted in Saudi Arabia and Oman. Performing a hydrogeology investigation prior to installation of drainage proved to be an effective measure in significantly reducing the overall cost. Recycling saline water provided an additional water resource for crop production and trees plantation.

22. Research to demonstrate potential for improving on-farm water use efficiency and the use of non-conventional water resources in irrigated agriculture in Tunisia and Egypt

The improvement of water use efficiency is possible through the implementation of deficit irrigation management strategies, better scheduling of water supply, introduction of "ACQUACARD" system for monitoring of water supply, etc. Moreover, the use of non-conventional water resources represents an additional water source in irrigated agriculture in order to save water for other uses.

The local actions are based on the activities of the partners of the Collaborative Irrigation Network of CIHEAM/IAMB which translate the ideas, conclusions and recommendations of the Network activities to actions on the ground in MENA region.

Three examples show the work of CIHEAM/IAMB: (1) deficit irrigation of orchards with low quality water in Mornag area (Tunis, Tunisia) in cooperation with INAT (Tunisia) and local Water User's Associations; (2) improvement of irrigation systems performance and water use efficiency in Ghezala Irrigation District (Tunisia), in cooperation with IRESA (Tunis, Tunisia) and local Water User's Associations; and (3) re-cycling of drainage water for sustainable irrigated agriculture in Behira Governorate (Western Nile Delta, Egypt), in cooperation with the National Water Research Center (Cairo, Egypt) and local water user associations.

(1) Deficit irrigation of orchards with low quality water in Mornag area (Tunis, Tunisia) in cooperation with INAT (Tunisia) and local Water User's Associations. Fruit trees cover about 40% of the irrigated lands and represent an important component of the productive farming system in the country. However productivity is usually low and irrigation with waters having more than 1.5 g/l total dissolved solids is commonly practiced without provision of drainage and consequent high salination hazard in irrigated orchards. Any strategy that may help to save water and control salinity, while producing more fruits, is needed. In the absence of a drainage system, techniques based on irrigation restrictions - Regulated Deficit Irrigation (RDI) - has been used successfully. RDI is based on the concept that water supply can be reduced to control vegetation growth during specific periods of the season, while fruit growth remains little or not at all affected.

(2) Improvement of irrigation systems performance and water use efficiency in Ghezala Irrigation District (Tunisia), in cooperation with IRESA (Tunis, Tunisia) and local water user associations. Existing large-scale pressurized irrigation systems in the selected area operate at low performance level, with consequent high water losses and wastage. The research is carried out at district scale considering meteorology, hydrology, cropping system and physical characteristics of the network to calculate the saved water yield in relation to the net water balance of the irrigation scheme in the frame of different climatic, hydrological and cropping scenarios. The result has been to demonstrate that water can be saved by improved technology and by better irrigation scheduling.

(3) Re-cycling of drainage water for sustainable irrigated agriculture in Behira Governorate (Western Nile Delta, Egypt), in cooperation with the National Water Research Center (Cairo, Egypt) and local water user associations. National Water Research Centre of Egypt initiated a long term management programme on a small scale perimeter located in the central delta with 30 farmers in an area of 26 ha. The aim of this research is to overcome factors that threaten the sustainability of agricultural production in Egypt. Trials (with such variables as water quality and quantity, inputs, irrigation systems and crop rotation are conducted on the farm level, testing different management practices and monitoring their impact on the soil, crop yield, and groundwater pollution.

23. Supplemental irrigation for improved rainfed wheat yield and water productivity in Syria

Rainfed wheat is an important contributor to food security of Syria. However, due to low precipitation and suboptimal distribution, rainfed yields and water productivity are very low. The consequences are farmers in the rainfed areas having low and unstable income.

The objective of this initiative, by ICARDA, is improved and more stable rainfed wheat productivity in Syria

through the development and transfer to farmers in rainfed areas of improved supplemental irrigation technology in an integrated package. Supplemental irrigation is the application of limited amounts of water to rainfed crops in critical periods, when rainfall cannot provide sufficient moisture for the crop, to improve and stabilize yields. Research work at ICARDA had shown great potential for this technique in Syria and the Middle East. Yields and water productivity was substantially increased with little water and cost. ICARDA and partners in the national program in Syria had developed a supplemental irrigation package to be transferred to farmers in rainfed areas. The package included 1) optimal irrigation scheduling (timing and amount), 2) deficit supplemental irrigation, 3) improved germplasm and 4) nitrogen fertilization. The package has been demonstrated to farmers against conventional rainfed strategies at several locations in Syria since the early 1990s.

The farmers' fields were divided into four parts to compare various strategies. One part included traditional rainfed practice the second application of the full supplemental irrigation package, the third application of deficit supplemental irrigation package at 50% of the crop water requirement, and the fourth included farmers traditional irrigation. Rainfall, irrigation and crop growth was monitored together with the farmers and final yields were determined. Field days were organized over the growing season and at the end of the season with all farming community observing the fields.

Across all locations and over the seasons the improved package of deficit SI increased farmers' production by over 130%. Full and traditional SI added 70% and 50% over rainfed system, respectively. Farmers had no doubts about the benefits of the improved technologies. However, the availability and cost of water for SI govern the adoption of the deficit irrigation option. It was clear that when water is limited and costly farmers tend to apply deficit irrigation and get higher income. The supplemental irrigation technique together with the improved package of scheduling, improved germplasm and nitrogen application has been adopted on a large scale in wheat rainfed areas of Syria and had a great impact on people's life in these areas.

24. A study on virtual water in Egypt

In light of water scarcity in Egypt, food security becomes one of the major challenges of the country. It must be noted that food security does not mean self-sufficiency. Food security is determined by the ability of a country to ensure that all people at all times have both physical and economic access to fulfill basic food needs. This definition has four dimensions for food security. These are: food availability either from domestic production or/and imports, stability of food supply within season and between seasons, accessibility to all segments of the population through distribution systems and reasonable prices and food affordability.

Within the framework of the above, a study for the assessment of virtual water within the imports and exports of agricultural products of Egypt was carried out. The assessment helped to recommend improved agricultural policies by studying the water intensity of Egypt's agricultural trade. It also provided an overview and valuation of the quantity of virtual water for different agriculture products through exports and imports. As a result, improved agricultural policies can be designed, aimed at food security, water savings, and better economic and social benefits from available water resources.

RISK MANAGEMENT

25. EMWIS: a Mediterranean-wide network of water resources knowledge

In order to build an effective cooperation and exchange of know-how, the ministries in charge of water of the Euro-Mediterranean Partnership (35 countries: 25 European Union members and their 10 Mediterranean partners) decided to set-up a regional information system by linking national systems. Each country is financing its own system, harmonizing the exchange of information between the stakeholders and implementing the regional recommendations that will guarantee interoperability.

EMWIS thus provides a unique point of access to all the relevant inland water information for each country to a consistent standard and high quality. This has led to better cooperation and information flow between all national stakeholders (who are at once providers and users of information). The system also provides indicators for monitoring effective implementation of national policies and international agreements (MDG, Sustainable Development), better participatory approach thanks to the sharing of information, responsiveness to the expression of needs and requirements, and the opportunity for public consultation between all the stakeholders: public administrations, user associations, private sector.

26. Water sector capacity building in Palestine

Water scarcity induces severe over-extraction of groundwater (almost the only water source in Palestine) in some areas like the Gaza Strip. Palestinians are demanding a larger share of the West Bank water resources, as most of the water is transported to Israel. Non- conventional sources of water that include treated wastewater and desalinated water will be introduced in Palestine to be used in the agricultural and domestic sectors respectively. However, there is still a long way to go to build capacity within water sector institutions to be able to manage and run investment projects, a need that goes hand in hand with the Palestinian Water Authority's strategic plan to restructure the water sector.

The estimated number of employees working in the sector is about 1500. The range of expertise required and the related training needs are huge, ranging from very basic training of technicians and field workers to very high level of technical and leadership training for high management levels. The expected assistance needed will be both local and international.

One of the entities through which training is provided in Palestine is the Birzeit University (BZU). A project was undertaken (1996-2001) for the development of capacity of both teaching and research staff of the BZU, and to upgrade facilities and equipment. In addition, an Institute of Water Studies (IWS) was established within BZU (2002-2004), in order to achieve a multidisciplinary approach of the sector problems in the educational MSc programmes, to perform research and generate income from consultancy work, research assignments, and tailor made courses that would meet the immediate needs of the water sector. This Institute now has an autonomous role as a collaborating center with links to knowledge providers in the Middle East.

27. Methodology for assessment of the development potential for groundwater in wadi systems

Typical of much of the region, the Eastern Desert of Egypt is a hyper arid area characterized by a dense network of dry wadi systems formed long ago. The region is subject to some sporadic precipitation occurring over mountainous areas, particularly close to the Red Sea shore, which is channeled throughout extensive watersheds as surface runoff and subsurface groundwater flow. Rainfall is characterized by a relatively high intensity of precipitation over short time duration (2-4 hours), and with a relatively long return period. The rain eventually translates into flash flood events Within these watersheds, networks of minor wadis join into main wadis which ultimately drain into the Nile or the Red sea. Because some of the watersheds collect precipitation over large areas and channel it through a few main wadis, substantial amounts of freshwater could potentially recharge the alluvial aquifers underlying the wadis. Moreover, ancient precipitation resulted in creation of a deep fossil water aquifer (currently known as the Nubian Sand Stone Aquifer). The opening and stretching of the Red Sea resulted into a system of NW trending faults which act as connectors between the deep aquifer (which may reach over a 1000-m depth) and the shallow aquifers of 100 m depth at several planes and locations within the Eastern Desert. A third lime stone aquifer (Carbonate Aquifer) also exists. Current groundwater us is haphazard and uncontrolled and presents a hazard to rational economic management.

Cairo University, together with Egypt's National Water Research Center, is leading a UNDP/GEF-funded targeted research project to develop replicable models for integrating groundwater resources of watersheds into national water budgets in arid regions. Tasks include: rainfall analysis and prediction of design storms; geo-chemical and isotopic analysis of groundwater samples to determine its age, source, and potential for recharge; soil sampling and infiltration tests; remote sensing tasks to develop co-registered mosaics for geology, land use, soil, and elevations of the entire Eastern Desert of Egypt; surface water modeling for all major wadis and computation of recharge to quaternary basins; geophysical tests and groundwater modeling; and exploration of development scenarios.

The program applies concepts of wadi hydrology rather than resorting to traditional hydrological approaches, which are mainly developed for temperate regions. It applies state of the art technologies for data collection, data analysis, prediction of hydrogeological responses, scenario management, and information handling.

The output of the project is an integrated methodology for assessing and estimating groundwater quantities, quality and sustainable utilization in wadi conditions, developed and tested for the case of the Eastern Desert of Egypt. This has allowed potential locations for shallow wells to be mapped across the whole desert. The methodology has good potential for replication in many Arab and MENA region countries.

28. Management of Water Quality in Mashreq and Maghreb Countries

The objective of the project is to enable countries in the region to improve water quality monitoring and dissemination of information by providing relevant data and information to institutions and decision makers. This is expected to allow development of a water quality monitoring management strategy for Mashreq and Maghreb countries The METAP program is formulated in five packages, namely:

1. Policy Coordination;
2. Legal and Regulatory Coordination;
3. Institutional Coordination;
4. Private Sector Participation;
5. Monitoring and Information Dissemination.

The National Water Research Center (NWRC) of the Ministry of Water Resources and Irrigation, Egypt has been selected as METAP's Consultant for this project. Consulting services will be provided to the following eight beneficiary countries: Algeria, Jordan, Lebanon, Libya, Morocco, Palestinian Authority, Syria, and Tunisia. Water quality monitoring guidelines applicable to Mashreq and Maghreb countries are proposed. The implementation of these WQM guidelines is expected to achieve the following results:

- Accurate and reliable water quality data coverage (in terms of space and time);
- Improved access and dissemination of water quality information and its guidelines by and to stakeholders in forms that are suitable for influencing policy dialogue;
- Increased public awareness on water quality issues; and
- Improved water quality management.

29. Re-use of oilfield wastewater for agro forestry using natural wetland treatment systems in Oman

Petroleum Development Oman (PDO) produces around 250,000 m^3/d of saline process water along with oil production, which must be disposed of. This water contains oil residues along with some heavy metals. In order to maximize re-use and minimize environmental impact, a research and development programme was carried out, resulting in the selection of biological treatment through natural wetland treatment systems as the most promising alternative. In this approach, a combination of physical and microbiological mechanisms are responsible for the removal of pollutants. A pilot wetland treatment system based on reeds (Phragmitis australis) has been constructed in southern Oman in April 2000 to investigate treatment and disposal of process water. The reed bed system was made up of two trains (beds in series) each containing four beds to undertake two basic functions; removal of the residual oils and heavy metals, and reduction of the volume of water using evapo-transpiration. The reed bed system works to degrade hydrocarbons by the action of soil dwelling microbes. It can absorb heavy metals through the physico-chemical action of the soil, by the precipitation of metal sulphides around the plant roots, or by direct absorption into the plant tissues.

Oil-contaminated water is filtered in the reed beds and subsequently used to irrigate biosaline trees and bushes. The pilot has demonstrated successfully the viability of this concept and an invitation to tender has been issued for the construction and operation of a 45.000 m^3/d treatment facility.

6. MAIN ORGANIZATIONS AND INSTITUTIONS
that offer technical and financial support to water issues

There are many water-related technical and financing organizations in the Arab Region, with national, regional or sub regional coverage. The following table lists in alphabetical order, some of the well-known organizations with a regional or sub regional reach.

No.	ORGANIZATION	OBJECTIVES	ASSISTANCE	HEADQUARTERS	CONTACT	TELEPHONE	E-MAIL AND WEBPAGE
1	Arab Economic Unity Council	Promoting unity and integration in Economic fields within the Arab region	Technical Assistance	Egypt	Dr. Ahmed Goueli, Secretary General	+202 575 5321	mahacaeu@yahoo.com www.caeu.org
2	Arab Fund For Social and Economic Development (AFESD)	Social and economic development in the Arab region	Technical Assistance and financing	Kuwait	Abdel-latif Al Hamad		
3	Arab Gulf Programme For United Nations Organizations (AGFUND)		Technical Assistance and financing	Riyadh, Saudi Arabia			
4	Arab Network for Environment and Development	Promoting coordinated activities of NGOs in environment and Development in the Arab region	Assistance in Networking of NGOs	Cairo, Egypt	Emad Adly, President	+ 202 516 1519	aoye@link.net
5	Arab Organization for Agricultural Development (AOAD))	Promoting agricultural integration in the Arab region	Technical Assistance	Khartoum	Dr. Salem Al-Lozy, General Director	+249 11 472 476	info@aoad.org
6	BUSHNAK GROUP	Consultancies for development	Technical Assistance	Jeddah, Saudi Arabia	Sir K Dwight Venner, Governor	+869 465 2537	info@eccbcentralbank.org www.eccb-centralbank.org
7	Cairo University	Education, capacity building and research	Technical Assistance and applied research	Egypt	Dr. Ahmed Wagdy, Professor	+202 573 2948	awagdya@yahoo.com
8	Canadian International Development Agency (CIDA)	Aid for development worldwide	Technical Assistance and financing	Canada	Aly Shady, President	+1 800 230 6349	info@acdicida.gc.ca www.acdi-cida.gc.ca
9	CARE	Worldwide reduction of poverty.	Technical Assistance and financing for water supply, sanitation and development	USA With country offices	Scott Faiia, Director of Egypt office		info@care.org www.care.org
10	Centre for Environment and Development of the Arab Region and Europe (CEDARE)	Capacity building in environment and development in the Arab region	Capacity building and technical assistance	Cairo, Egypt	Dr. Nadia Ebeid, Executive Director	+202 451 3921	mail@cedare.org www.cedare.org
11	CIHEAM/Bari	Capacity building and research in agriculture	Technical Assistance	Bari, Italy	Atef Hamdy, Director of research	+39 080 46 06 221	hamdy@iamb.it

No.	ORGANIZATION	OBJECTIVES	ASSISTANCE	HEADQUARTERS	CONTACT	TELEPHONE	E-MAIL AND WEBPAGE
12	Darwish Consulting Engineers	Consultancies in water projects	Technical Assistance	Cairo, Egypt	Raouf Darwish, chairman	+20 2 258 1559	raoufdarwish@dceltd.com
13	Egyptian Holding Company for Water and Wastewater, Egypt	Water supply and sanitation services	Services	Egypt	Dr. Abdeloui Khalifa	+20 2 392 9830	akhalifa46@hotmail.com
14	Egyptian National Committee for Irrigation and Drainage	Effective irrigation / drainage management	Technical Assistance	Cairo, Egypt	Dr. Hassan Amer, chairman	+20 2 446 4626	encid@link.com.eg
15	EUROPEAN INVESTMENT BANK (EIB)	Financing development projects	Financing water projects				
16	German Development Agency (GTZ)	Aid for development worldwide	Technical Assistance and financing	Germany, with country offices		+49 6196 79-0	info@gtz.de www.gtz.de
17	Global Environmental Facility (GEF)	Financing globally relevant environmental programs	Technical Assistance and financing	USA	Leonard Good, CEO & Chairman	+202 473-0508	secretariat@TheGEF.org www.getweb.org
18	Global Water Partnership (GWP)	Fostering IWRM worldwide	Technical Assistance	Sweden	Emilio Gabbrielli, Executive Secretary	+46 0 8 562 51 900	gwp@gwpforum.org www.gwpforum.org
19	International Center for Agricultural Research in the Dry Areas (ICARDA)	Cooperation in agricultural research in the region	Technical Assistance	Syria	Dr. Adel Elbeltagy, Director General	+963 21 2213433	a.el-beltagy@cgiar.org
20	International Center for Biosaline Agriculture (ICBA)	Research in biosaline agriculture	Technical Assistance	Dubai, UAE	Dr. Faisal K. Taha, Director of Technical Programs	+971 4 3361 100	f.taha@biosaline.org.ae
21	International Development Research Center (IDRC)	Research in development issues worldwide	Technical Assistance and financing	Canada, with Middle East and North and North Africa office in Egypt	Dr. Lamia El Fattal, Senior Officer	+202 336 7051	lelfattal@idrc.org.eg
22	International Water Resources Association	Cooperation in water resources worldwide	Technical Assistance	Canada	Aly Shady, President	+1 819 994 4098	aly_shady@acdi-cida.gc.ca
23	InWEnt – Internationale Weiterbildung und Entwicklung (Capacity Building International, Germany)	Capacity building	Technical Assistance	Germany			
24	Islamic Development Bank	poverty reduction and development in Islamic countries	Financing	Jeddah, Saudi Arabia	Karim Allaoui, Water Resources Specialist	+966 2 646 6920	kallaoui@isdb.org
25	Japan International Cooperation Agency (JICA)	Aid for development worldwide	Technical Assistance and financing	Japan With country Offices	Sadako Ogata, President	+81 3 5352-5311/5312/ 5313/5314	jicagap-opinion@jica.go.jp www.jica.go.jp
26	JAPAN WATER FORUM		Technical Assistance	Japan			
27	King Fahd University of Petroleum and Minerals	Education and research	Technical Assistance	Saudi Arabia	Dr. Waleed Abdel-Rahman, professor	+ 966 3 860 2895	awalid@kfupm.edu.sa

No.	ORGANIZATION	OBJECTIVES	ASSISTANCE	HEADQUARTERS	CONTACT	TELEPHONE	E-MAIL AND WEBPAGE
28	Kuwait Institute for Scientific Research	Scientific research	Technical Assistance	Kuwait			
29	Middle East Desalination Research Center	Desalination research studies	Technical Assistance	Oman			
30	Observation Du Sahara Et Du Sahel (OSS)	Studies in sahara region of Africa	Technical Assistance	Tunisia			
31	Swiss Agency for Development and Cooperation	Aid for development worldwide	Technical Cooperation and project funding	Switzerland			
32	The Royal Netherlands Embassy in Egypt	Aid for development worldwide	Technical Assistance and project funding	Embassy in Egypt	Dr. Tarek Morad, Deputy Head of Economic Affairs Development Cooperation Division	+202 739 5500	
33	The World Bank	Financing development worldwide	Technical Assistance and financing	USA With country Offices	Inger Anderson, Director, Water, Environment, Social and Rural Development Department	+1 202 473 1760	IANDERSEN1@ worldbank.org www.worldbank.org
34	UN Economic and Social Commission for West Asia (UN-ESCWA)	Cooperation for socio-economic development in the region	Technical Assistance	Lebanon	Dr. Hosny Khordagui, Water team leader	+961 1 978 527	Khordagui@un.org
35	United Nations Development Program (UNDP)	Aid for development worldwide	Technical Assistance and financing	USA With country offices	Elly Kodsi, UNDP RBAS		www.undp.org
36	United Nations Educational, Scientific and Cultural Organization (UNESCO) Cairo Office	Cooperation for education and science issues worldwide	Technical Assistance and financing in water	France, with regional office in Egypt	Dr. Mohamed Abdulrazzak, Director of UNESCO Cairo Office and Regional Bureau for Science in the Arab States	+202 794 5599	mabdulrazzak@mail.unesco.org.eg
37	United Nations Environment Programme (UNEP)	Cooperation in Environmental issues worldwide	Technical Assistance	Kenya with regional office in Bahrain	Dr. Habib Elhabr, Regional Director	+973 178 12777	habib.elhabr@unep.org.bh www.unep.org
38	United Nations Food and Agricultural Organization (FAO)	Worldwide cooperation for agricultural and watershed management issues	Technical Assistance	Italy With regional offices	Jacques Diouf Director-General	+39 06 57051	FAO-HQ@fao.org www.fao.org
39	United Nations University (UNU)	Capacity building	Technical Assistance	Canada with regional in UAE	Dr. Waleed Saleh, Regional Coordinator	+971 429 77741	wsaleh.uni-inweh@nchrd.gov.jo
40	United States Agency for International Development (USAID)	Aid for development worldwide	Technical Assistance and financing	USA With country offices	Andrew S. Natsios, Administrator	+1 202 712 4810	pinquiries@usaid.gov www.usaid.gov
41	University of Jordan	Capacity building and research	Technical Assistance	Jordan	Dr. Muhammad Shatanawi, Professor	+962 6 535 5000	shatanaw@ju.edu.jo

7. REFERENCES

1. AWC (2005) *"State of the Water in the Arab region"*. Arab Water Council Report.
2. A. Goueli (2005) "Virtual Water and Arab Food Security" 4th Forum, Mexico.
3. A. Goueli, A.Abdel-Moniem (2005) "Virtual Water and Egyptian Food Security" 4th Forum, Mexico.
4. ACSAD (1997) "*Water Resources and their Utilisation in the Arab World*" 2nd Water Resources Seminar March 8-10, Kuwait
5. ACSAD (1998) "*Data Bank of the Arab Region Water Resources*"
6. Alalawi and Abdulrazzak, M. (1993) "*Water in the Arabian Peninsula: Problems and Perspective*" Water in the Arab World: Perspectives and Prognoses. Division of Applied Sciences, Harvard University, Cambridge, United States
7. AOAD (2004) "Annual Report on Arab Food Security"
8. Bahrain Country Report, 1995. "*Implications of Agenda 21 for Integrated Water Resource Management in the ESCWA Region*". Expert Group Meeting, 2-5 October 1995, Amman.
9. CEDARE (2004) "Wastewater Management and Reuse Assessment for the Mediterranean", El-Quosy, CEDARE, Report WRM-Jn2004
10. CEDARE (2005) " MDG status in the Arab States" 2nd Consultative Workshop for the Preparation for the 4th Forum, Cairo, Egypt, Dec 14 – 14, 2005
11. CEDARE / AWC / UNDP (2005) "*Status of Integrated Water Resources Management Plans in the Arab Region*" Arab Water Council Report
12. CEHA (2003) "Regional Consultation to Review National Priorities and Action Plans for Wastewater Reuse and Management" Amman 20-22 October, 2003. Jordan Country Paper by Saleh Malkaw, Water Authority of Jordon.
13. ESCWA (2005) "Water Resources Issues in the Western Asia Region", Beirut, Lebanon. E/ESCWA/SDPD/2005/WP.3
14. ESCWA, 2005. "Water Resources Issues in the Western Asia Region". ESCWA Regional Preparatory Meeting Sep 2005
15. ESCWA, UNEP and IDB, (1996) "Water resources Assessment in the ESCWA Region Using Remote Sensing and GIS Techniques".
16. FAO, 1995 "*Irrigation in Africa in Figures*". FAO Water Report #7, Rome.
17. FAO, 1997 "*Irrigation in the Near East Region in Figures*". FAO Water Report #9, Rome.
18. FAO, 2004 AQUASTAT
19. IDRC (2002) "First WDM Forum on Wastewater Reuse", 26-27 March 2002, Rabat, Morocco
20. Kuwait Country Report, 1986. "Water resources and utilization in Kuwait". Proceedings of the Symposium on Water Resources and Utilization in the Arab World, Kuwait.
21. Qatar Country Report, 1995. Implications of Agenda 21 for Integrated Water Resource Management in the ESCWA Region. Expert Group Meeting, 2-5 October 1995, Amman.
22. UAE Country Report, 1986. "Water resources and utilization in Kuwait". Proceedings of the Symposium on Water Resources and Utilization in the Arab World, Kuwait.
23. UNEP (2000) "Water Resources Management in West Asia", Global Environment Outlook GEO 2000
24. UNESCO (1998) "World Water Resources, A New Appraisal and Assessment for the 21st Century", by Igor A. Shiklomanov, State Hydrological Institute, St Petersburg, Russia, International Hydrological Program.
25. United Nations University, 1997. "Freshwater Resources in Arid Lands" The UNU Global Environmental Forum V.
26. UNU (1995) "Managing Water for Peace in the Middle East, Alternative Strategies", by Masahiro Murakami.
27. WB, 2005. "A Water Sector Assessment Report on the Countries of the Cooperation Council of the Arab States of the Gulf" World Bank report, May 2005.
28. World Bank (2006) "MENA Development Report on Water"
29. WRI (2001) ,
30. WRI/UNDP/UNEP/WB (1998) "1998-99 World Resources, A Guide to the Global Environment" World Resources Institute, United Nations Environment Programme, United Nations Development Programme and The World Bank, 1998.
31. Zubari, W. K. (1997) "*Towards the Establishment of a Total Water Cycle Management and Re-use Program in the GCC Countries*" 7th Regional Meeting of Arab IHP Committees, 8-12 September 1997, Rabat, Morocco

ANNEX 1

International and regional conferences on water since 1972

The UN Conference on the Human Environment, *Stockholm (1972)*, is one of the earliest land marks of the Global Water Movement. The conference declares that "*A point has been reached in history when we must shape our actions throughout the world with a more prudent care for their environmental consequences*". An action Plan has then been formulated at the UN Conference on Water, *Mar del Plata (1977)* against the "relatively little importance that has been attached to water resources systematic measurement".

The experience learnt from the water and sanitation decade (1981-1990) shows the importance of comprehensive and balance country-specific approaches to the water and sanitation problem. It clearly indicates that more effort, time and cost, than was originally thought, is inevitably needed. This has been followed by a Global Consultation on Safe Water and Sanitation for the 1990's, *New Delhi (1990*), which took place in parallel with the World Summit for Children. The Summit highlighted the importance of clean water provision in all communities for all their children, as well as universal access to sanitation.

The International Conference on Water and the Environment in *Dublin (1992)* set out Guiding Principles on water development and management. The UN Conference on Environment and Development (UNCED Earth Summit) in *Rio de Janeiro (1992)* underlined the importance of "the holistic management of freshwater... and the integration of sectoral water plans and programs within the framework of national economic and social policy". Through the Ministerial Conference on Drinking Water Supply and Environmental Sanitation in *Noordwijk (1994)* an Action Program has been set "to assign high priority to programmes designed to provide basic sanitation and excreta disposal systems to urban and rural areas. The UN International Conference on Population and Development in *Cairo (2004)* resulted in a Program of Action "to ensure that population, environmental and poverty eradication factors are integrated in sustainable development policies, plans and programmes.

The Declaration on the Social Development, *Copenhagen (1995)* adopted resolutions "to focus our efforts and policies to address the root causes of poverty and to provide for the basic needs of all. These efforts should include the provision of... safe drinking water and sanitation". The *Beijing (1995)* Declaration and Platform for Action, issued during the UN Fourth World Conference on Women, states to "ensure the availability of and universal access to safe drinking water and sanitation and put in place effective public distribution systems as soon as possible". The Habitat Agenda adopted at the UN Conference on Human Settlements, *Istanbul (1996)*, declares that "we shall also promote healthy living environments, especially through the provision of adequate quantities of safe water and effective management of waste". The *Rome (1996)* Declaration on World Food Security reflects the international will "to combat environmental threats to food security, in particular, drought and desertification, restore and rehabilitate the natural resource base, including water and watersheds, in depleted and overexploited areas to achieve greater production".

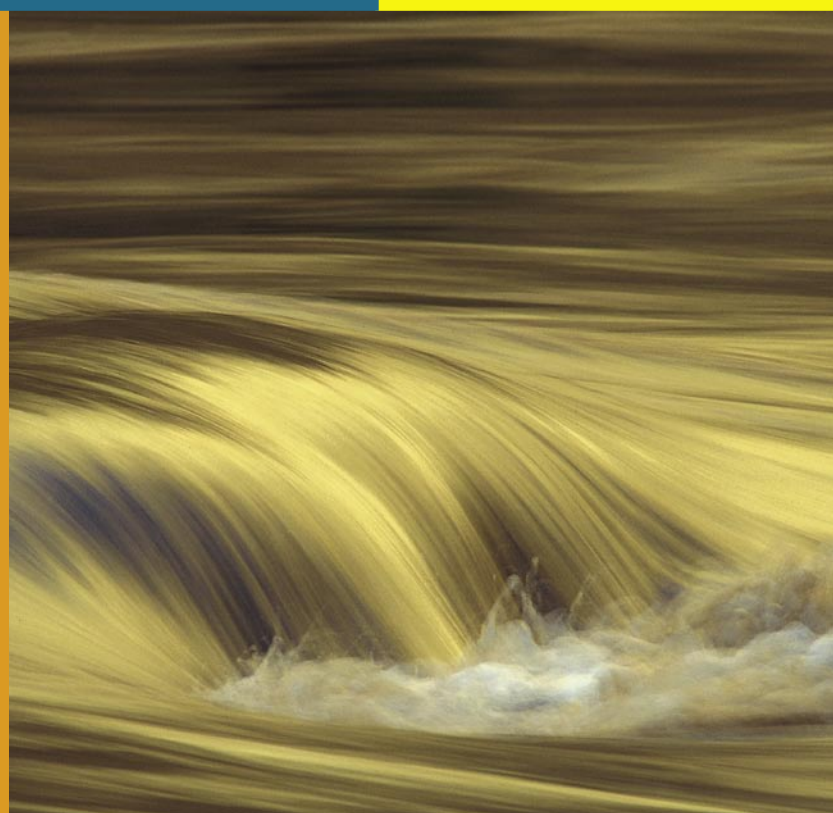
The first World Water Forum issued the Marrakech (1997) Declaration to "recognize basic human needs, to have access to clean water and sanitation, to establish an effective mechanism for management of shared waters, to support and preserve ecosystems, to encourage the efficient use of water,...". The 2nd World Water Forum in The Hague (2000) generated a lot of debate on the Water Vision for the Future and the associated Action Plan, dealing with the

state and ownership of water resources, their development potential, management and financing models, and their socio-economic, cultural and environmental impacts. The Ministerial Declaration identifies meeting basic water needs, securing food, protecting ecosystems, sharing water resources, managing risks, valuing and governing water wisely as key challenges.

The Millennium Objectives established at the UN Millennium Assembly held in 2000 followed by the Rio+10 World Summit on Sustainable Development, Johannesburg (2002, have called for developing integrated water resources management (IWRM) and water efficiency plans for all countries by 2005. Eight millennium Development Goals (MDGs) are ratified and supported by a unanimous political will, these are to: (1) Eradicate extreme poverty & hunger, (2) Achieve universal primary education, (3) Promote gender equality & empower women, (4) Reduce child mortality, (5) Improve maternal health, (6) Combat HIV/AIDS, malaria & other diseases, (7) Ensure environmental sustainability, and to (8) Develop global partnership for development. Water has been a common factor and a cross cutting issue to all MDGs. More specifically Goal (7) requires to **reduce by half the proportion of people without sustainable access to safe drinking water.**

The 3rd World Water Forum *Kyoto*, Shiga and Osaka *(2003)* took the debate a step further also within the context of the new commitments of meeting the goals set forth at the Millennium Summit of the United Nations in *New York (2000)*, the International Freshwater Conference in *Bonn (2001)* and the World Summit on Sustainable Development in *Johannesburg (2002).* The Kyoto discussions focused around the question "from water scarcity in the MENA region to water security", which is achievable only through major reforms in the management of water resources. Some countries in the region made significant progress with reforms to meet their water challenges and to achieve the Millennium Development Goals, while others were at early stages of the reform agenda. Water reform requires capacity building and empowerment of the public and private sectors as well as community organizations to realize and fulfill their roles.

In order to address water challenges of similar nature at the global level, the 4th World Water Forum is to be held in *Mexico City (March 16th to 23rd, 2006).* The Forum addresses global water issues which have been broken into 5 main complementary themes representing some of the most important challenges and problems faced by the world: *Water for Growth and Development; Implementing Integrated Water Resources Management; Water Supply and Sanitation for All; Water Management for Food and Environment;* and *Risk Management.* The main objective of the 4th World Water Forum is to have an impact on the policy agenda. In accordance with the main theme of the Forum "Local Actions for a Global Challenge", the Forum will depend on its preparatory process to collect views of local stakeholders all around the world.



ANNEX 2

Consultative Workshop in preparation for the 4th World Water Forum: Cairo, June 19th – 20th, 2005

Key water issues identified by the Workshop for the MENA Region

The 4th World Water Forum is to address global water issues under the main theme of "Local Actions for a Global Challenge". This theme is broken down into five complementary topics: (1) Water for Growth and Development; (2) Implementing Integrated Water Resources Management; (3) Water Supply and Sanitation for All; (4) Water Management for Food and Environment; and (5) Risk Management. At the June 2005 Consultative Workshop, the following full list of key water issues was compiled under these five topics.

1. Water for Growth and Development

- water scarcity
- uneven distribution of water resources, long distance water conveyance

2. Implementing IWRM

- water use efficiency in an integrated basin context
- water demand management
- water valuation
- inequity of water distribution among sectors
- transboundary water
- water depletion

3. Water Supply and Sanitation for All

- lack of financing for water supply augmentation
- unaccounted for water
- high cost of water treatment and desalinization
- inadequate access to clean water supply in rural areas
- inadequate sewerage and sanitation services in towns and cities
- health impacts

4. Water for Food and Environment

- water security vs. food security
- salinization
- treated wastewater acceptance for irrigation
- rural livelihood and poverty reduction
- agricultural water management and environmental protection

5. Risk Management

- climate variability and long term strategic planning
- desertification

Issues were also listed according to the cross-cutting perspectives proposed for the 4th Forum:

a. New Models for Financing Local Water Initiatives

- financing water infrastructure
- unbalanced budget distribution – water not priority
- debt burden reduces financing capacity

b. Institutional Development and Political Processes

- private sector participation: lack of incentives, understanding
- devolution of water management functions
- lack of water ethics
- lack of participation: community, women, poor
- political willingness to address problems
- uncertain role of NGOs and CBO
- institutional and legal frameworks for water management
- insensitivities and inequities of gender issues
- lack of enforcement of regulation and rules, especially groundwater

c. Capacity Building and Social Learning

- lack of incentives to manage water efficiently
- limited exchange of experience & knowledge
- capacity building of involved sectors
- poor public awareness and poor role played by media

d. Application of Science, Technology and Knowledge

- lack of science based decision-making
- development of non-conventional water resources
- lack of access to appropriate technologies

e. Targeting, Monitoring and Implementation Assessment

- inadequate data and information
- inadequate mainstreaming of cross cutting issues
- benchmarking of water management (evaluation of current resources, comparison of indicators between countries and other regions)

ANNEX 3

Institutions and Organizations Contributing to the Consultative Process

	Organization	Country / Organization Represented	City
1	The World Bank	WB	Washington DC
2	Center for Environment and Development of the Arab Region and Europe	CEDARE	Cairo
3	Ministry of Water Resources, Algeria	Algeria	Alger
4	United Nations Educational, Scientific and Cultural Organization	UNESCO	Cairo
5	Ministry of Water Resources and Irrigation, Egypt	MWRI	Giza
6	Ministry of Regional Municipalities, Environment, and Water Resources, Sultanate of Oman	Oman	Muscat
7	Qatar Public Agency for Electricity and Water	Qatar	
8	Ministry of Municipalities Affairs and Agriculture, Qatar	Qatar	
9	Ministry of Energy, Kuwait	Kuwait	Kuwait
10	Ministry of Water and Electricity, Saudi Arabia	Saudi Arabia	
11	Islamic Development Bank	IDB	Jeddah
12	Arab Organization for Agricultural Development (AOAD)	AOAD	Khartoum
13	Water Resources Directorate, Ministry of Municipalities Affairs and Agriculture, Bahrain	Bahrain	Bahrain
14	Egyptian National Committee for Irrigation and Drainage	ENCID	Cairo
15	National Authority for Water, Ministry of Irrigation and Water Resources, Sudan	Sudan	Khartoum
16	International Development Research Center (IDRC)	IDRC	Giza
17	Palestinian Water Authority	Palestine	Ram Allah
18	Ministry of Water and Irrigation, Jordan	Jordan	Ataman
19	Food and Agricultural Organization (FAO)	FAO	Cairo
20	Darwish Consulting Engineers	Darwish Consultants	Cairo
21	The Royal Netherlands Embassy	The Netherlands	Cairo
22	Ministry of Rural Development, Hydraulics, and Environment, Mauritania	Mauritania	Nouakchott
23	International Center for Agricultural Research in the Dry Areas	ICARDA	Aleppo
24	Secretariat of Planning, Libya	Libya	
25	Techno Park	UAE	Dubai
26	United Nations Environment Programme	UNEP	Bahrain
27	International Center for Agricultural Research in the Dry Areas	ICARDA	Aleppo
28	Societe Nationnale d'Expeloitation et de Distributtion des Eaux (SO.N.E.D.E.)		Tunis
29	CIHEAM/Bari	CIHEAM / BARI	Bari
30	Ministry of Water and Environment, Yemen	Yemen	Sanaa

31	National Office for Water Supplying Djibouti, Ministry of Agriculture and Water Resources, Djibouti	Djibouti	Djibouti
32	Ministry of Irrigation and Water Resources, Sudan	Sudan	Khartoum
33	UN Economic and Social Commission for West Asia (UN-ESCWA)	ESCWA	Beirut
34	Ministry of Water Resources , Libya	Libya	
35	Ministry of Irrigation, Syria	Syria	Damascus
36	Arab Network for Environment and Development	ANE&D	Cairo
37	Hydrosult Inc., Canada.	Canada	Montreal
38	Ministry of National Land. Water, and Environment, Morocco	Morocco	
39	Nile Water Sector	MWRI	Giza
40	International Water Resources Association	AWC/IWRA	Gatineau
41	Ministry of Water and Irrigation, Jordan	Jordan	Irbid
42	International Center for Biosaline Agriculture (ICBA)	ICBA	Dubai
43	Ministry of Rural Development, Hydraulics and Environmen	Mauritania	
44	National Water Research Center, Egypt	NWRC	Cairo
45	Arab Economic Unity Council	EWP	Cairo
46	Irrigation and Hydraulics Dept., Faculty of Engineering, Cairo University, Egypt	Cairo University	Cairo
47	Egyptian Holding Company for Water and Wastewater, Egypt	EHCD&S	Cairo
48	King Fahd University of Petroleum and Minerals	Saudi Arabia	
49	ARAB GULF PROGRAMME FOR UNITED NATIONS ORGANIZATIONS	AGFUND	Riyadh
50	Palestinian Hydraulic Group	Palestine	Ramallah
51	INTERNATIONAL CENTER FOR BIOSALINE AGRICULTURE	ICBA	Dubai
52	International Water Studies Center, Ministry of Water Resources	Iraq	
53	BUSHNAK GROUP	BUSHNAK GROUP	Jeddah
54	CANADIAN INTERNATIONAL DEVELOPMENT AGENCY	CIDA	Quebec
55	ARAB FUND FOR SOCIAL AND ECONOMIC DEVELOPMENT	AFSED	
56	Observatoire Du Sahara Et Du Sahel	OSS	Tunis
57	JAPAN INTERNATIONAL COOPERATION AGENCY	JICA	Tokyo
58	EUROPEAN INVESTMENT BANK	EIB	Grand Duchy Luxembourg
59	Middle East Desalination Research Center	MEDRC	Muscat
60	International Network for Water, Environment and Health	UAE	Dubai
61	GLOBAL WATER PARTNERSIP	GWP	Athens
62	UNIVERSITY OF JORDAN	Jordan	Amman
63	JAPAN WATER FORUM	JWF	Tokyo
64	Kuwait Institute for Scientific Research, Kuwait	Kuwait	Kuwait
65	Swiss Agency for Development and Cooperation	SAD&C	Berne
66	United States Agency for International Development	USAID	Cairo
67	GTZ office in Cairo	GTZ	Cairo
68	United Nations University	UNU	UAE

ANNEX 4

Land and water resources statistics for the Islamic Republic of Iran

Geography and population	Land use	Total area (1000 ha)	164820
		Arable land (1000 ha)	15020
		Permanent crops (1000 ha)	2068
		Cultivated area (arable land and permanent crops) (1000 ha)	17088
	Population	Total population (1000 cap)	68070
		Rural population (1000 cap)	23197
		Urban population (1000 cap)	44874
		Population density (cap/km^2)	41
		Total active population in agriculture (1000 cap)	6374
		Male active population in agriculture (1000 cap)	3771
		Female active population in agriculture (1000 cap)	2603
Climate and water resources	Precipitation and evaporation	Average precipitation in volume (km^3/yr)	376
		Average precipitation in depth (mm/yr)	228
	Internal renewable water resources	Groundwater: produced internally (km^3/yr)	49
		Surface water: produced internally (km^3/yr)	97
		Overlap: surface and groundwater (km^3/yr)	18
		Total internal renewable water resources(km^3/yr)	129
		Total internal renewable per capita (m^3/cap/yr)	1888
	External RWR	Total external WR (actual) (km^3/yr)	9
	Total renewable water resources	Total renewable (actual) (km^3/yr)	138
		Total renewable per capita (actual) (m^3/cap/yr)	2020
		Dependency ratio (%)	7
Water use	Water withdrawal by sector	Agricultural water withdrawal (km^3/yr)	66
		Domestic water withdrawal (km^3/yr)	5
		Industrial water withdrawal (km^3/yr)	2
		Total water withdrawal (summed by sector) (km^3/yr)	73
		Agricultural water withdrawal as part of total (%)	91
		Domestic water withdrawal as part of total (%)	7
		Industrial water withdrawal as part of total (%)	2
		Total water withdrawal: per capita (m^3/cap/yr)	1071
	Waste water	Waste water: produced volume (km3/yr)	3
		Waste water: treated volume (km3/yr)	0
	Pressure on water resources	Ag water withdrawal as % of TRWR	48
		Total water withdrawal as % of TRWR	53
Virtual water	Crops import	Average VW Crops (millions of cubic meters)	5820
	Livestock import	Average VW Livestock (millions of cubic meters)	1020
	Total import	Total VW (km^3/yr)	7

ANNEX 5

UNDP/AWC Partnership for IWRM

Most of the countries of the region are progressing in different phases and speeds towards developing national strategic water plans (see, for example, CEDARE/AWC/UNDP 2005). However, awareness of formulation, development, and implementation of IWRM plans to meet the target date of 2005 is lagging and in several cases lacking. The following are the principal problems or "gaps":.

1. Experience and information are not easily shared among Arab countries.
2. Mobilizing the political will and awareness on the need to achieve the WSSD IWRM target of 2005 and other water related MDGs are lacking.
3. Capacity building is required for IWRM plans development.
4. Capacity building is required for IWRM plans implementation.
5. Shortage of water resources professionals exists in development agencies including UNDP COs.
6. Several countries need to strengthen their capabilities in reporting "State of the Water" and assessing their own water resources.
7. Coordination among the donor community in the water sector is required to avoid duplication and assure streamlining of water related activities towards IWRM plans development and implementation.

AWC has worked with UNDP in a partnership agreement to develop an action plan to close these "gaps". The actions concerned are discussed in the following paragraphs.

Institutional Strengthening of the Arab Water Council.

The AWC will be strengthened and will become eth regional focal point for IWRM plans. The UNDP can assist in institutional strengthening of the Arab Water Council. The AWC will act as a knowledge hub for capacity building in the Arab region and will provide technical assistance for Arab countries to develop IWRM plans, and technical means for implementing such plans. The AWC will thus become an effective tool for executing Goal 1 of the UNDP/AWC partnership objectives: capacity building for Arab countries to achieve water related targets.

Regional UNDP COs in the Arab Region can mitigate capacity needs in the Arab countries. AWC will identify available capabilities and successful implementation experience in the water sector. According to emerging needs, AWC will guide Arab countries to achieve their capacity building while providing the following services:

- Evaluate capacity building and technical requirement needs in the Arab region.
- Design custom-tailored capacity building plan for each country depending on specific needs.
- Coordinate with UNDP COs, through AWC, the action plan for capacity building and technical assistance for Arab countries.

The preliminary framework dialogue of work is expected to be as follows:

- AWC will identify the various capacity building needs for the different Arab Countries.
- AWC will coordinate with UNDP COs to correspond with the relative countries officials to identify specific capacity building requirements for each Arab country.
- AWC will compile the capacity needs from various countries based on the correspondence received from the Arab water sectors and UNDP COs and recommend an action plan.
- AWC will recommend a map road to address and satisfy the required capacity building for the various Arab countries. (Addressing the capacity building requirements will be a continuous process at various

stages of each country development. The capacity building can be in terms of providing expertise, training, development tools, etc... to be identified in Phase II of this study).

In general, the concept of Center of Excellence for Water Resources is well adapted in several countries including Pakistan and USA. This entry point can bridge the previously identified gaps numbers 1 and 2.

IWRM Plans Development Program

Regional UNDP COs in the Arab Region, through AWC, can support Arab countries in developing IWRM plans by year 2005. Bridging the gaps between the existing water strategies/laws in each country and specific requirements for IWRM plans, UNDP/AWC partnership can assist in providing the required expertise, similar examples, and guidance in developing national IWRM plans. This effort will have to be integrated with similar initiatives within the Region. This entry point can bridge the previously identified gap numbers 3.

IWRM Plans Implementation Program

Developing an IWRM plan for further implementation goes through series of steps (refer to Guideline for preparing IWRM plan document). On the other hand, the target date of 2005 set by WSSD in Johannesburg to set a national IWRM plan for all countries is approaching. An action plan is required for development of these plans and implementation at a later point. Arab countries cannot afford missing-a-turn along the road to IWRM plan development.

UNDP/AWC partnership can assist countries in identifying the bottlenecks for implementing IWRM plans in their region. The partnership can also assist in mitigating the financial means and administrative requirements for effective implementation. Again, this effort will have to be integrated with similar initiatives within the Region. This entry point can bridge the previously identified gap number 4.

Regional Program for Water MDGs in the Arab Region

Regional Coordination Unit & National Task Forces for Water MDGs in the Arab Region to standardize the assessment criteria for monitoring progress in achieving water MDGs, to mobilize the political will for achieving MDGs, raise public awareness on water MDGs, to assess the availability of national funds for achieving MDGs (to identify the need for additional funding requirement). Numerous Examples are available for goals and plans that have not reached their end target because of failure to monitor their development and implementation while considering the extent of compliance with the set action plan. The establishment of a regional coordination unit for the monitoring and evaluation of the MDGs for water (Coordination Unit for Water MDGs) will serve this purpose.

The established unit will continuously monitor the progress of IWRM plan at Arab countries. Utilizing the existing capabilities and concept of AWC, this unit should be established within and under the umbrella of AWC to have a strategic position that would enable the unit to carry out its monitoring responsibilities. The unit will set action plans for each Arab country to develop IWRM plan by the target date. The unit will also follow up implementation phase. Specifically the unit will be responsible for the following tasks:

- Set action plan for each Arab country to develop a satisfactory nation IWRM plan by the target date.
- Monitor each country actions to fulfill the set action plan. The unit will raise flags to assist countries when drifting away or lagging along the set action plans.
- Recommend correction actions to countries facing problems in executing action plans to develop their IWRM plans.

The unit will communicate with existing regional hub(s) at the Arab region. Under supervision of the unit, the identified hub(s) will communicate with UNDP COs to set an action plan for each country in the Arab region. The UNDP COs will monitor on a periodical schedule the follow-up of each country with the set plan and convey the compliance to the unit. Accordingly, the unit will evaluate the taken step and identify whether the countries are on track or require correction action to keep focused on their targets. This entry point can bridge the previously identified gap number 2.

IWRM Capacity Building Program for Governments & Civil Societies

The UNDP/AWC partnership can mitigate capacity needs in the Arab countries. The partnership will identify available capabilities and successful implementation experience in the water sector. Accordingly, the partnership will design a

specific capacity building program for various countries to achieve the development target. Specifically, groundwater management and wastewater reuse shall be a key task in capacity building programs. Regional organizations inn the region (for example: CEDARE, ESCWA, FAO RNE, UNDP RBAS, UNEP ROWA, UNESCO ROSTAS, ACSAD, ..etc) can be major players in capacity building and training streaming to avoid overlapping and wasting of resources and to improve coordination. This entry point can bridge the previously identified gaps numbers 3 and 4.

IWRM Capacity Building Programs for UNDP COs

UNDP plays an operational role in assisting countries to build cross-sectoral capacities and put in place effective and sound policies and institutions to manage and develop water resources in a sustainable way. However, UNDP is limited in its ability to provide assistance in water quality/ pollution and water pricing/cost recovery where specific technical skills are necessary. UNDP/AWC partnership will provide the in-house capacity building for its own country offices (COs) resources to sustain its strength to accomplish its target mission in the water sector. This entry point can bridge the previously identified gap number 6.

Arab Water Facility

The Arab Water Facility will assist in establishing national Donor-Assistance-Groups (DAGs) for donor agencies to coordinate their activities in the Water Sector on the national level. Based on country needs assessments, the Arab Water Facility will also identify the priority projects in the water sector and coordinate the communication with potentially interested donor agencies to fund and implement these projects. Subsequently, the AWF will mobilize funds for soft and infrastructure water projects. The AWF will prioritize programs for funding, set criteria for accepting projects, and define guidelines for considering water-related project proposals. This entry point can bridge the previously identified gaps numbers 5 and 7.

State of the Water Report in the Arab Region

Similar to the World Water Development Report (AWDR), the AWDR or SWRAR will periodically present a look on freshwater resources in the Arab region; identify the challenges to life and well being in addition to the management challenges. The AWDR or SWRAR will introduce pilot case studies that have been implemented worldwide and specifically in the Arab countries to benefit future attempts in the region.

****

4th World Water Forum

Cristobal Jaime Jaquez *General Director of the National Water Commission of Mexico*	Co-Chair of the International Organizing Committee of the 4th World Water Forum
Loïc Fauchon *President of the World Water Council*	Co-Chair of the International Organizing Committee of the 4th World Water Forum
Cesar Herrera Toledo *National Water Commission of Mexico*	Secretary General

Supporting Team to the Regional Process

Jose Antonio Rodriguez Tirado *National Water Commission of Mexico*	Regional Coordinator.
Maria Isabel Badillo Ibarra *National Water Commission of Mexico*	Chief Officer, Regional Team
Marco Antonio Maldonado Arellano *National Water Commission of Mexico*	Chief Officer, Regional Team
Jorge Luis Meza Reyna *National Water Commission of Mexico*	Chief Officer, Regional Team
Luis Vazquez Molina *National Water Commission of Mexico*	Chief Officer, Regional Team
Enrique Zarate Bohorquez *National Water Commission of Mexico*	Chief Officer, Regional Team
Ernesto Cespedes Oropeza *Foreign Affairs Ministry of Mexico*	Ministerial Coordinator
Ricardo Martinez Lagunes *National Water Commission of Mexico*	Thematic Coordinator
Heidi Storsberg Montes *National Water Commission of Mexico*	Communication Coordinator
Daniel Zimmer	Exofficio, Executive Director World Water Council
Paul van Hofwegen	World Water Council
Elisabeth Catton	World Water Council