MANAGEMENT OF WATER UTILITIES

CASE STUDIES FROM THE ARAB REGION

First Edition

ACWUA
Arab Countries Water Utilities Association

SWEDEN

"Support of ACWUA's Utilities Management and Utilities Reform Technical Working Groups Project is being carried out with support from Swedish development cooperation. The project is the sole owner of the production, and the publisher is responsible for the content."

FOREWORD BY ACWUA

The water sector in the Arab region suffers from chronic problems and faces many challenges in terms of water supply and sanitation services. These challenges are common in most of the Arab countries and are summarized in water scarcity; increasing demand due to growing populations and conflicts; rapid urbanization; water pollution/water quality; limited access to drinking water & sanitation services in rural areas; lack of funding resources; ineffective water pricing and lack of cost recovery and asset management applications. Consequently, there is room for substantial improvements in terms of administrative procedures, water policies, laws and legislations, as well as technical capacity.

Herein arises the role of the Arab Countries Water Utilities Association (ACWUA) and other community-based organizations, in raising awareness at all levels within utilities, especially at the top and middle management levels that have the direct influence over decision makers, in emphasizing the need for development of new policies, and the amendment of existing legislations that would encourage the development of utility management approaches and techniques, which in turn lead to performance improvements and better Water Supply and Sanitation (WSS) Services.

According to its mandate, ACWUA is playing a fundamental role in promoting and disseminating best practices in water utility management in the Arab world. Through the initiation of the (Utilities Management) Technical Working Group (TWG), ACWUA introduced different Utilities' Management topics (that were set according to utility members' needs) for research and discussion: Cost Recovery, Non-revenue Water, Water for the Poor, Energy Efficiency, and Asset Management—among others.

Throughout the last two years, the Utilities Management TWG members met twice annually to share their countries' experiences, exchange knowledge in the form of case studies, and discuss potential aspects of utility management accordingly. This publication includes the results of these meetings, where all case studies are produced in a very informative and professional manner, to present a valuable reference about the management of water utilities in the Arab Countries. These group meetings and all their associated activities were financially supported by the Swedish International Development Cooperation Agency (SIDA) within a two-year support project.

I would like to express my sincere gratitude to the authors of this publication, our committed TWG members who showed real dedication to this project and contributed with their expertise to bring out this honorable work.

I would like also to thank the Swedish International Development Cooperation Agency (SIDA) for supporting the production of this publication.

Last but not least, I would like to thank ACWUA Secretariat team and the TWG advisory team from (ECO Consult) for their efforts throughout the two-year working period of the TWG up till the point this publication became available to serve the water and sanitation sector in the region.

Sincerely Yours,
Eng. Khaldon Khashman

Secretary General

COnt Ent s

Introduction

Background and Overview

Since inception, the Arab Countries Water Utilities Association's (ACWUA's) role and mandate has been set to serve its constituency in upgrading their competences by improving their performance in the delivery of water supply and sanitation (WSS) services. In accordance with this role and mandate, ACWUA adopted a leading role in the region in presenting and examining approaches to improve the efficiency of the Operation and Maintenance (O&M) systems and standards, to implement reform and restructuring initiatives to improve operational performance, to extend services, to advance management systems, and finally to exchange expertise in developing operation and maintenance procedures and applications. Bearing this in mind, ACWUA recognized the need for setting the required technical, administrative, legal, scientific and economic frameworks that are necessary to enhance the performance of utilities and service delivery.

Accordingly, ACWUA initiated interdisciplinary Technical Working Groups (TWGs) comprising qualified experts from ACWUA member utilities to address specific utility issues in different high priority areas in the water and sanitation sector. Those areas were identified by the association through carrying out a needs assessment or its member utilities. To this end, ACWUA obtained the necessary funding to launch and activate the Utilities Management (UM) TWG from the Swedish International Development Cooperation Agency (SIDA).

The UM TWG comprised ten members representing ten different ACWUA utilities and their respective countries working together for a two-year period of engagement in the TWG. The TWG members met twice to three times annually to design a work plan and schedule; design the outlines for the final deliverables of their work; present their respective experiences in managing WSS services; exchange knowledge in that respect regionally; and present a future outlook that would serve ACWUA in further identifying improvement opportunities in the WSS sector regionally. The UM TWG relied primarily on its members' expertise in the management of utilities in their respective organizations and countries, and complemented those competencies through information gathering and stakeholder consultation. The TWG members also participated in international and regional conferences presenting their experiences and reaching out to other WSS professionals and experts.

Management of WSS Services in the MENA Region - the Need for Improvement

A bird's eye view of WSS services in the MENA countries reveals several regionally common characteristics. Most of the Arab region is faced with acute water shortages that put tremendous pressure on utilities to develop and sustain adequate water supplies to meet the existing demand. Population growth, economic development activities and urbanization are directly impacting the demand for such services, and resulting in a rapidly growing demand. Further exacerbating the problem is the sectoral allocation of services based on a social viewpoint that is not completely backed by the economic viability perspective. This is manifested in mostly subsidized tariffs that in some cases cover O&M costs, and in other cases do not. Furthermore, developing additional WSS services adds financial burdens on the utilities which need more government support and subsidies. And at the heart of all this lies the issue of weak state-owned utility performance and the inability to provide the level of service required by the customers.

All the above manifestations reflect the need for improving and developing utility management practices to improve service provision. The themes related to utilities management and service improvement revolve around issues related to tariff setting and adjustment and its suitability taking into consideration socio-economic aspects, and the cost of service provision (including costs of production, distribution, depreciation and even debt service costs), in addition to improving technical and management efficiencies and competencies of utility staff and other related stakeholders. This is in order to enhance utility performance in terms of – inter alia - asset management, energy efficiency, minimizing the non-revenue water amounts, enhancing cost recovery and increasing the service provision for the underprivileged and in remote areas.

Accordingly, the primary strategy for improving utility management is based on enhancing the management and technical competencies of utility staff through programs for capacity building, skills improvement, and knowledge exchange and transfer at all levels. This includes cooperation agreements and twinning at the local level among the utilities of the same sector and between different sectors; at the regional level; and with at international levels both in the private and public sectors.

On the technical and management levels, there are several well-noted good practices that target improved service provision; in Egypt for, example, the Holding Company for Water and Wastewater (HCWW) has initiated the application of best practices in managing assets to improve asset management and maintenance techniques in several of its subsidiaries. On the other hand, the National O ce for Electricity and Water Supply (ONEE) in Morocco was able to achieve full cost recovery through the proper adjustment of tari s, taking into consideration the socio-economic aspects, and improving the billing and collection processes, in addition to minimizing non-revenue water amounts. As for Jordan, several projects have been initiated in partnership with the private sector with the ultimate goal of improving the e ciency of energy utilization.

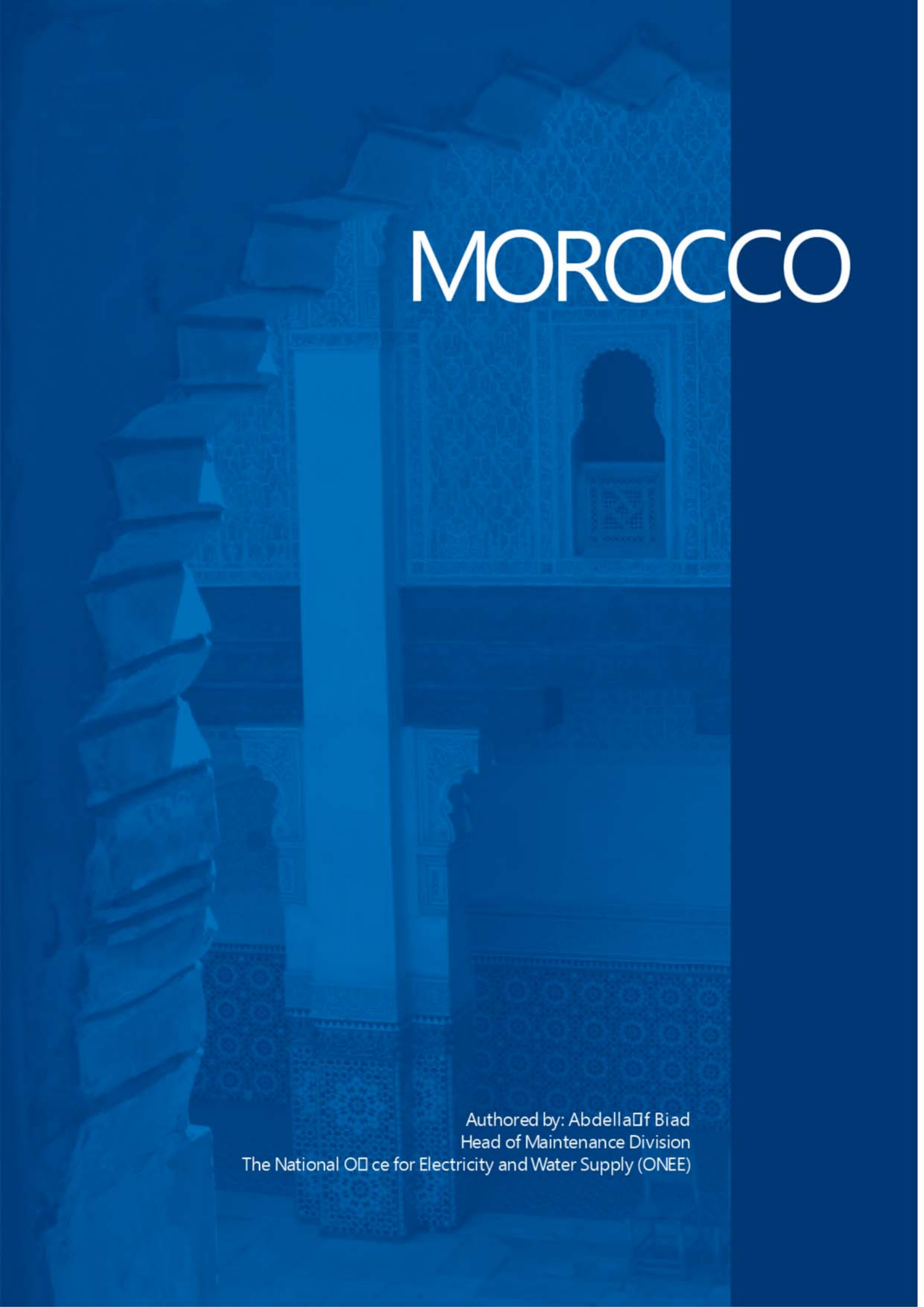
This Publica on

The main deliverables of the work of the TWG during the period of its engagement are two reports:

1. A compilation of the UM TWG regional case studies report, which covers the main theme of the TWG for the participating ACWUA member countries; and
2. A best practices guide in the area of utilities management, applicable in the region.

The publication in hand is the rst of those two deliverables, and includes compilations of the experiences of the participating ACWUA countries in terms of utilities management. It includes separate chapters for the ten participating countries with the author identi ed. In each chapter a country background is provided with focus on water resources, uses and service providers; the institutional and legislative framework governing the sector; the main technical areas related to operations and management of services within utilities, including applied tari s and cost recovery, Non-revenue Water (NRW), energy e ciency, water for the poor and other areas.,This "Case Studies" publication is the rst step that precedes the publication of the "Best Practices Guide in Utilities Management in the Middle East and North Africa (MENA) Region", which provides an in-depth analysis of the regional experience in this area, success factors, opportunity for replication and improvement and lessons learned.

Accordingly, this publication includes the experience of each participating country presented in the aforementioned context depending on the available information to the TWG members. The information included within is the results of the research and consultation e orts that were undertaken by the TWG members in their respective organizations and countries, and constitute the primary source of information.



MOROCCO

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ACRONYMS

BCM	Billion Cubic Meter
CMMS	Computerized Maintenance Management System
GIS	Geographical Information System
GPI	Gender Parity Index
HCP	High Commission for Planning
IWRM	Integrated Water Resources Management
Km^2	Squared Kilometers
m^3	Meter Cubed
MDGs	Millennium Development Goals
MCM	Million Cubic Meter
NRW	Non-revenue Water
ONEE	National O□ ce of Drinking Water Supply
ONEP	National O□ ce for Drinking Water
ORMVA	Regional O□ ces for Agricultural Development
PPP	Public-private Partnership
UN	United Nations
WSS	Water Supply and Sanitation
Yr	Year

Introduction

Water and sanitation utilities around the Arab countries are confronted with many difficulties and challenges as they strive to make organizational improvements, where Utility managers are required to thoroughly consider a wide range of issues related to any improvement initiatives they embark on. General economic conditions, staff turnover, communication between internal management and relevant external stakeholders, involvement of staff across the organization, aging and occasionally decaying infrastructure, applied rate issues, and limited staff resources are some of the issues managers are required to address.

This case study will focus on specific utilities management practices that are applied in Morocco, such as identifying revenues and costs of service, associated with the applied tariff; Non-revenue Water (NRW), asset management and energy efficiency.

Country Background

Geographic Location, Area and Population

The Kingdom of Morocco is located to the northwest of Africa, where it is bordered by the Mediterranean Sea from the north, Mauritania from the south, the Atlantic Ocean from the west, and Algeria from the east. The overall area of Morocco is around 710,850 km2 with a 3,500 km long coastline.

The population of Morocco has witnessed a significant increase, as it rose during the period between 1960 and 1982 to 11,626,000 inhabitants, registering a growth rate of 2.8% per year. According to the census of September 2nd, 1994, Morocco's population stood at 26,073,717 inhabitants. This number increased to 29,840,273 million during the census of 2004 (including 51.435 foreigners) distributed as 13,415,659 urban inhabitants amounting to a ratio of 51.4%, and 12,658,058 inhabitants in rural areas, amounting to a ratio of 48.6%. Morocco has been transformed during this period from a mostly rural population to a heavily urbanized population. In terms of fertility, the rate has fallen from 4.23 children in 1982 to 3.69 children per woman in 1994, and then to 2.89 children per woman in 2003.

topography and Geology

Morocco has often been called the country of contradictions. This observation is confirmed more than ever in the natural environment: the snowy peaks of the high Atlas mountain chain (which mostly exceed 3,500 m of elevation), the vast stretching plains and plateaus or basins that prevail on the surface, the dry desert ecosystems where biological diversity is limited, and those areas that are abound with various forests. All of the above show considerable diversities.

The mountain ranges stretching 500 km from east to west cover a distance of more than one fifth of the total area, which is a major factor in shaping the landscape of the country. This includes: The Rif Mountains in the north, which stretch from the Atlantic Ocean in the west to the lower Melwiyya in the east; the group comprising the upper central plateau as well as Middle and High Atlas in the middle represent the two large ranges (with the highest peak of Jebel Toubkal at 4,165 m), and the Anti-Atlas in the south, not to mention the isolated highlands. Outside these mountain ranges, the plains, plateaus and basins comprise most of the land.

Atlantic Morocco consists of Atlantic coastal plains and plateaus (West, Chaouia, Doukkala, Abda) or internal plains and plateaus (Tadla, Haouz, Central Plateau, Rahamna, contour, Phosphate Plateau). In Eastern Middle Atlas the eastern Mediterranean comprises middle plains (such as plain Tarifa) or internal plains. Away from the Mediterranean coast there are the arid High plateaus and their extensions that are typical for the harsh climate, which makes them perfect for pastoral activities.

Finally, the pre-desert and desert areas extend in the south and southeast, consisting of plains and plateaus sometimes overlooked by prolonged sand dunes or mountains. The area is characteristic by being dry and harsh with excessive high temperatures, water scarcity, and thus scarce vegetation.

From a geological point of view, there are some ancient rock formations (belonging to the pre-Cambrian and the first geological period) in Morocco, and some areas with volcanic rocks, plains, plateaus and ponds with sedimentary rocks, as well as wide plains covered with modern river sediments.

Land, River, Lake and Dam

The hydrological system is distributed starting from the central water reservoir represented essentially in the High Atlas and the Middle Atlas. The Rif range contributes to feeding the rivers that head towards Sebou. Depending on the climatic conditions, factors such as the concentrated rainfall, evapotranspiration as well as the low rainfall amounts usually explain the irregular flow even in areas of heavy rains. High evapotranspiration explains the high deficit and the disparity between the coastal and inland areas.

There is an essential river network in Morocco which consists of mountain tributaries that descend from the Atlantic Ocean and the Mediterranean Sea, and flow from the Middle Atlas mountains in general. All rivers in Morocco descend towards the Atlantic Ocean except for Malwiyya River, which empties into the Mediterranean Sea, and the River Dera which empties into the desert. The rivers in Morocco overflow in the winter and in early spring. Some of the most important rivers include:

Table 1: Rivers in Morocco
(Source: Own, 2012)

Main River		
River	source	Length (km)
Draa	High Atlas	1,200 km
Oum Er Rbia	Middle / High Atlas	600 km
Sebou	Middle Atlas \ Rif	500 km
Moulouya	Middle Atlas \ High Atlas \ Rif	450 km
Tensift	High Atlas	270 km
Ziz	High Atlas	270 km
Bouregreg	Central Plateau	250 km

Morocco has 130 large water dams, and dams of various capacities that are distributed all over the country. They have multiple functions, such as to provide water for drinking, industrial and irrigation purposes, as well as recharging water basins, containing floods, protection against soil erosion and against pollution, recreation and energy supply. The construction of dams in Morocco began in the 1920's; more specifically since 1929 until the independence in 1956, about a dozen water dams were built, mostly concentrated in northern and central Morocco. The pace of construction accelerated in the early fifties to build a dam between valleys with a capacity amounting to 1,384 Million Cubic Meters (MCM). The construction continued at the same pace in the years after independence. At the end of the seventies Al Masira Dam was built, currently the second largest dam in Morocco, with a capacity of 2,760 MCM. The eighties and early nineties witnessed the construction of a large number of small dams that were scattered over the national territory, as well as building the largest Moroccan dam, Al Wahda dam. The first decade of the new millennium witnessed building many small dams associated with some major projects. Nowadays, the water dams in Morocco provide the country with a capacity of up to 17.2 Billion Cubic Meters (BCM).

Climate

Morocco is characterized by a mild climate along the Mediterranean coast. The temperature rises in the inner areas during the summer, but it can get very cold in the winter season. In the highlands, the temperature sometimes drops to lower than 10 below zero, and snow covers the tops of the mountains most of the year. Rain mainly falls in the winter, mostly heavier in the northwestern areas and less in the eastern and southern regions.

Economy and socio-economic Developme

Morocco is characterized by a growing economy that depends mainly on agriculture, mining and foreign investments. The government had been in control of the mining industry, most of the transportation services and some industries until 1993, when the Moroccan economy entered a new phase of a privatization program, whereby, the House of Representatives passed the law 89-39 that same year. The law authorizes the transfer of public facilities to the private sector. Previously, a number of factors had hindered the economic reform in Morocco, including: a high rate of population growth, unemployment, a large public administration, suffering within the agricultural sector of waves of drought, an excessive dependency on the export of a single commodity- the phosphates, and reliance on imported energy sources from abroad.

Achieving the Millennium Development Goals

Morocco has committed in 1990 to achieve the Millennium Development Goals (MDGs) as defined by the international community. A few years shy from 2015, it is safe to say that Morocco's achievements, both in the economic field as well as in the field of human development, would qualify it to be among the countries that will be able to achieve the MDGs in this scope. It is a fact confirmed by all of the studies conducted by the High Commission for Planning (HCP), as well as the expectations of many individuals and institutions within the United Nations (UN). Furthermore, the evidence lies in the credibility of the available statistical data. The comparison between the last two decades clearly indicates that the average economic growth increased from 2.2% to 4.4%, while this growth rose (without counting the primary sector) from 3.0% to 4.8%. Domestic demand rose with an average annual rate of 5.1% instead of 2.4%; the gross investment rate rose from 24.8% in 1999 to 32.6% in 2009; and the unemployment rate witnessed a decline from 13.8% in 1999 to 9.1% in 2009, although it is still high among the holders of post-graduate degrees. The household expenditures recorded an increase in consumption of 4.3% as an annual average and 5.6% as of the year 2003. The purchasing power of households has improved by 2.4% per year as a result of the improvement of individual income by an annual rate of 4,3%, and prices at consumption by 1.9%

In addition to the above, access to and availability of the basic services has increased substantially; whereas access to electricity and water was possible only in urban areas, the rate in rural areas has risen from 9.7% in 1994 to 83.9% in 2009 for electricity, and from 14% to 90% for drinking water. In the field of education, the rate of enrollment in schools (ages 6 - 11 years) has gone up from 52.4% to 90.5% at the national level, while it almost tripled overall, and quadrupled for females in the rural areas. This has changed the ratio of females to males in primary education from 66% to 89%, and doubled the Gender Parity Index (GPI) in rural areas.

On the other hand, life expectancy at birth has gone up from 65.5 years in 1988 to 72.9 in 2009. This development constitutes an indication of the progress made in the areas of nutrition and public health. The relatively low death rate among mothers and children, which is predicted by the primary results of a demographic research currently being carried out, reflects the great efficacy of health education and awareness of the population.

sec□or Overview

Since gaining its independence, Morocco has adopted a strong and dynamic policy in the □eld of water in order to overcome the negative e□ects of climate change, through better management of water resources and storage of water during the rainy years, in order to cope with the need during the drought years. Thus the main objectives were: responding to the growing demand for drinking water on the part of the population, and providing agriculture with its essential needs in order to provide the nutritional needs and encourage export agriculture.

The challenge at the time, which was put to practice in 1998, was the attempt to irrigate one million hectares by the end of the last century. The policy of dams enabled Morocco to ensure water and food security, and improve the incomes of farmers in irrigated areas, as well as the intensi□cation and diversi□cation of agricultural production, and the development of agricultural exports. Since its initial perceptions the water policy in Morocco focused for a rather long time on the mobilization of □nancial resources:

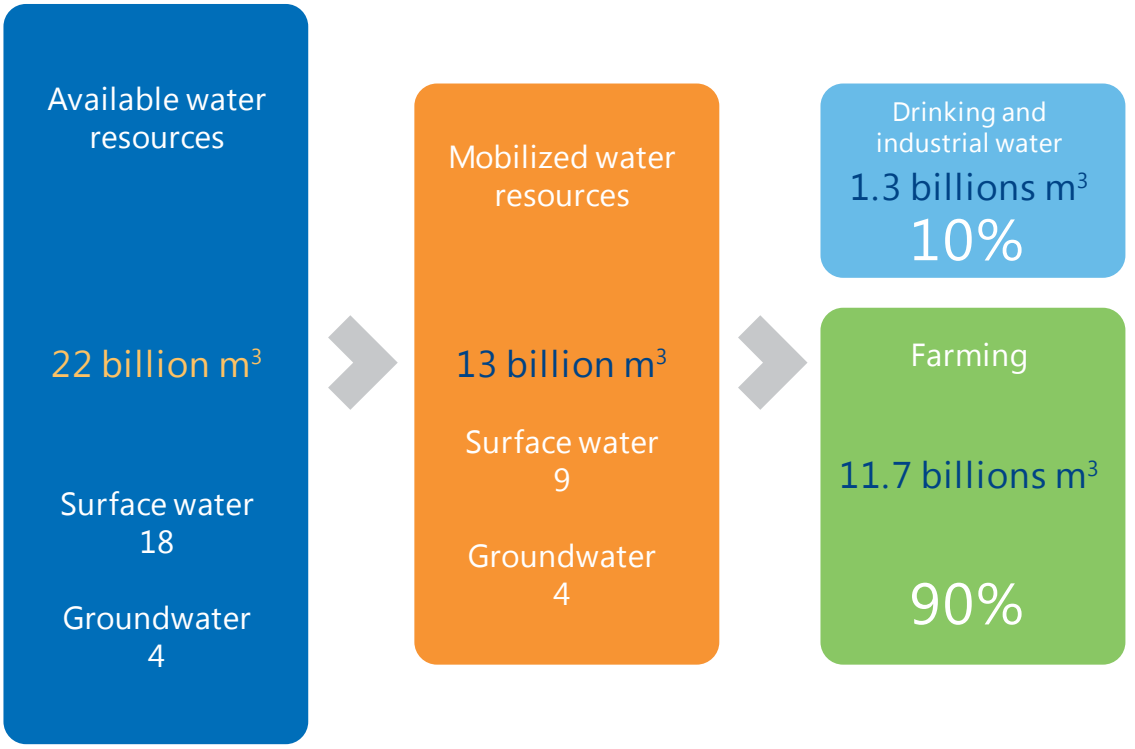

Figure 1: Available and Mobilized Water Resources
(Source: Planning Directorate/Needs and Resources Planning Section)

Completed works have enabled:

1. The mobilization of 75% of the viable surface water by completion of 130 large dams and more than 100 small dams with an overall capacity of 17.5 BCM, as well as construction of dozens of facilities to divert water;
2. The construction of several groundwater wells thus enabling the mobilization of all groundwater;
3. Irrigating more than 5.1 million hectares of agricultural land;
4. Securing to all access to drinking water (Of the past 30 years, two decades were marked by drought; however water supply was available);
5. Protection from □oods in cities and plains; and
6. Producing about 10% of the national energy needs through hydropower.

Besides the aspect of the mobilization of water resources, which is considered to be one of the real successes of the Kingdom, wastewater and water pollution has received great interest since the early nineties to cover the ine□ ciencies in this □eld.

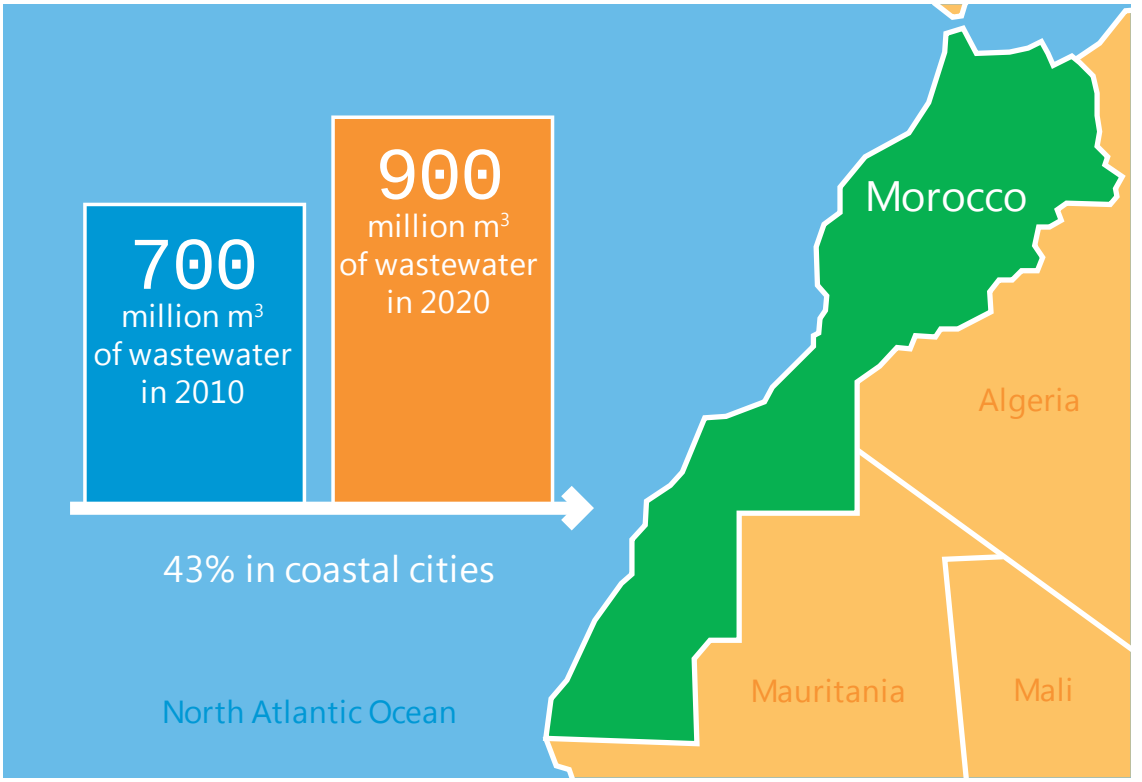

Figure 2: Wastewater Amounts in Morocco
(Source: planning Directorate/ Needs and Resources Planning Section)

Morocco is faced with a set of challenges in the management of its water resources, such as:

1. Limited water resources: 730 m^3 per capita per year currently, and 520 m^3 per capita per year by 2020;
2. Increasing water demand: 13.7 BCM currently and 16.2 BCM by 2030;
3. Climate change and the emergence of extreme weather events such as floods and droughts,
4. Soil erosion and dams filled by mud : the loss of approximately 75 MCM;
5. Over-abstraction of groundwater;
6. Water pollution; and
7. Low prices of mobilized resources especially for irrigation.

The Institutional Framework of the sector

Overall, the involved parties in the water sector in Morocco can be categorized into three main bodies as illustrated in Figure 3 below:

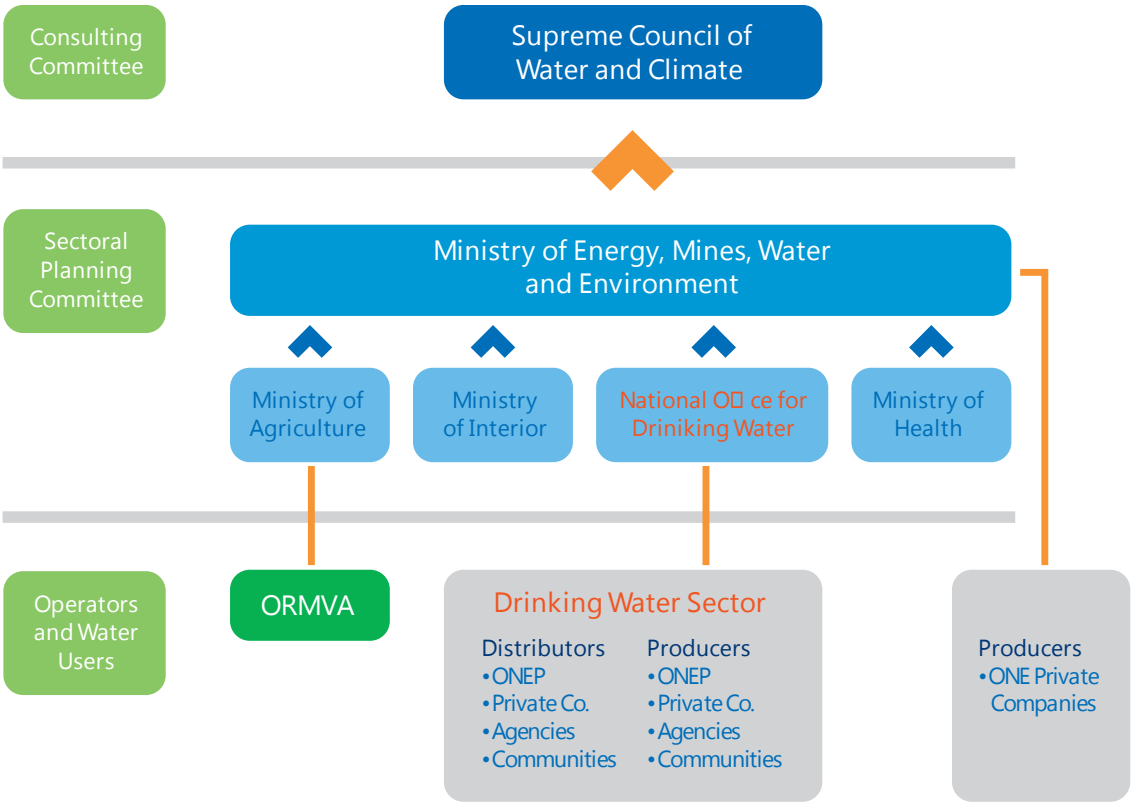

Figure 3: Institutional Framework of the Sector
(Source: Planning Directorate/ Needs and Resources Planning Section)

- Advisory body;
- Sectorial Planning body; and
- Other stakeholders.

1. The Supreme Council for Water and Climate

The Supreme Council for Water and Climate is the deciding body on water policies. In addition to the tasks that can be authorized by the government, the Supreme Council for Water and Climate advises on the following:

- The National Strategy for climate change, adaptation with and mitigation of its impacts on water resources;
- National Water Master plan;
- Integrated Water Resources management (IWRM) plans in water basins, particularly water allocation among the different sectors and regions in the country and for the same basin, as well as the requirements for investment and protection and conservation of water resources.

The Supreme Council for Water and Climate consists of:

- The first half of its members includes representatives of the state; water basins agencies; National Office for Electricity and Water Supply (ONEE) and the regional offices for agricultural investment.
- The other half of the representatives include water users elected by their counterparts; housing regional councils elected by their counterparts; representatives of higher education and scientific research institutions in the field of water engineering and conservation; and representatives of national expertise from professional and scientific associations in the fields of water engineering and conservation.

The Council can also call upon any qualified specialist in the field of water to participate in its sessions as needed.

2. Ministry of Energy, Mines, Water and Environment

It is the governmental body that is responsible for the management of natural resources in Morocco, including water. It is in charge of several tasks, including:

- Identifying and evaluation of water resources;
- Monitoring the weather and informing of any weather changes;
- Planning for the development of water resources;
- Transport of water;
- Management of water resources;
- Contributing to the protection of people and property through forecasting and monitoring weather related risks;
- Preservation of the water related infrastructure and resources; and
- Research and development in the fields of water and weather.

3. Water Basins Agencies

Water Basins Agencies were created as public institutions by virtue of Water Law No.10/95. These agencies are subject to the supervision of the government institutions in charge of water. Each water basin agency is assigned with the following;

- Preparing IWRM master plan for resources under its jurisdiction;
- Follow-up and monitoring of the implementation of the master plan for resources under its jurisdiction;
- Granting licenses and concessions for the use of public water domain provided by the master plan under its jurisdiction;
- Providing any needed financial assistance or other (such as technical) support, whether for the protection of water resources from pollution or for the management or use of the public water domain;
- Undertaking water-measurements, as well as hydrological and hydro-geological studies used for the planning and management both at the quantitative and qualitative levels;
- Ensuring compliance with all quality standards and all applicable laws and regulations targeting the protection and rehabilitation of water resources in cooperation with the government authorities in charge;
- Proposal and implementation of appropriate measures, especially the regulatory ones, for providing the population with water in cases of water shortages for mitigating flood risks;
- Management and monitoring the use of water resources;
- Completion of the necessary infrastructure for prevention and mitigation of flood risks;
- Keeping a recognized record of water rights, concessions and granted water wells licenses.

The water basin agency is managed by a management council that consists of:

- Representatives of the State;
- Representatives of the public institutions responsible for the production of drinking water, water for irrigation and generation of hydropower;
- Concerned agricultural chamber,: chambers of industry, commerce and relevant services; concerned regional councils; concerned ethnic groups; and water users associations, etc.

There are nine water basins in Morocco: Souss-Massa-Drâa, Tensift, Bouregreg, Oum Er Rbia, Loukkos, Sebou, Guir-Ziz- Rheris, Sakia El Hamra, Oued Eddahab, and Moulouya.

4. Regional Office for Agricultural Development (ORMVA)

The "Regional Agricultural development Office" is a public institution with both civil and financial independence, and that reports to the Ministry of Agriculture. The office is responsible for storing, collection, distribution and transfer of water from or to agricultural institutions. The water intended for use by farmers is generally allocated according to their region based on certain decrees that include the areas designated for this issue. As for the management of the regions allocated to the office from the public water domain, it is managed by authorization from the relevant Minister by virtue of the decree issued on 11 Muharram 1344 (August 1, 1925) concerning the water law. The office operates public facilities for irrigation and reform purposes.

5. National Office for Drinking Water (ONEP)

ONEP is a public institution founded in 1972. It has an industrial and commercial character as well as financial independence. The main functions of ONEP include the following:

- Planning the supply of drinking water within the Kingdom and programming of projects;
- Carrying out studies related to drinking water supply as well as ensuring the establishment of production and distribution units;
- Monitoring the quality of produced and distributed water as well as control of pollution or drinking water;
- Providing distribution services as commissioned by local municipalities;
- Participation and technical assistance: conducting studies in partnership with the relevant ministries; and
- Preparing legislative and regulatory text as needed and as relates to its functions.

As of October 2000, ONEP was assigned to manage the sanitation sector in centers that fall under its jurisdiction. And as of 2004, ONEP was assigned with supplying drinking water in the rural areas. The strategic foundations of ONEP include:

- Improving and securing the supply of drinking water in urban areas;
- Securing the supply of drinking water in rural areas according to the principle of the right to water; and
- Effective intervention in the sanitation field to protect the environment and water resources.

The table below shows the most important indicators for drinking water:

Table 2: Key Indicators
(Source: Planning Department/Resources Planning Section)

Indicator	1975	1985	1995	2011
Production (MCM / year)	350	600	740	920
Supplied population (million)	7.6	11.4	15.5	30.7
Urban areas	5.3	9.4	13.7	18.4
Rural areas	2.3	2.0	1.8	12.3
Access to water networks in urban areas (%)	83	97	100	100
Access to water in rural areas (%)	22	17	14	92

The following are ONEP's achievements in the area of wastewater up till the end of 2011:

- ONEP became responsible for managing sanitation services in 83 municipalities;
- Construction of 46 treatment plants with an overall capacity of 174,000 m^3/day, thus contributing to raising this capacity from 6% in 2005 to 24% in 2011, taking into consideration the achievements of the municipalities;
- Operating about 6,000 km of sewer and rainwater collection network; and
- As for investments: ONEP completed several projects between the years 2000 and 2011 with a total value estimated at 5.76 billion dirhams, benefiting 3.2 million people spread over 83 cities and centers.

6. Municipal autonomous agencies for the distribution of water and Electricity

Any autonomous municipal agency for the distribution of water and electricity is a public institution with a commercial and industrial character. It enjoys administrative and financial independence in accordance with Decree No.2.64.394 dated September 29th, 1964 concerning municipal agencies with legal character and financial independence. The agency reports to the Ministries of Interior and Finance, as well as being monitored by the State`s financial control of public companies and other institutions. According to this decree, the municipal councils and municipal union committees that decide - to ensure public interest of an industrial or commercial character – on the creation of an office that has legal character and financial autonomy, decide on the amount and type of appropriation to the office. A draft of the internal system should also be added to the constituent decision. This decree shall determine the scope of the special regulations for each particular office especially the specifications for operation purposes. The agency is headed by a board of directors and a management committee, and a Director to manage the work.

Table 3: Municipal Autonomous Agencies
(Source: Own, 2013)

Agency	symbol	Date of Establishment	tasks
Autonomous agency for distribution of water and electricity in Fez	RADEEF	1969	Water-Sewage-Electricity
Autonomous agency for distribution of water and electricity in Sa	RADEES	1972	Water-Sewage- Electricity
Autonomous agency for distributing the new water and electricity nd Jadida	RADEEJ	1971	Water-Sewage- Electricity
Autonomous agency for distribution of water and electricity- Meknes	RADEM	1969	Water-Sewage- Electricity
Autonomous agency for distribution of water and electricity -Oujda	RADEEO	1976	Water-Sewage
Autonomous agency for distribution of water and electricity- Taza	RAEETA	1978	Water-Sewage- Electricity
Autonomous agency for distribution of water and electricity Kenitra	RAK	1970	Water-Sewage- Electricity
Autonomous agency for distribution of water and electricity Tadla	RADEET	1981	Water-Sewage- Electricity
Autonomous agency for distribution of water and electricity Larache	RADEEL	1996	Water-Sewage- Electricity
Autonomous agency for distribution of water and electricity Chaouia	RADEEC	1976	Water-Sewage
Autonomous agency for distribution of water and electricity Marrakech	RADEMA	1971	Water-Sewage- Electricity
Multi-service autonomous agency Agadir	RAMSA	1982	Water-Sewage

Legal and Regulatory Framework of the sector

The legal and regulatory framework distinguishes between:

1. Stakeholders - drinking water production: production of drinking water is distributed as follows:

   - ONEP is the most important producer on the national level: 80% (920 MCM in 2011);
   - Distribution agencies, private sector companies and municipalities: 20%.

2. Stakeholders - distribution as well as management of sanitation sector in urban areas: these services are under the jurisdiction of local municipalities established under the sponsorship of the Ministry of Interior in accordance with the requirements of the communal charter. There are currently four applied approaches to run these services in urban areas:

   - Delegation of management to private companies for sanitation services and electricity and drinking water distribution Lydec: SUEZ Group in Casablanca since August 1997; Redal: Veolia group in Rabat since January 1999; Amendis: Veolia group in Tangier and Tetouan since January 2002;
   - Management through the municipal autonomous agencies in major cities, and there are currently 12 agencies in each of Agadir, Marrakech, El jadida,Sa, Settat, Beni Mellal, Kenitra, Meknes, Fez, Taza, Oujda and Larache.
   - Delegation of management to ONEP: The o ce manages the distribution of drinking water in small and medium-sized towns, if local municipalities are interested (595 centers in 2011). ONEP subscribers/ customers reached around 1.5 million subscribers. After amending the law for establishing ONEP in the year 2000, the latter started engaging in sanitation services in the centers where it is responsible for drinking water distribution at the request of the concerned municipalities (83 centers in 2011).
   - Management through local municipalities in the remaining municipalities.

Key Documents that Guide sector Management

Applicable Policies and strategies

Successive Moroccan governments have strived to give water utilities great importance by developing and updating the national strategy in this field whenever necessary. This strategy focuses on the effective management of water demand:

1. Reducing demand by 2.5 BCM per year;
2. Management and development of available supply (mobilizing water resources: 5 BCM per year);
3. Protection of water resources and preserving the ecosystem (preservation and recharging water basins artificially; protection of water resources' quality and pollution prevention through the implementation of national programs for sanitation and pollution prevention; and preservation of basins, oases and wetlands);
4. Minimizing the impact of water associated risks and adaptation to climate change (improving the protection of people and property against flooding through the implementation of a national program for the protection against floods; fighting the impacts of drought through the implementation of a drought management program on the level of water basins agencies);
5. Proceeding with legislative and regulatory framework reform (completing the applied provisions of the Water Law; and reviewing the Water Law in order to make it more compatible with the present and future requirements); and
6. Modernization of management, developing the skills and qualifications of human resources (developing and qualifying human resources; updating working tools and methodologies; capacity development of professional and technical competencies; and supporting scientific research).

Water Law

In 1995 the public authorities issued the law 10/95 or what is known as the "Water Law". This law seeks to adopt a national water policy based on a future vision that takes into account the development of water resources on one hand, and national requirements on the other. This includes legal measures designed to rationalize the use of water, improving access to water, assuring collaboration of authorities, and addressing of disparities between cities and rural areas within the framework of programs that aim to achieve water security at the level of the entire Kingdom. Some of its most important cornerstones include:

- Decentralized management on the regional level in the context of water basins;
- Inclusion and participation of all water users;
- Development of economic mechanisms to encourage economic use of water and preserving it under the principle of "polluter pays and user pays";
- Developing IWRM master plans in order to plan for the sustainable management of water resources at the level of authorities in a participatory agreed upon framework in order to improve the living conditions; and
- Modernization of water basins agencies that ensure the integrated and decentralized management of water resources.

The provisions of the Water Law focus on the following:

- Water as a public domain;
- Acquired rights for the public water domain;
- Preservation and protection of the public water domain;
- Planning for water basins and the use of water resources;
- General conditions and terms for the use of water;
- Fighting water pollution;
- Water designated for food production purposes;
- Prerequisites for the exploitation and sale of natural water for medical purposes as well as the so called "spring water or bottled water";
- Provisions relating to water for irrigation;
- Provisions relating to the use of water in cases of a drought,
- Transitional and miscellaneous provisions;
- Municipalities and water;
- Water police: offenses and penalties.

Communal Charter

In terms of decentralization, it can be said that Morocco initiated its approach rather early, where the Communal Charter, which was adopted on the 30.09.1976, appeared to expand the responsibilities of the municipal councils. Two more communal charters were adopted in 03.10.2002 and 18.02. 2009/2007 in order to develop local governance; modernize local administrations; strengthen civil unity; and improve the management of public utilities. The Communal Charter has stipulated the following in article 39:

"The local Council decides on the creation and management of public utilities, particularly in the following sectors: - supply and distribution of drinking water – electrical power distribution - sanitation - collection of household waste and similar waste, its transfer to public landfills - public lighting - public urban transportation –- transporting the sick and wounded - slaughterhouses and transport of meat and fish – graveyards and facilities for the transportation of the deceased."

The Council decides on the manner in which public utilities are to be managed: directly by the agency, an independent agency, a concession and any other approach such as delegated management of public facilities in accordance with applicable laws and regulations.

Law of Delegated Management

Delegated management or delegation of authority is a contract whereby a legal person called "the delegator" who is governed by public law, authorizes for a limited duration the management of a public utility assuming its full responsibility to a legal person governed by public or private law –called "the delegate" which entitles him to collect fees from those customers, and to make profits of the said management or both. This is known as Law No. 05-54 or delegated management of public utilities. From these definitions we conclude that a delegation of management has the following characteristics:

- It is a management contract that includes three key elements: an agreement, a scope statement and annexes;
- It concerns the management of a local public industrial or commercial utility;
- It is a contract that combines between two parties: a delegating authority, which is a legal entity governed by public law with financial independence, and the delegate representing a private legal entity, either national or foreign; and
- The companies with authorization are subject to the labor law.

The aforementioned law expects the delegate to be established in form of a company subject to Moroccan law, whose purpose is restricted to the management of the public utility, as well as the stipulation of law concerning the principle of retaining customers and their acquired rights by the delegate, and transparently providing financial information of the delegated management to the delegating authority.

The law 05-54, which consists of 34 articles, specifies the legal and accounting system as components of the delegated management, especially due return and repossessed goods, with the possibility of mortgaging the return assets by the delegate according to precise conditions, intended to preserve the continuity of the public utility in the event that the latter cedes to perform his trust in favor of the delegator, as well as the requirements of rights and duties of the delegator and the delegate, in which the law grants the latter the right to use the public domain with the help of the delegator. The general stipulated principles include:

- Respecting the principle of competition and transparency: call for competition, direct negotiation, economic and financial balance for the delegated management contract;
- The delegate holds the responsibility for the risks of managing the utility he was commissioned with;
- Follow-up of the delegated management and monitoring of the implementation of the contract;
- The public domain is under disposal and assets that shall be compulsorily returned to the delegator at the end of the delegated management can also be subject to mortgage; and
- Possible resorting to arbitration and possibility for the delegate to subcontract on part of the contractual obligations.

sPECIFIC Ut ILIt IEs MAn AGEMEn t Iss UEs

Applied t ari□□for Wa□er supply a□d sa□i□a□o□ service□

The tari□ system in force is based on the basic assumptions in which the responsible authorities has taken into account the following considerations:

1. Social considerations, through the creation of social tari□ blocks, and the allotment of speci□c tari□ block to bene□t the low-income population, so that this particular social segment is able to take advantage of this vital service within a rate that suits their purchasing power.
2. The adoption of the budget criteria and the rational management of the available □nancial resources

The used social blocks systems as well as the pricing system are both determined by the Ministry in charge of public a□airs and governance.

The tari□ system distinguishes between the bulk water price at production for the bene□t of agencies and establishments with delegated management, and the retail price at distribution in small and medium centers managed by National O□ ce for Water and Electricity (ONEE). Adopted prices are either ascending depending on the amount of domestic consumption (blocks system), or uni□ed as is the case with other (industrial and preferential) consumption uses. The system also ensures a horizontal cross-subsidy between the urban and rural environments. A vertical cross subsidy can also be possible through switching between the blocks.

As illustrated in tables 2 and 3, the tari□ is often uni□ed during the production for the cities that are being supplied from the same water basin. It includes two joint contributions for the bene□t of small and medium-sized centers managed by the O□ ce and in order to provide rural areas with water, as well as fees for the water basin agencies in return for water supply. The sanitation fee is calculated from the amount of consumed drinking water through water billing. The customer is also required to perform a onetime contribution to connect his/her home to a safe drinking water and sanitation network: as one payment or in installments; the contribution includes neighborhood fee, connection to a sanitation network as well as connection expenses. Within the framework of Morocco`s policy to make water supply more public and enhance the access to water for the Rural areas and the underprivileged, the water sector intended to facilitate the procedures concerning the connection issue through the following;

- Determining the length of the connection by maximum 15 meter, instead of calculating the real length of the connection, knowing that the applicable connection fee (contribution) in rural areas is less than the urban areas by 50%;
- Extending the duration of the water connection fees payment from □ve and a half years (as in the urban areas) to seven years, which enables the low-income population to bene□t from the supply of drinking water and pay the connection fees in installments.

ONEE issues quarterly bills in cities and centers where it manages the production and distribution of water based on the actual, regular and punctual reading of the meter. Errors rarely occur in the meter reading, but are addressed in timely manner if they occur. In order to enhance the collection rate and increase the cost recovery, ONEE facilitates the payment of bills with high amounts if needed ONEE also remains available to all subscribers to provide them with further clari□cations and explanations that are necessary to address all the complaints that may occur in this regard. Despite the fact that the current tari□ system has contributed e□ectively in bridging the investment and management needs, however it is now su□ering from several disorders, including for example:

- All consumers bene□t from the social blocks (vertical cross-subsidy) system, regardless of their standard of living;
- Informal professional sector bene□ts from the block system intended for domestic consumption;
- The current tari□ system is not conducive of water demand management and optimizing consumption;
- Due to ecological and environmental considerations a tari□ reference must be adopted that is based on the amount and extent of pollution caused by industrial and manufacturing facilities, in order for that to be used as a base for calculating sanitation fees.

In general, ONEE exerted many e□orts that contributed to the improvement of the level of service including:

- Expanded representation across the Kingdom;
- Establishing customer service locations for water billing and payments and other services;
- Establishing customer service locations for bills payment in countries with a Moroccan community such as in France, Italy and Belgium;
- Modernization of managing customer services through the adoption of a new information system;
- Establishing a customer call center prepped with a number for receiving calls and an electronic portal;
- Simplifying administrative procedures related to bene□tting from connection and supply services;
- The adoption of a social approach by facilitating payment of connection fees for drinking water and sanitation;
- A personalized handling of all the requests and questions raised by customers.

n o□-Reve□ue Wa□er

NRW refers to the di□erence between the total quantity of produced or pumped water into the network to be provided for subscribers and billed and legally consumed water as it arrives to subscribers through their meters. It is often di□ cult to determine the water consumed illegally, therefore it is estimated in an arbitrary way, in order to calculate the amounts of produced and billed water. NRW is estimated to be 30%.

NRW is caused by a variety of reasons, including inaccuracies in meters reading, the quality of used meters or the method with which they were installed, inappropriate meter sizes, illegal use of water, water loss at source and during transmission, physical leakage in distribution networks, high network pressure, and inadequate maintenance of networks and pumps.

ONEE cooperates with local authorities to implement measures that target the reduction of NRW, including identifying and controlling physical leaks whether with local micro contractors or through ONEE crews; optimizing energy consumption; delegating engineering studies and assessments to capable contractors; delegating various operational functions; facilities and assets maintenance, operating pumps; outsourcing the security of facilities; identifying leaks on main lines and in distribution networks; detection of illegal use; identifying and documenting the locations of pipes and valves; developing plans for the reduction of NRW, etc.

E□ergy E□ cie□cy

Energy expenses are the second most important component in the overall cost of production and distribution of drinking water, and comes after salaries of sta□. These expenses reach to more than 500 million Moroccan Dirham (equivalent to 50 million Euros).

Applied E□ergy E□ cie□cy Mea□re□o□ □he Orga□iza□o□al Level

- Holding assessment seminars with regional directorates/Administrations;
- Simplifying procedures for changing limits for power usage in facilities to reduce associated penalties; and
- Completion and implementation of a computer program, to store and analyze related data available within a database, and training technicians to use it.

Applied E□ergy E□ cie□cy Mea□re□o□ □he t ech□ical Level

- Renewal of low e□ ciency motors and pumps;
- Tracking consumption in order to determine optimum subscription power;
- Performing energy audits;
- Tracking pumping periods in order to reduce them during peak hours (the highest price for a kilowatt hour);
- Arranging the exploitation of water resources using the Kilowatt hours indicator and starting with the lowest per produced cubic meters;
- Periodically reviewing the e□ ciency of motors and pumps in use; and
- Improving the power factor in active pumps and equipments.

However, Morocco is confronted by many difficulties and challenges in this regard, including:

- Inadequate capacity of reservoirs;
- Difficulty in implementing periodic reviews of the efficiency of motors and pumps in use;
- Difficulty in coordinating between distribution agencies and ONEE concerning management of distribution reservoirs,
- The impact of drought periods on water levels in the exploited wells,
- Too few experts in energy audits specifically in the field of water and sanitation.

Advanced Maintenance Management

ONEE is currently entering into a partnership with a French company to apply a Geographic Information Systems (GIS) program that was planned to be completed in 2013.As for maintenance, ONEE completed the necessary documents and scope statement for the acquisition of a Computerized Maintenance Management System (CMMS)--expected to be implemented in 2014. In the meantime, maintenance activities of the water networks and sanitation are being documented and reflected on maps, using traditional means in addition to a database on the computer. Maintenance activities are managed according to a procedure that is prepared in advance for this purpose and that has been circulated to all regional directorates/Administrations.

COnCLUsIOn

The Moroccan experience in the field of managing water utilities enabled Morocco in the following issues:

- Establishing public institutions with substantial experience in in the field of management of the water sector;
- Encouraging the creation of professional capabilities locally and internationally in engineering firms;
- Supporting the creation of a network of private companies that are capable of accomplishing major projects;
- Creating sophisticated and advanced laboratories to monitor and control the work;
- Creating Institutes, schools and universities specializing in the field of water.

Furthermore, the practices and the national experience gained have broadened the opportunities for ONEE. All the above is manifested through the following projects:

- Managing the water services in Cameroon in the Cameroonian water company starting on the 2nd of May 2008 according to a Public-private Partnership (PPP) contract.
- Managing water supply and sanitation (WSS) services in Port of Tangier through the Mediterranean Tangier Services Company starting on the 1st of September 2008 according to a PPP contract.

REFERENCES

- Reports from the Administrative Council of the National Office for Drinking Water.
- http://siteresources.worldbank.org/NEWSARABIC/Resources/Morocco_water.doc.pdf Law 40.09 concerning the National Office of Electricity and Drinking Water.
- Law No. 10.95 related to Water.
- Law No. 54.05 related to the delegated management for public utilities.
- Presentation by The National Office for Drinking Water: Directorate for Drinking Water Supply - Directorate of Commerce and Marketing - Planning Directorate (Esami Abdul Salam, Head of Needs and Resources Planning).
- Presentation by Projects Directorate.
- Morocco's Fiftieth Report.
- Web portal for Morocco www.maroc.ma.
- National Report 2009 - Millennium Development Goals - March 2010.
- Display of the State book at the Ministry of Energy, Mines, Water and Environment in charge of water and the environment – Najeeb Banbibah - October 2010.

MAURITANIA

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ACRONYMS

CM	Cubic Meter
HDI	Human Development Index
Km	Kilometers
MDGs	Millennium Development Goals
NGOs	Non-governmental Organizations
NRW	Non-revenue Water
NWC	National Water Council
UN	United Nations
UNDP	United Nations Development Program
USD	United States Dollars

In t RODUCt IOn

Water and sanitation utilities around the Arab countries are confronted with many di□ culties and challenges as they strive to make organizational improvements. Water sector utility managers must consider a wide range of issues in their management improvement initiatives. General economic conditions, sta□ turnover, communication between internal management and relevant external stakeholders, involvement of sta□ across the organization, aging and occasionally decaying infrastructure, applied rate issues, and limited sta□ resources are some of the issues managers address.

The case study will focus on speci□c utilities management practices that is applied in Mauritania, such as services costs and revenues according to the applied tari□, non-revenue water, assets management and energy e□ ciency.

Cou□□ry Backgrou□d

Geographic Loca□o□, Area a□d Popula□o□

Mauritania is located at the western coast of Africa, bordered by the Atlantic Ocean to the west (with 720km coastline), Morocco and Algeria to the north, Senegal to the south, and Mali to the east. Mauritania is well known for its desert lands and small population – estimated at 3.2 million as of 2011 with a total area of 1,085,000 km2.The country receives less than 200mm of rainfall annually. . The frequent drought events have contributed to the emigration of population from rural areas to urban areas, which in turn have put tremendous pressure on the water and sanitation infrastructure.

Geography a□d t opography

The topography of Mauritania consists primarily of plateaus and plain □elds, where the latter stretch over vast areas. In addition, rocky mountains also exist, referred to as "Gallaba" by the locals; those are mountains of medium elevations of which the highest include: "Kadiat Al-Gill Mountain" (elevation of 950 m) in the State of Tierse, "Ashnaf Mountain" in the State of Takant, and Al-Isaba mountain series.

River□ Lake□a□d Dam□

The hydrological system of groundwater is marked by its complexity due to the discrete water layers within the aquifers, whereas formation of groundwater depends on two main characteristics - porosity and rainfall amounts. Some aquifers are considered important due to the quality and amount of water available. In addition, the coastal sedimentary water basin (Itrarza, Binshab and Belnwar) and the South-eastern part of Tawden water basin (Al-Thuhr Lake), have continuous water layers.

As for surface water, Mauritania has several important sources, which of particular importance include the Senegal River and its tributaries. Furthermore, there are important permanent lakes and swamps as well as water streams, which till today are ine□ ciently utilized. An agreement was signed between Mauritania, Senegal, Mali and Guinea to regulate the participatory usage of the Senegal River water based on its main cornerstone.

The available water in Mauritania is allocated as follows: 88% for agriculture, 9% for municipal use, and 3% for industrial use.

Clima□e

Given its geographical location, Mauritania is characterized with a very dry climate, resulting in the low population density. This is in addition to several drought events, which a□ected severely and doubled the areas of deserti□cation. There is a high disparity between the temperatures during daytime and night time. During the day, temperatures at coastal areas are moderate, due to sea breeze. Occasional dry and sandy winds cover orchards and villages which are still combating deserti□cation.

Eco□omy, Popula□o□ a□d s ocio-eco□omic Develope□□

Minerals (steel and gold) and □shing are the main pillars of Mauritania's national economy. Steel comprises 40% of exports. The shores of Mauritania are amongst the richest shores of Africa. In 2011, the United Nations Development Program (UNDP) stated that Mauritania witnessed remarkable progress in terms of the Human Development Index (HDI), where the annual growth rate increased by 1.25% from 1990 till 2010; the highest compared to any other rate of southern Saharan and Arab countries.

Achieving the Millennium Development Goals

In 2000, Mauritania adopted the United Nations (UN) Millennium Declaration. In addition, it has pledged to reduce the proportion of population without access to regular and sustainable water and sanitation services. It is anticipated that by 2015, access to water will reach 74%, which is in line with goal 7 of the Millennium Development Goals (MDGs).

sector Overview

the Institutional Framework of the sector

Several reform processes have been undertaken, in order to create an institutional framework that is in line with the guidelines of the Sector Development Strategy adopted in 2009, and the guidelines of the Strategic Master Plan for combating Poverty (2006-2010).

In 2005, an autonomous ministry was mandated officially with water and sanitation (Ministry of Water and Sanitation), instead of the Ministry of Energy, Water, and New Technologies. On the central level, an institutional framework was adopted which provides for the structuring and organization of the central management. Several economic stakeholders participated in the water sector reform process, through providing funds to undertake studies which address the reform process of the sector and improving its capabilities.

The National Water Council (NWC) along with its permanent and regional committees, sets consultation processes on the central and regional levels for all involved stakeholders within the water and wastewater sector (public sector, local communities, Non-governmental Organizations (NGOs), private sector), to improve and build good sectoral coordination schemes. The following presents the functions and assignments of the Ministry of Water and Sanitation and its affiliated institutions:

1. Planning, Follow-up and Cooperation Directorate: responsible for developing sectoral development plans, conducting assessment studies and improving cooperation.
2. Water Directorate: mainly involved in strategic issues through developing and executing water sector policies and strategies. Within this context, the Directorate prepares development plans, follows up on implementation of programs, enforces the water law, and coordinates and monitors activities of water sector companies and institutions.
3. Sanitation Directorate: responsible for developing and implementing sanitation sector policies and strategies. It also prepares sector development plans and ensures and monitors program implementation.
4. Hydrology and Dams Directorate: participates in developing and implementing public policies and strategies related to collection of surface water, as well as monitoring the meteorological and hydrological cycle. It also prepares development plans and ensures and monitors program implementation.
5. Regional Directorates: plans and coordinates activities related to water and sewage in designated regions.
6. The National Center for Water Resources: a government institution responsible for exploring, assessing, following up and protecting water resources.
7. The National Water Company: established by virtue of law No. 88/2001, on 29 July 2001, regarding the division of "Sonlak" into two companies for production, transportation, and distribution of drinking water in urban areas.
8. The National Office for Sewage Services: responsible for managing and monitoring sewage networks and rainwater as well as sewage water treatment plants in the country.
9. The National Office for water services in Rural Areas: responsible for production, transmission and distribution of drinking water in rural area.
10. The National Company for pipe and traditional water wells, responsible for improving the national implementation capacity of pipe wells and traditional wells, and controlling their cost on the national level.
11. Municipalities are also involved in the water sector by developing their own water facilities depending on self financing capabilities or through decentralized cooperation.
12. Other partners (institutions, consultants, NGOs, etc.) participate in the implementation of projects.

Legal and Regulatory Framework of the sector

A legal, regulatory, and financial framework has been developed for the water sector. The valid Water Law, endorsed in 2005, assigns the authorities of the Ministry responsible for the water sector. The Law also stresses on maintaining water resources and determines delegation methods and responsibilities in for supervision on activities. It also identifies authorities of the Multi – Sector Regulatory Authority that also includes water

sector. The financial decentralization of the budget preparation started in 2005. A medium term expenditure plan was set for the period 2007 – 2010. Regulations and instructions for the implementation of Water Law were endorsed.

Key Documents that Guide sector Management and Related Investments Programs

Key investments in urban areas started in recent years, amounting to around $600 million; $450 million of which are for the Aftout Coastal project and $130 million for water distribution in Nouakchott. As a result of investments made in several cities (such as Noathibo, An-Na'mah, etc.) and the re-acquisition of some centers of the National Office of rural Water Services, the coverage of the National Company for Water spread from nine cities in 2001 to twenty four cites in 2012.

Furthermore, the operation of Aftout facilities, which produce 90,000 cubic meters per day, reduced the water deficit in Nouakchott and reduced water extractions from Edini Lake. it is expected that increasing the production in Nowathibo will help meet the water demands of the city till 2030, where rehabilitation and expansion of the water distribution network in the city was ongoing until 2013. Service provision was improved in many other cities in the country.

With regards to the role of the private sector, Law no. 30/2005 issued on 2 Feb 2005 includes the water code, and identifies conditions for provision of public water (chapter 8), whereas Decree no. 107/2007 issued on 13 April 2007 identifies the authorization ceiling of distribution of drinking water for a population of 500 inhabitants.

sPECIFIC UtILItIEs MAnAGEMEnt IssUEs

The following table presents some of the performance indicators of the drinking water sector in Mauritania between 2004 and 2008:

Table 1: Performance indicators of Drinking Water Sector
(Source: www.acwua.org and www.arabwaterutilities.org)

Indicator	2004	2005	2006	2007	2008
1.1 Water Coverage (%)	59	63	67	39	28
2.1 Sewerage Coverage (%)	N/A	N/A	N/A	N/A	N/A
4.1 Total Water Consumption (l/person/day)	79	77	67	92	125
4.7 Residential Consumption (l/person/day)	40	36	34	40	53
6.1 Non Revenue Water(%)	30	32	36	34	38
6.2 Non Revenue Water (m3/km/day)	15.9	15.6	16.2	17.5	21.9
8.1 % Sold that is metered (%)	100	100	100	100	100
11.1 Operational Cost W&WW (US$/m3 water sold)	0.57	0.51	0.72	0.71	N/A
12.3 Staff/1000 W pop served (w/1000 W pop served)	1.8	1.8	1.5	2.0	2.9
18.1 Average Revenue W&WW (US$/m3 water sold)	0.56	0.61	0.66	0.32	0.36
23.1 Collection Period (Days)	318	326	321	765	N/A
23.2 Collection Ratio (%)	95	105	116	84	N/A
24.1 Operating Cost Coverage (ratio)	0.99	1.19	0.91	0.45	N/A

Applied tariff of Water and sanitation services

Prices are determined by the relevant public authorities in urban areas, and are subject to regular reviews. The National Company adopted the block tariff system taking into account the economic conditions of the more vulnerable segments of society. Summarized below is the applied tariff system for drinking water that is collected periodically every two months:

- Block A: 0-20 Cubic Meters (CM) - 0.34 USD per ton.
- Block B: 20-60 CM - 0.96 USD per ton.
- Block C: 60 CM and above - 1.24 USD per ton.

Non-Revenue Water

In urban areas, cost recovery is low, while the percentage of non-revenue water (NRW)/water losses is high. This is due to: (i) defects in distribution networks which are also considered old, (ii) inaccuracies in billing subscribers and resorting to estimating consumption in some cases, and (iii) lack of maintenance activities for networks and pumps. The table below presents NRW values in Mauritania between 2004-2008.

Table 2: Non-Revenue Water &Water Quantity in cubic meter
(Source: www.acwua.org)

Year	2004	2005	2006	2007	2008
Non-Revenue Water Amounts (%)	30	32	36	34	38

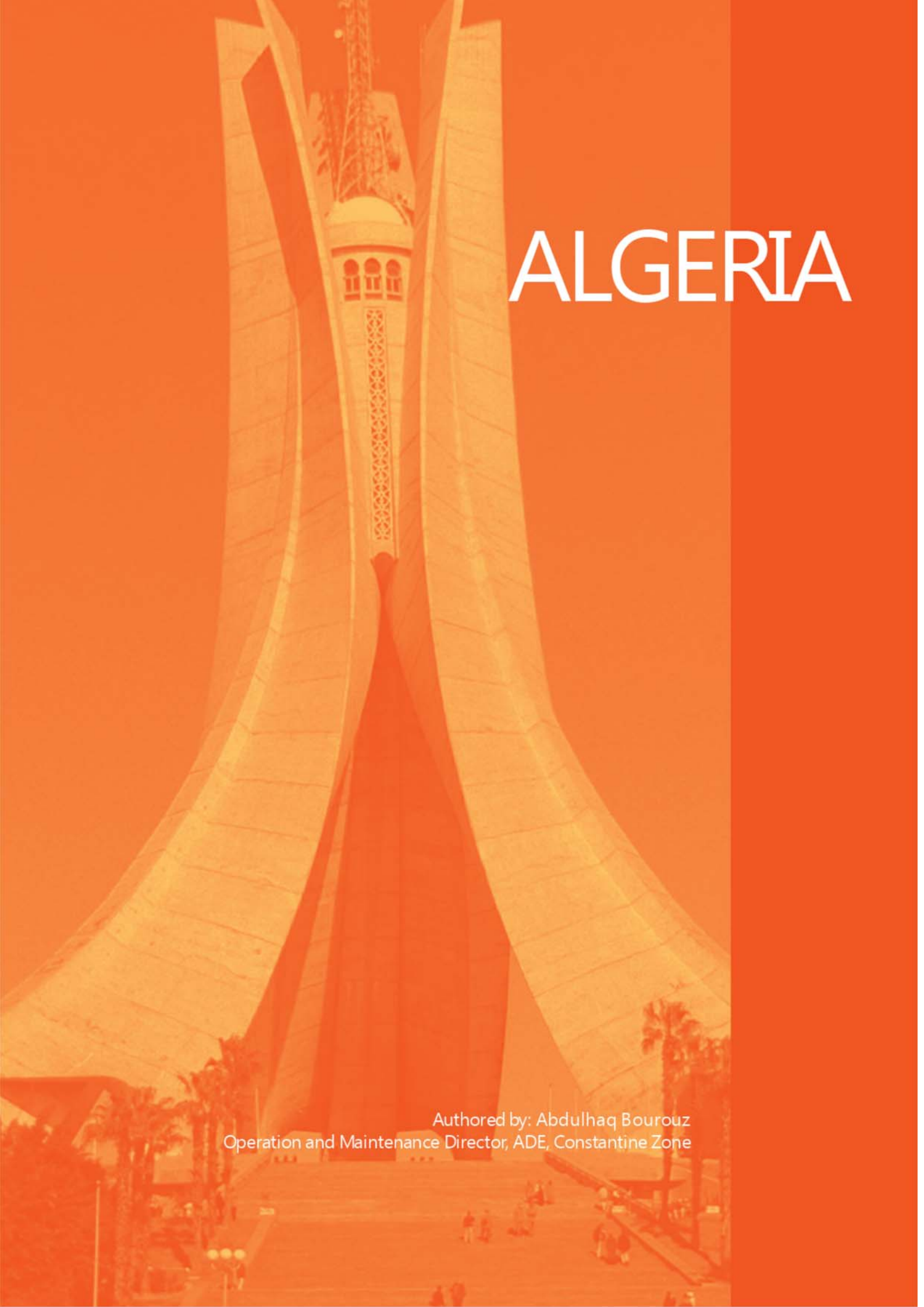
Assets and Maintenance Management

Assets management is yet an unknown concept, but is rather considered in important investments. Currently, an inventory is being conducted for all fixed assets in urban areas as well as the development of an information system to follow-up on management of assets.

In conclusion, the water and wastewater sector in Mauritania still requires development from a technical and institutional perspective, in order to provide the best services to customers whilst ensuring optimal operation of facilities in accordance with international standards and regulations.

REFERENCES

1. Water Code
2. Strategic Framework for Combating Poverty (Work Plan 2011/2015)
3. Various assessment reports
4. IBNET Database



ALGERIA

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ACRONYMS

GIS	Geographic Information System
Km^2	Kilometer Squared
MDGs	Millennium Development Goals
NRW	Non-revenue Water
SCADA	Supervisory Control and Data Acquisition
USD	United State Dollars

In t RODUCt IOn

Water and wastewater utilities around the Arab countries are confronted with many challenges as they strive to make organizational improvements. Water sector utility managers must consider a wide range of issues in their management improvement initiatives. General economic conditions, sta turnover, communication between internal management and external stakeholders, involvement of sta across the organization, aging infrastructure, tari issues, and limited sta resources are some of the issues managers address.

The case study will focus on speci c utilities management practices that is applied in Algeria, such as services costs and revenues according to the applied tari , non-revenue water, assets management and energy e ciency.

Cou ry Backgrou d

Geographic Loca o a d Popula o

Algeria is located in the north western part of Africa, bordered by the Mediterranean Sea to the north (with 1,200km coastline), Tunisia and Libya to the east, Morocco and Mauritania and the Western Sahara to the West, and Mali and Niger to the South. Administratively, Algeria is divided into 48 governorates and 1,541 municipalities, with a population of 36 million and an area of 2,381,741 km^2, while the population density varies from region to region. The population growth rate in Algeria was considered to be amongst the highest in the world, estimated at 3.4%; however, recently it has decreased markedly, as in 2008 it was estimated at 1.78%.

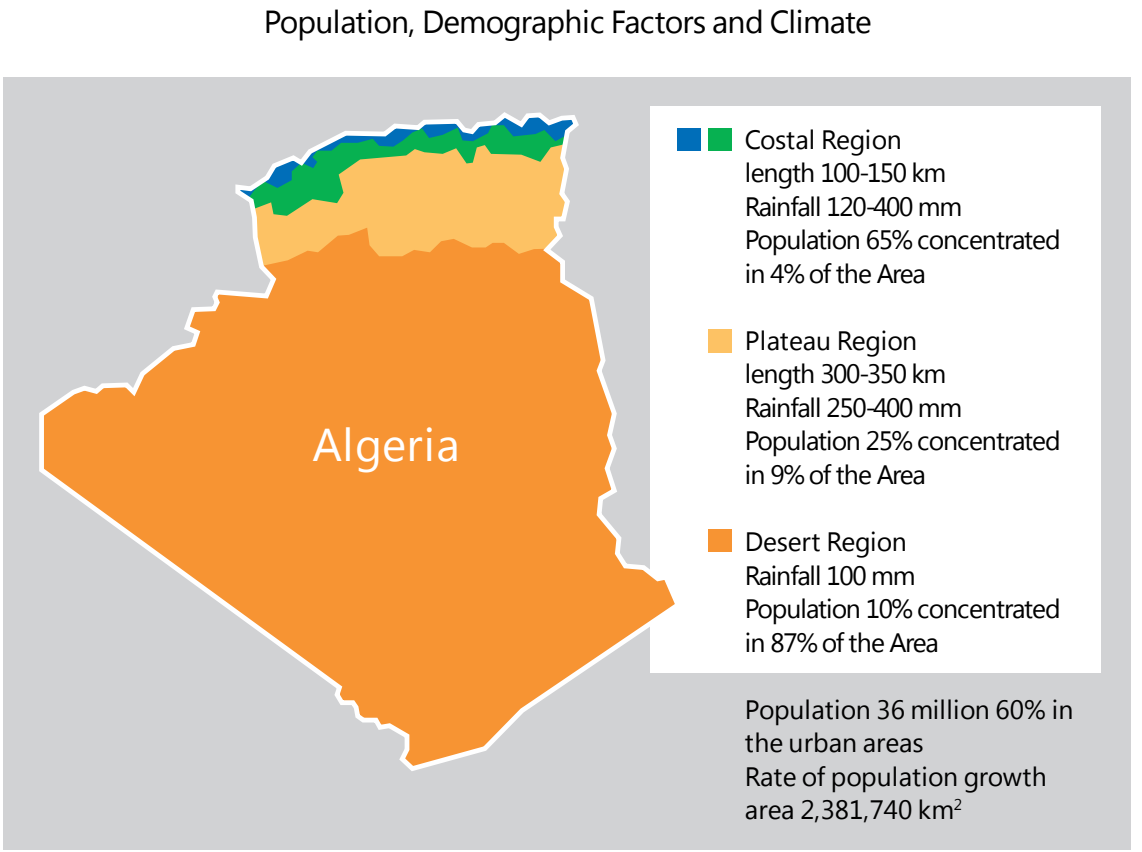


Figure 1: Population and Demography
Source: Own, 2013

t opography a d Geology

Geologically, Algeria is divided into two regions; the northern region and the southern region, and they are separated by the Atlas mountain series. The regions di er in the geological events which took place, and

represent the oldest and latest geological formations in Algeria. Within the desert in the south, geological formations date back to the "Arkevian Age", whereas in the northern region more recent geological formations date back to the □rst geological age; there are recent formations that date back to □rst centuries afterwards, due to variety of activities as well as to the impact of water currents on land in the third and fourth ages.

Algeria is distinguished with its diversity in topographical features between the northern region and the desert hills of the southern region.

The northern region has an area of 381,741 square kilometers, and includes the Atlas Mountain series which extend along the seashore. The mountain series is most known for the Jarjara Mountain, which stands at an elevation of 2,308 meters above sea level.

La□d, River□ a□d Dam□

The southern region has an area of 2 million square kilometers, consisting mostly of desert hills, which most importantly includes Al-Tasili and Al-Haqar hills (at an elevation of 2,918 meters above sea level). Plains extend between the seashore and the hill series which most importantly includes the Muteijeh plain □eld. Within this □eld, some valleys exist with □uctuating water □ow in streams (fast in winter and slow in summer); Chlef valley is the longest and most important of all, with a length of 650 kilometer. There are 85 utilized dams in Algeria, with a total storage capacity of 7 billion cubic meters at 80% capacity as of April 2012.

Clima□e

The prevailing climate in Algeria can be characterized depending on topographical areas within the country. This includes the coastal areas, highlands, and desert areas.

The coastal area extends between 100-150 km, where 65% of the population resides on an area not exceeding 4% of the country's area. The climate within such areas can be characterized as Mediterranean, being moderate and humid during winter and hot and dry during summer, with an average annual rainfall between 1,200-1,600 mm.

On the other hand, the highlands extend between 300-350 km, where around 25% of the population resides on 9% of the country's area. The climate within such areas can be characterized as hot and dry during summer, and cold winters with low rainfall events which amount to around 400mm annually.

Finally, within the desert areas, 10% of the population resides on 87% of the country's area. The climate is characterized as being dry during summer with rare and abrupt rainfall events during winter.

Eco□omy, Popula□o□ a□d s ocio-Eco□omic Develope□□

Revenues from the oil and gas sector are the main pillar of the Algerian economy, and the main source of income – amounting to around 95%. The economic reforms adopted by the Government in 1995 as well as the increase in oil revenues, provided the country with remarkable □nancial resources which were allocated for a wide range of economic projects. Such projects focused on sustainable economic development, as well as meeting the vast demands of the population in many di□erent areas, in particular those related to employment, housing, education, training, health, water supply, energy, etc.

It is worth mentioning, that Algeria is considered an economically promising country, attracting foreign investors and companies seeking to enter new dynamic □elds of investment. To enhance the Algerian economy, in 2001 the Government implemented a plan which included a program to support economic recovery, with an allocated budget of 200 billion USD till the year 2014. The plan aimed at: (i) revitalizing productive agricultural activities, (ii) strengthening public services in the □elds of water supply, transport, and infrastructure, (iii) improving living conditions and development of local human resources, and (iv) Supporting institutional reforms. The share of the water resources sector was around 20 billion USD.

Achievi□g □he Mille□□ium Develope□□Goal□

To achieve the Millennium Development Goals (MDGs), the Government of Algeria was keen on improving the water and sanitation services. To this extent, the following was achieved: (i) 93% of the population has access to drinking water, (ii) 87% of the population is connected to the wastewater network, (iii) the per capita share of drinking water is around 160 liters per capita per day.

sec□or Overview

The water sector in Algeria witnessed signi□cant development in relation to mega projects which were implemented, especially after the year 2000. Such developments secured the population and the various sectors with potable water, and avoided the water crisis which faced the country in the late nineties due to drought. Twenty billion USD were allocated to develop the sector.

The Ins€tu€onal Framework of the Sector

- The reform process introduced by the Algerian Government throughout the last two decades included the restructuring of public water utilities. As a result, the Ministry of Water Resources was established, which is responsible for developing the National Policy for Water Resources, ensuring its implementation and upgrade. A number of agencies and institutions were also established under its tutelage including: Water Resources Directorates within each governorate, for a total of 48 Directorates.
- Five Hydrographic Basin Agencies
- Algerian Water Company: the company is responsible for the implementation of the National Policy for Drinking Water all over the country. Additional responsibilities include the operation, production, transport, treatment, storage, transfer, distribution and supply of drinking and industrial water. Furthermore, it is responsible for developing and rehabilitating the infrastructure within its jurisdiction.
- The National Sanitation Bureau: which is responsible for the protection of water all over the country as well as the implementation of the National Policy for sanitation?
- The National Agency for Water Resources: which maintain statistics on ground and surface water resources and develops maps of springs and their usage.
- The National Agency for Dams: responsible for the development of mega projects for collection of surface water resources (dams), maintaining and protecting existing dams, implementing major works for connecting the dams with each other.
- The National Agency for Irrigation: implements irrigation projects in irrigated areas.

Legal a□d Regula□ory Framework of □he sec□or

The legal and regulatory framework of the water sector in Algeria witnessed remarkable progress in line with the public policy at the national level. This is evident through the endorsement of the Water Law of 2005, as well as several decrees in relation to many issues. This includes in speci□c the following:

- Creation of Algerian Water Company which was delegated through a concession the responsibility of managing water services.
- Creation of the National Sanitation Bureau which was delegated through a concession the responsibility of managing sanitation services.
- Creation of the National Authority for Integrated Water Resources Management.
- Establishing consultation framework for integrated water resources management.
- Specifying the responsibilities of the National Consultative Council of Water Resources.
- Executive decree for prices set for drinking water and sanitation services.
- Two executive decrees that include the terms of reference for the concession contracts for managing water and sanitation services.
- Executive decree for the basic model law of Hydrographic Basin Agency.
- Executive decree for the master plan for developing water resources.
- Decree endorsing the creation of Water Utilities Quality Control Authority.

Key Docume□□□Guidi□g sec□or Ma□ageme□□

The Water law endorsed 2005, in addition to the master plan for developing water resources, are the most important documents that manage and direct the sector. The law identi□es main principles and rules that are applied regarding usage and sustainability of water resources, being a national asset. On the other hand, In January 2010 a decree was issued concerning planning in the water sector in Algeria. It explains how to develop master plan for developing water resources in a consultative approach, up till evaluation and endorsement, as well as identifying regional boundaries. It also speci□ed how to develop the national water master plan, as well as approve it and execute it. The Ministry of Water resources develops those two plans for a period of twenty years, and re-evaluates them every □ve years on the basis of outcomes.

I□ve□□me□□Program□for sec□or Developme□□

Sector investment programs within the past time period included the following:

- Building 19 dams to double storage capacity for surface water to reach 9 billion cubic meters.

- Completion of 13 sea water desalination plants with a total capacity of 2.26 million cubic meters per day to guarantee continuous supply of water to coastal cities, re-allocate surface water to non-coastal cities and provide irrigation to farming plots.
- Rehabilitation of water networks stop water leakage and improve service provision as well as set in place water services management systems by using geographical information systems and maps for leakage detection, and adopting commercial principles and automated services and capacity development. This program covers 32 cities.
- Rehabilitation of sewage networks for the protection of the environment. Forty four sanitation water treatment plants were constructed. Total volume of treated wastewater shall reach one billion cubic meters by 2015, to be used in irrigation.
- Developing awareness programs for communities, industry and farmers, on the importance of the e cient use of water to maintain water resources.
- Training and educating human resources on new methodologies as well as follow up of new technologies.

Role of Private sector in Water sector Development

Private sector has a limited role in the management and the operation of water utilities. Regional companies were created in Algiers, Oran and Constantine to apply modern management and operation and maintenance techniques for water and sanitation, and upgrade technical and scienti c level of human resources there. Each of the three companies signed a concession contract with specialized foreign companies. The contracts aim to improve sta capacities and competences, and apply modern operation and maintenance and management techniques.

sPECIFIC Ut ILIt IEs MAn AGEMEn t Is s UEs

I roduc o

The Ministry of Water Resources is responsible for setting the tari for water and sanitation services, and it delegated this authority to the Algerian Water Company. An ambitious program has been put in place for the rehabilitation of water networks to reduce non-revenue water (NRW) as of 2010.

Applied t ari for Wa er a d s a i a o service

The Government sets water tari s, based on an increasing block system based on level of consumption. The tari system recovers all or part of the costs related to the operation, maintenance, rehabilitation and development of facilities. The issued invoice comprises xed and variable segments as well as a xed charge for e ciency in use and water quality, and operation fees. Whereas the Variable Part is determined in accordance with the actual consumption of water and the operations fees, the Fixed Part is the subscription fee and covers part of the cost of subscription, maintenance of water meter, and connection of the user to the water and sanitation networks. Billing and collection is the responsibility of company or party responsible for providing water and sanitation services.

Table 1: Subscription Fees per Type of Consumption

type of Co ump o	sub crip o Fee i Algeria Di ar	
	Wa er	s a i a o
1st category (Residential)	240	60
2nd category (Commercial and services)	450	60
3rd category (Industry and hotels)	4,500	2,100

The xed charge for e ciency in use and water quality vary amongst areas within the cities, where in northern cities it reaches 8%, whereas in southern cities it reaches 4% of the water bill amount. These charges are considered contributions to the National Fund for Integrated Water Resources Management, by the water

users. As for the operation fees, it is 3 Algerian Dinars per cubic meter billed, and is considered a contribution by the users for the rehabilitation of facilities. These charges are transferred to the national government by the authority in charge for water and sanitation services.

Applied Water and sanitation tariff system

The Variable Part: it includes categories of users according to type of use as follows:
- 1st category (residential): billing takes place quarterly (every three months).
- 2nd category (commercial and services): one flat rate is applied.
- 3rd category (Industry and hotels): one flat rate is applied.

Table 2: The Variable Part per consumers' categories

Categories of Consumers	Consumption (per billing period)	Applied Indices (Water & sanitation)
Residences	0-25 m^3	1
	26-55 m^3	3.25
	56-82 m^3	5.5
	>82 m^3	6.5
Commercial and services	flat rate	5.5
Industry and hotels	flate rate	6.5

Each region has a specific reference rate for water and sanitation services as shown in the following table:

Table 3: Reference Price per Region

Region	Reference Price In Algerian Dinar	
	Water	Sanitation
Algiers, Oran and Constantine	6.30	2.35
Chlef	6.10	2.20
Ouargle	5.80	2.10

The applied tariff for all regional categories is calculated by multiplying the reference price by the applicable index.

Cost Recovery

As is the case in most Arab countries, water is a subsidized good, due to the large difference between cost of service and applied tariffs. The actual cost of each cubic meter is 46 Algerian dinars, which exceeds the average charge estimated to be 18 Algerian dinars. This renders total cost recovery or even operational cost recovery impossible. As a step in the right direction, a number of mechanisms have been put in place according to the Water Law, to compensate the concessionaire for the discrepancy between costs and revenues.

non-Revenue Water

NRW is at 50% including physical leakages, non-billed water and illegal connections to the main network. This percentage is calculated by defining the volume of billed quantities and dividing it by volume of total water produced. Several measures have been taken to minimize NRW, including:
- Rehabilitating the water distribution networks to reduce physical leakage events.
- With the help of police, combating illegal connections.
- Installation of water meters.
- Submitting plans for the rehabilitation of old networks to the relevant governmental entities such as the Ministry of Water Resources and its regional departments. The plan is to rehabilitate the networks in 32 cities in the next two years.

servi□g □he U□derprivileged

The government tends to provide all rural and remote areas with drinking water through establishing new water distribution networks. Furthermore, as part of the mega projects implemented, water is provided by bulk in rural areas through constructing public water taps. The taps are operated by municipalities or local associations. In few cases, the municipality settles the subscription fees of water supply and sanitation services to such regions. The National Fund for Drinking Water □nances water and sanitation projects in remote and rural areas, while other projects are funded by Ministry of National Solidarity. To mention few of those projects: one project aims to divert water of Taqsbat dam that shall provide water to 200 villages. A second project is to divert water from Bosayyaba dam to mountain villages in Gigel province. A third project is to implement a network to supply Tamenrast City in the south.

E□ergy E□ cie□cy

Energy cost constitutes 47% of the operational costs and 13% of the total costs. Several measures are adopted to control the increasing use of energy in the □eld of water sector, this includes:

- Apply overconsumption penalty charges,
- Amend energy prices with the Electricity Company,
- Correcting the power factor,
- Billing corrections,
- Temporary suspension of contracts with Electricity Company in cases construction work on the levels of institutions;
- In 2010 energy costs were reduced by 9% for water services on the national level.

Several initiatives have been implemented to reduce the energy use and related costs, these include:

- A specialized unit was established to follow up on energy costs in each of the a□ liated water units that represent the Algerian Water Company.
- Pumping stations and water treatment plants were upgraded to reduce energy consumption.
- Water pumping was stopped between 17:00 and 21:00 except in cases of emergency.
- Specialized technical sta□ members were trained in the □eld of energy e□ ciency in the training center in the Algerian Water Company and the Electricity Company.
- In terms of partnerships in this area, specialized employees were trained on the topic to improve capacities and competencies by local and foreign companies specialized in the □eld.
- All listed initiatives were monitored on the regional level to identify reductions in cost of energy, and ensure sustainability.

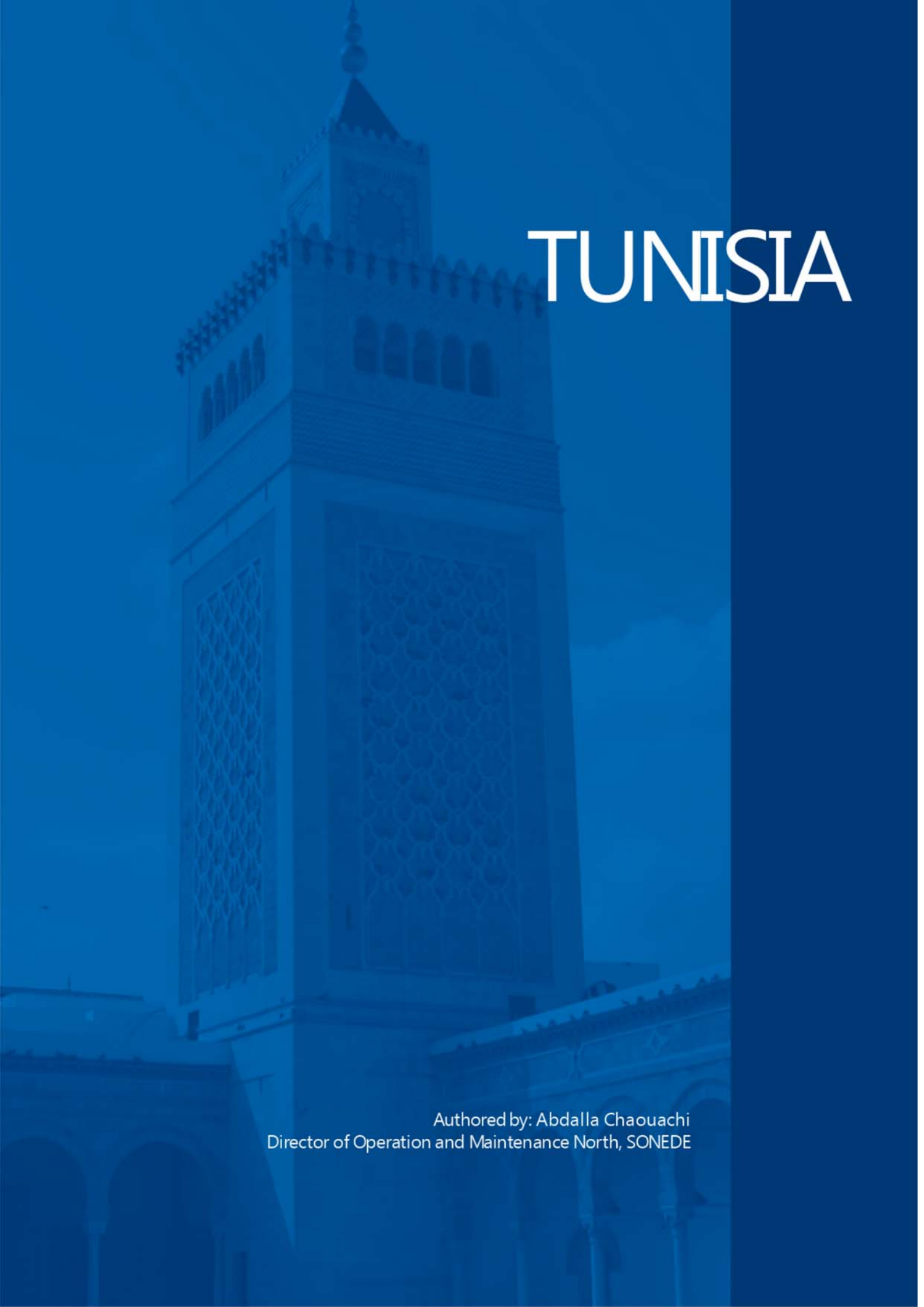
A□□e□a□d Mai□□e□a□ce Ma□ageme□□

In the absence of a central system/body for the maintenance of all water production, treatment and distribution facilities, all infrastructures are managed by special automated software by the implementing institution. Special automated programs are designed for operation and maintenance. The Algerian Water Company seeks to establish a central body to manage maintenance operations, and build a database for all facilities and spare parts used on the national level to protect equipment and machines. On the regional level, there is a local maintenance program in each regional unit that sets a preventive and corrective maintenance schedule. Supervisory Control and Data Acquisition (SCADA) systems are used in desalination facilities, water treatment plants and pumping stations. Geographical Information System (GIS) is also applied in cities that underwent network rehabilitation programs. Furthermore the Algerian Water Company units bene□ted from the GIS to include water quality monitoring points, volumes and pressure. There is also an ongoing project covering 32 cities that entails rehabilitating the networks, and where GIS will be used by 2013.

It can be concluded that the water sector in Algeria has undergone a vast improvement in quality and performance, and is still developing, and this is all due to good planning and policies applied by the State.

REFERENCES

1. Water sector programs
2. The Official Gazette



TUNISIA

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ACRONYMS

CMMS	Computerized Maintenance Management System
DG/BGTH	General Management for Dams and Mega Water Projects
GD/GREF	General Management for Rural Engineering and Water Utilization
MCM	Million Cubic Meter
ONAS	National O□ ce for Sanitation
SONEDE	National Company for Drinking Water Utilization and Distribution

In t RODUCt IOn

Water and wastewater utilities around the Arab countries are confronted with many challenges as they strive to make organizational improvements. Water sector utility managers must consider a wide range of issues in their management improvement initiatives. General economic conditions, sta turnover, communication between internal management and external stakeholders, involvement of sta across the organization, aging infrastructure, tari issues, and limited sta resources are some of the issues managers address.

This case study will focus on Tunisian experience in speci c utilities management issues and the important factors of costs recovery, applied water tari , non-revenue water, assets management and energy e ciency.

Cou ry Backgrou d

Geographic Loca o , Area a d Popula o

Tunisia is located in the far north of Africa, bordered by the Mediterranean Sea in the north and east by a 1,300 kilometers long coastline, Libya to the south east with a 459 kilometers long border, and Algeria to the West with a 965 kilometers long border. Tunisia's overall area is 163,610 square kilometers divided as follows: 33,000 km2 desert, 54,000 km2 farmed areas, 48,000 km2 forests and plains, and the rest is wasteland. Total population is 9,910,900 inhabitants in 2004. According to estimates of Statistics Institute of June 2010, population is estimated to reach 10,549,100 inhabitants; 66% in urban areas and 34% are in rural areas.

t opography a d Geology

Tunisia overlooks the Mediterranean Sea from two sides; the rst one is in the north with a rocky coastline, and the second is in the east with a sandy coastline. The country mainly comprises plains that cover more than half of its area. Those include plains towards the coastline such as Mujarrada Al-Su a, Al-Sahel and Al-Jafara, and inside plains such as Mujarrada Al-Wasta, Al-Olya, Al-Juraid and Nafrawa. Rocky Mountains occupy limited areas within three mountain ranges: the northern shore mountain, the Tunisian Al-dhuhriya Mountain, and Matmata Mountain in the south. As for the coastline, the northern part is rocky and high close to zigzag with deep wide gulf areas such as Tunis gulf, and elevations such as Al-Tayeb area. Behind the shores, there are narrow plains close to the mountains. The eastern coastline is sandy, low with few zigzags and wide gulf areas such as Al-Hammamat, Qabes, Jarba and Qarqana islands. As for the mountains, there is only one mountain range which is the Atlas Range with Khameer Mountain peak being the highest. Highlands spread from Al-Shotout plateau in Algeria west till sandy plains of Al-jareed coastline to the east.

The country is divided into two huge areas with same length approximately: the central area which consists of subsequent low marshlands called Al-Shat; (Shat Al-Garsa, Shat Al-Jareed and Shat Al-Fajij), and the northern area that includes the mountain range from south west to north east. The mountain peak with the highest elevation is Al-Shanani Mountain that reaches 1,544 meters above sea level, and it constitutes the merging point of Atlas Mountain north with mountains of southern Algeria.

River Lake a d Dam

Generally, surface water resources are characterized by their dependence on water ow in valleys, which is irregular in the case of Tunisia. As for groundwater, it is non-renewable in most cases. Groundwater salinity varies according to regions, where it is less than 1.5 g/l for 54% of total amount of water, and 84% in the northern part of the country. Surface water amounts to 2,700 Million Cubic Meter (MCM), and 2,175 MCM for groundwater, which makes a total of 4,875 MCM. Noteworthy is that 83% of water used is allocated for agricultural purposes, and the remaining 17% for all other sectors. These water resources are mobilized by 100,000 surface wells, 5,868 deep wells and 88 springs, and surface water sources are supplied by 92 huge dams, 226 dirt dams and 844 mountain lakes.

There are several valleys and rivers that spread across the country, most of which are in the north. The most prominent valley in Tunisia is Mujarrada Valley. It springs out in Ahras Souq and pours in the Mediterranean near Tunis gulf area. It runs for 350 kilometers in the Tunisian lands out of 450 kilometers total length. It is ever owing, and its water level changes depending on rainfall rate. Its water level varies from 1 to 1,000 cubic meters per second. Water ows through main tributaries such as Kassab valley, Baja valley, Mallaq valley, Tasa valley, and Silyana valley. Main cities and towns that tributaries pass through are: souq Ahras, Jandoubah, Bou Salem, Tastour, Majaz Al-Bab Tabarba and Al-Jadida. Sidi Salem is the largest dam in Tunisia. It is built over Al-Jadida valley. As for lakes, main lakes are Ishkel lake (12,600 hectares), Tunis lake, Benzert lake, Al-Bayan lake and Ghar Al-Milh lake. The table below shows the most important dams in Tunisia, in addition to the year of construction:

Table 1: List of Dams in Tunisia
(Source:Own, 2013)

Dam	Co□□□ruc□o□ Year	Capaci□y MCM
Al-Kabeer	1925	22
Bani Mteir	1954	61.6
Mallaq	1954	270
Bzeirek	1959	6.4
Sheeba	1963	8
Nabhana	1965	86
Al-Akhmas	1966	8.2
Al-Masri	1968	6.9
Kassab	1968	82
Beer Masharqa	1971	53
Bouhartema	1976	117.5
Sidi Saad	1981	209
Sidi Salem	1981	814
Joumeen	1983	130
Ghazaleh	1984	11.7
Lubna	1986	30.1
Silianeh	1987	70
Al-Hawareb	1989	95.3
Sajnan	1994	137.5

Clima□e

The climate of Tunisia is semi arid, due to irregular rain fall in terms of location or frequency. Three types of climates can be observed in Tunisia: the Mediterranean climate in the northern part of the country, where rainfall exceeds 400 mm per annum, and reaches 1,500 mm in some regions. The second is the semi arid climate in the center where annual rainfall varies between 200 – 400 mm, and the third is the dry climate in the south where annual rainfall is below 200 mm. Total rainfall quantity is 36 MCM per year. Only 4.88 MCM are stored in dams which constitutes 17% of the total amount.

Eco□omy a□d s ocio-eco□omic Developme□□

The country's economy relies on agriculture, tourism, industry and services. Per capita is Tunisian Dinars 5,319 (USD3,600). 40% of Tunisians work in services sector, 34% in industry and 26% in agriculture.

s ec□or Overview

The development of the Tunisian water sector has been confronted by three main challenges; namely acute water scarcity (non-renewable water resources at the most part), increasing costs of water services including mobilization, treatment, distribution and transport, and the continuous increase in water demand.

Wa□er Produc□o□

Production of water increased in 2010 by 6.9%. It reached 528.3 MCM from 494.1 MCM produced in 2009. This quantity includes water sold to Qabis Local Society that decreased relatively compared to □gures from 2009 (3.2 MCM). Available water resources in Tunisia include:

1. Surface Water: total surface water produced was 294.3 mm3 compared to 281.3 mm3 in the past year; with an increase of 4.6%. This quantity represents 55.7% of total production and constitutes bulk water purchased from the North Canal and Networks Company and representing 81.3% of total surface water. Bulk water is treated in 13 treatment plants owned by the Company. Main production centers are: Ghadeer Al-Fulla and Bali centers which produce 47% and 33% of total surface water respectively.

2. Ground Water: ground water quantities increased by 10.8% this year, reaching 214.3 MCM. In 2009, the quantity was 193.3 MCM, out of which 84.4 MCM were abstracted from wells across all regions.

Institutional Framework of the sector

There are several organizations that supervise the various stages of water handling, protection and development:

- General Department for Water Resources;
- The National Water Distribution Utility (SONEDE);
- General Department for Dams and Mega Water Projects (DG/BGTH);
- The National Bureau for Sanitation (ONAS);
- General Department for Rural Engineering and Water (GD/GREF).

the national Water Distribution Utility

The National Water Distribution Utility was established as a public institution by virtue of law No. 22/1968, in July 1968, later amended by law No. 21 for 1976 on 21 Jan. 1976. It is categorized as a public institution in accordance with decree No. 2560 dated 23 Oct. 2007. The company operates on commercial basis in accordance with the Companies' Law unless stated explicitly in its law. It is mandated with the production and distribution of drinking water to fulfill water demand across the country. Related activities include water production, treatment and storage, water distribution (operating the networks and maintaining the networks and all related facilities and equipments). It also responsible for undertaking all necessary assessments, studies and works, as well as customer services including water connections, supply and quality control of product. The below table presents the achievement of the National Water Distribution Utility:

Table 2: Achievements of National Water Distribution Utility

Field	Unit	2009	2010	target per Contract	Level of Achievement based on target per Contract(%)
Water Production					
Water production	MCM	494.1	528.3	582.7	99.9%
Surface water	MCM	281.3	294.3	-	-
Ground water	MCM	193.3	214.3	-	-
Desalinated water	MCM	19.5	19.7	-	-
Water Purchase Cost	Million dinar	8.3	9.6	-	-
Power Consumption	Watt/hour/m3	564	574	564	101.8%
Distribution					
Water billed	MCM	366.6	388.4	392.3	99%
Number of Subscribers	million subscribers	2,225	2,304	2,305	100%
Average consumption per billing period	Cubic meters	31.2	31.9	-	-
Rural supply percentage	%	48.3	49	48.7	0.3 point
Total supply percentage	%	82.4	82.7	82.6	0.1 point
Percent connections in urban areas	%	99.2	99.3	99.2	0.1 point
Percent connections percentage in rural areas	%	43.6	44.4	43.4	1 point
Total connection percentage	%	82.3	82.6	82.3	0.3 point
New connections	Unit	80341	83905	80,000	104.9%
Network pipes	km	1009.7	992	1000	99.2%
Revenue					
Total network revenues	%	76.1	76.2	76.6	-0.4 point
Revenues of bulk supply	%	91.6	92.3%	91.8	0.5 point
Revenues of distribution network	%	82.7	82.1	83.2	-1.1 point
Leakages	Leakage	135,859	147,733	-	-
Number of leakages per 1,000 subscribers	Leakage	61	64	-	-
Breaks	Crack	12,313	13,407	-	-
Number of breaks per 100 km of network	Crack	27	28.7		
Handling					
Percentage of connections handling	%	71.5	75.7	-	-
Percentage of handling distribution networks	%	91.7	98.7	-	-
Human Resource					
Total no. of staff	Person	6,875	6,830	6,800	100.4%
No. of permanent staff	Person	5,972	5,979	6,000	99.7%
No. of temporary staff	Person	903	851	800	100.1%
Percentage of organization	%	9	9.7	10.2	-0.5 point
No. of subscribers per permanent staff	Subscriber / staff	373	386	384	100.5%
No. of training days	Day	5,151	6,082	6,100	99.7%

Legal and Regulatory Framework of the sector

Water sector in Tunisia aims at achieving several goals that focus on water demand management and the development of new water resources. For that, the water sector set a futuristic program that follows the nationally endorsed water policy. The program aims at reducing water consumption by 30% of the current level of consumption, and it also aims at controlling the demand of water by 2030, in addition to developing new non-conventional resources such as desalination of brackish water and sea water, the reuse of treated wastewater, and increasing the use of non-conventional water resources by 7% of the total water resources.

SPECIFIC UTILITIES MANAGEMENT ISSUES

Applied Water tariff

The current water tariff set up seeks to achieve three main goals of social, financial and economical sides. The social side strives to enhance the access to water for low income citizens and to meet their basic needs, with low tariff both in urban and rural areas. This ensures the right of disadvantaged groups to adequately receive and access water. The purpose of the financial side is to maintain a utility with good financial health, thus enabling it to plan for and carry out capital investment projects that aim at ensuring sustainability of the sector and continuity of water supply. The core of the economical side is the optimal use of water resources and a control on water demand, and urging consumers to manage their consumption to help protect resources for future generations.
The tariff is set up as an increasing block tariff with seven blocks:

1. Two Social blocks: Tariff equals 21% and 36% of average cost of service respectively.
2. Two blocks for medium consumption: Tariff varies between 45 – 82% of average cost of service.
3. A Fifth block: The tariff is equal to average cost of service.
4. Two last blocks for major consumers: The tariff exceeds the average cost of service (140% and 146% of average cost of service).

Additionally, the tariff system comes in two parts:

1. Fixed amount: depending on meter diameter, it is 3.8 Tunisian Dinar per billing period for almost 99% of subscribers (meter diameter is 15 millimeters). This is important as there are other types where consumption is zero.
2. Variable amount that depends on consumption block, with one tariff per block.

non – Revenue Water

The National Water Distribution Utility takes several measures for water demand management, implemented through various mechanisms. In this regard, the central management body has the role of planning, studying and follow up on national strategic programs in relation to water demand management. On the other hand, the Regional Departments undertake all the functions related to networks inspection, provision of measurement tools, leakage detection, and fixing breaks. As the same level, several other programs are implemented targeting proper water demand management including network rehabilitation (135 kilometers of network per year), rehabilitation of water connections, meters replacement, leakage detection (inspection of 5,000 kilometers per year), installing meters, upgrading all water facilities, maintenance of pressure control tools, awareness campaigns, and seminars on water efficiency and demand management, and the production and broadcast of related radio and television programs.

As for the issue of demand management when it comes to major consumers, four public institutions (one regional hospital and three university campuses) have installed and implemented several water saving measures in their systems. Examples for such measures include rehabilitating and replacing old steel networks and utilizing water saving devices such as those installed on water taps and sprinklers and using pressure pumps and auxiliary meters.

One year after implementing all the above mentioned measures, there was a 53% reduction in water consumption in the universities and 35% in the hospital.

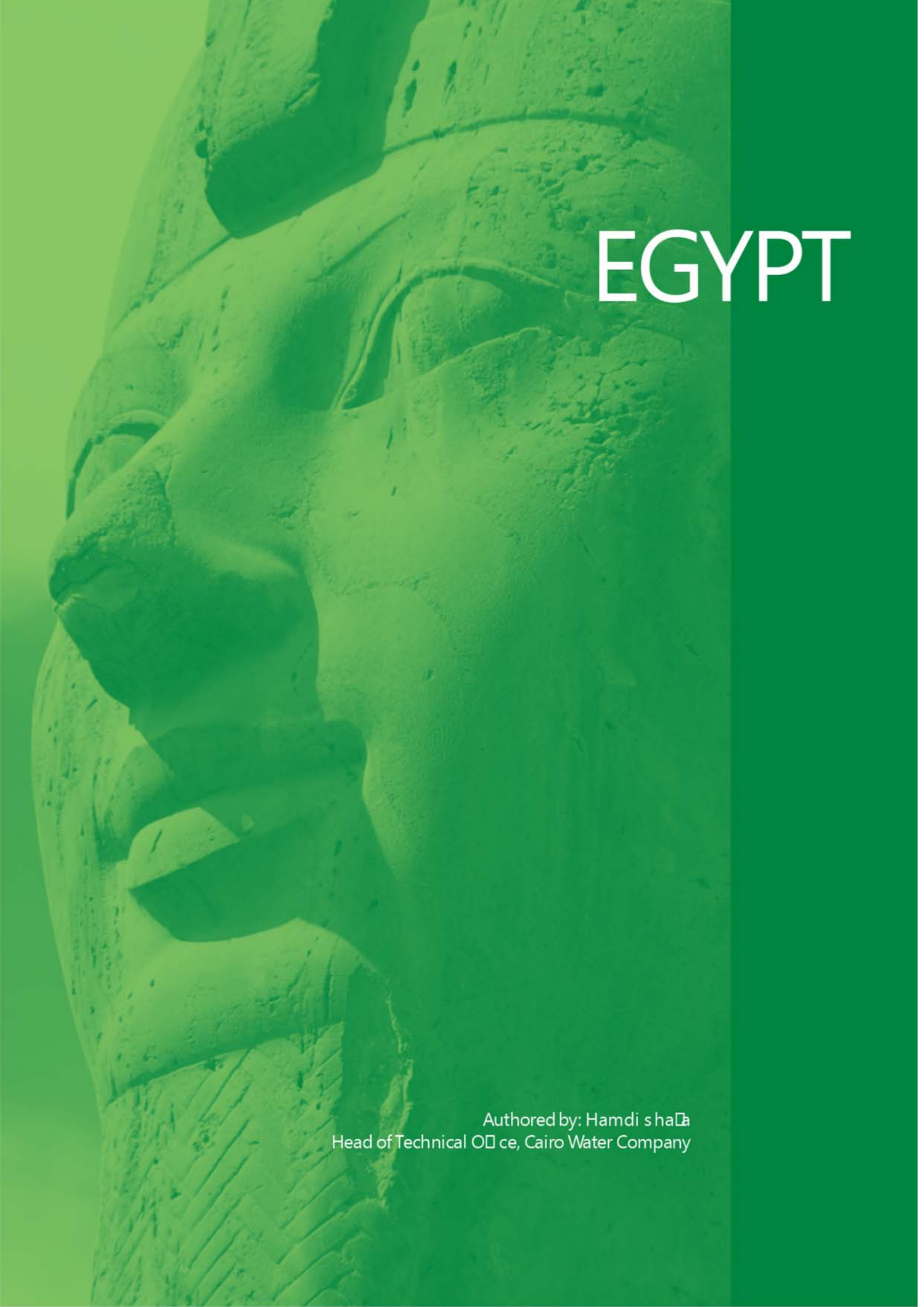
E□ergy E□ cie□cy

In 2010, the National Water Distribution Utility recorded a total cost of energy consumption of 41.9 million Tunisian Dinars (equivalent to 30 million US dollars), which represents 17.7% of total transactions and 14.3% of total cost. In terms of electricity, the total power consumption of the Utility in 2010 reached 317 Giga Watt with a total cost of 38.9 million Tunisian Dinars (equivalent to 28 million US dollars). In addition, fuel consumption reached 2,760 cubic meters for 3 million Tunisian Dinars (equivalent to 2 million US dollars).

Aiming at improving energy e□ ciency, several studies are being conducted to utilize wind and solar power, in addition to equipping pumping stations with data loggers to follow up on energy consumption data and apply proper preventive maintenance programs. Recently terms of reference were developed for the procurement of a Computerized Maintenance Management System (CMMS), this was in line with controlling and optimizing energy use. In addition, energy audits are being conducted in pumping stations with over 2 Giga watt / hour per year power consumption.

REFERENCES

1. The annual report of the General Department for Water Resources, Ministry of Agriculture, 2011.
2. The Annual Report of the National Water Distribution Utility, 2010.
3. The Annual Report for Water Demand Management, 2011.
4. The Annual Census Report of the National Distribution Utility, 2011.
5. The national census for the year 2004.



EGYPT

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ACRONYMS

GDP	Gross Domestic Product
GIS	Geographic Information System
HCWW	Holding Company for Water and Wastewater
MARS	Monitoring, Analysis, and Reporting System
NRW	Non-revenue Water
PHC	Primary Health Care
SCADA	Supervisory Control and Data Acquisition
TSM	Technical Sustainable Management

In t RODUCt IOn

During the last decade, Egypt witnessed signi□cant development in the □eld of water and sanitation, through the establishment of the Holding Company for Water and Wastewater (HCWW) in 2004. Thus public utilities were converted to companies that apply commercial principles. The HCWW and its subsidiaries have spared no e□orts in order to utilize modern technologies, to provide unique services in the □eld of water and sanitation, and to maintain a clean environment, thereby protecting the health of Egyptian citizens. However, HCWW and its subsidiaries shall not be able to reach this goal without the support of the Egyptian citizens and the display of loyalty to their beloved country, through properly managing water demand, conservation of nature and protection of water resources from pollutants caused by the behavior and lifestyle of some individuals.

Cou□□ry Backgrou□d

Geographical Loca□o□, Area a□d Popula□o□

Egypt is located in the northeast corner of the African continent, where it is bordered by the Red Sea from the East, Libya from the West, the Mediterranean Sea from the north and Sudan from the south. It is worth mentioning that part of Egypt is situated in Asia (the Sinai Peninsula). Egypt has been depending on agriculture since 7000 years (the Pharaonic civilization for example). It also has the □rst and largest Islamic educational institute (Al-Azhar). Egypt was honored by being mentioned in the Qur'an more than once ("Enter Egypt, if Allah wills, in security"). Egypt comprises an area of one million km^2 and a population of about 82 million inhabitants. The country is located between the latitudes 22 and 32 to the north and longitudes 24 and 36 to the east.

Egypt is divided geographically into four main sections: the Nile Valley and the Delta, with an area of about 33 thousand km^2, and where the Nile Valley runs for about 10 kilometers alongside the River Nile. Therefore, it is the primary factor that controls the geographical distribution of the population. The Western Desert occupies approximately 680 thousand km^2, and the Eastern Desert with an area of about 225 thousand km^2. As for the Sinai Peninsula, it has a total area of about 61 thousand km^2.

La□d, River□ Lake□a□d Dam□

As for the water resources in Egypt, they comprise the Nile River (86%) - rain and wells (10 %) and seawater (4%). Egypt's share of the Nile water has been steady for half a century. Since 1959 when the population was about 20 million inhabitants and till this day, the Egypt's share of the Nile which amounts to 55.5 billion cubic meters continues. Rainwater and wells are relied upon in the desert areas, while coastal areas on the shores of the Mediterranean Sea and the Red Sea depend on the desalination of sea water. Egypt has a number of lakes, including Lake Nasser, Burullus Lake and Lake Manzala. There are two dams; the High Dam and the Aswan Dam.

Clima□e

Egypt's location to the north-east of the African continent on the edge of the Sahara a□ects the type of the prevailing climate. Egypt is located between latitudes 22 and 32 degrees north, which cause the di□erent climatic conditions from a subtropical warm climate in the South to the mild climate in the North at the Mediterranean coast. The average recorded annual temperature is between 20-25 degrees Celsius. Larger di□erences in temperature are usually between summer and winter as well as between the coastal and inland areas. The Khamasin wind phenomenon occurs repeatedly between February and June. This period represents the temperature change period between the Mediterranean and the desert climates. This is when average rainfall is as its lowest in Egypt, and concentrated along the northern coastline. The winter season in Egypt begins from October until May, accompanied by rainfall and hot and cold fronts that weaken by the time they arrive to Egypt. The climate has a major impact on crop production, especially in the growth cycle, while it is considered relatively ine□ective in other periods. The lands in Egypt are cultivated in the summer and winter seasons.

Popula□o□ a□d socio-eco□omic I□dica□or□

With regards to foreign investments, Egypt has shown a strong commitment to economic reform and structural adjustment of all emerging markets. The national economy is based primarily on the following four sectors: tourism, remittances from Egyptians working abroad, Suez Canal revenues and oil. Among the demographic factors a□ecting Egypt:

1. Illiteracy rate: the last census shows that the illiteracy rate decreased from 39.4% to 28.6%. The government has also set an executive plan aiming at reducing the ratio to 10%.
2. Infant mortality rate: This represents the number of children (less than one year of age) who die each year per thousand live births. In Egypt it amounts to 29.5%.
3. Fertility rate: fertility levels vary from one community to another and are dependent on many of the social, economic, cultural and health factors prevailing in the community as well as the use of birth control methods. It has been noted that levels of fertility are high in developing countries compared to developed countries. For example the total fertility rates in Japan, France and Germany reached (1.4, 2.0, 1.3), while the rates in each of Yemen, Jordan and Egypt were (5.5, 3.6, 3.0) respectively.
4. Life expectancy at birth: The average age at birth is about 71.57 years, while the average age for males at birth is 74.22 years and for females 69.04 years.
5. Gross Domestic Product (GDP) per capita: representing the Gross Domestic Product divided by the population in the middle of the year. It amounts to 2,698 dollars per year.
6. Availability of health services: the basic strategy for the provision of health services is called Primary Health Care (PHC). It not only provides curative and preventive health services, but also includes educational, social development and economic services as well.

sec□or Overview

Wa□er s ec□or Gover□a□ce a□d Ma□ageme□□Mecha□i□m□

Re□ecting on the country's interest in the sector, the Ministry of Housing is providing the required □nancial investments through its executive body, in order to complete the projects of drinking water and sanitation as well as providing funds for the national project for sanitation in Egyptian villages. This is in addition to enhancing the role of the regulatory system, to operate as a balancing factor between the interests of utilities, and the consumers, which is considered a major aspect of the reform and restructuring initiatives undertaken in order to develop and increase the e□ ciency of the sector and improve the service for the citizens. It should be noted that after the creation of a new Ministry of Utilities at the end of 2012, the sector is now subject to restructuring. This report has been prepared before the establishment of the new ministry. As shown in the □gure below:

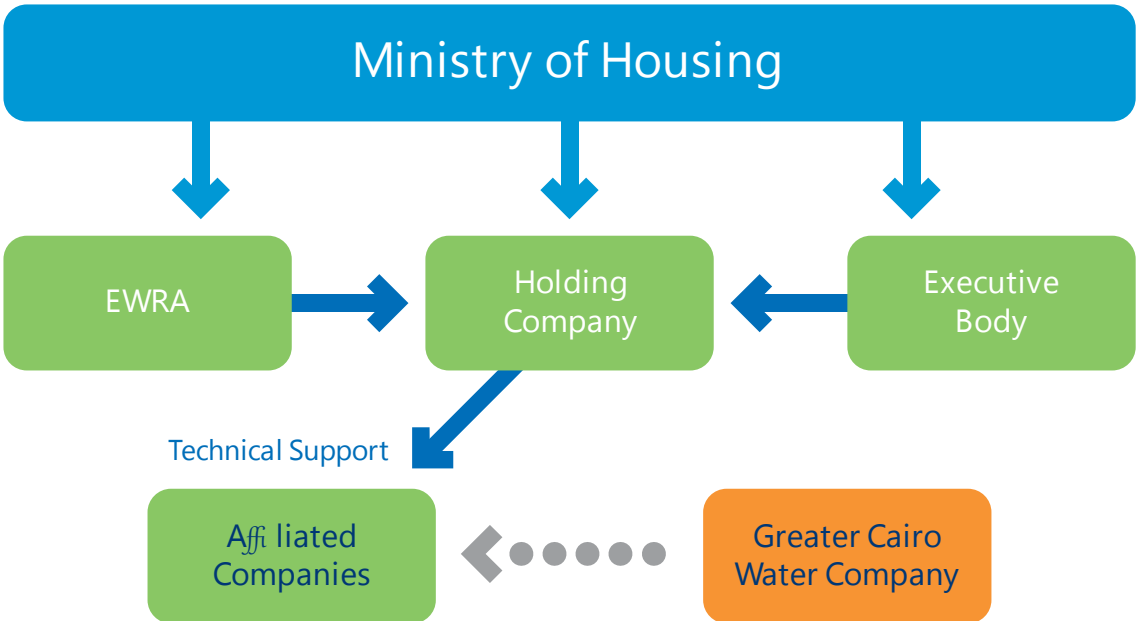

Figure 1: Institutional Setup of the Water Sector in Egypt
(Source: Ministry of Housing, 2011)

Bulk supply

Water utilities in Egypt are responsible for bulk supply. Water companies provide such services to complete residential complexes (areas in Rehab City and New Cairo) against a certain price, whereas a private company (such as Alexandria Company for Contracting in Rehab) in these complexes controls the distribution and collection of the costs for this service.

The Role of Policies and Strategies – The Case of Cairo Water Company

Water sector strategies in Egypt are based on a clear and specific vision and mission to be able to perform the developmental role of the sector, whereas the government deems to reach the level of the global industry in the production and distribution of water in Egypt. Its message is presented in the provision of water services according to Egyptian standards based on sustainable economic and developmental foundations. In order to achieve this strategy, the drinking water company in Cairo has pursued since its foundation as a subsidiary in 2004, a sophisticated modern policy that contributed to the development of the company and raised its efficiency at the level of its different sectors. This resulted in receiving numerous administrative quality certificates such as the Technical Sustainable Management (TSM) certificate through policies applied to the following areas:

Management of Operations

The efficiency of treatment plants has been improved through the adoption of an integrated system for washing filters, operation of pumps, training of personnel, monitoring and control systems at all stages of the treatment process and the use of chemicals in appropriate doses. All of the previous has contributed to lowering the operating costs.

The company has reviewed the used maintenance systems, and is working on updating them to ensure rapid completion of the required maintenance, extending the life of equipments and safety of the workers. Specialized maintenance programs are used for equipments and usage of approved computer programs in the organization of maintenance work at the stations.

The company has defined the interest in human resources as one of the key elements for development and progress. As a result, the human resources aspect of work has witnessed substantial improvements on several fronts:

- The adoption of a new organizational structure for the company that takes into consideration the implementation and updating of operation and maintenance programs, as well as achieves its goals in the futuristic development plan.
- The establishment of a department for employees' service similar to customer service centers, in order to provide all required services and respond to all requests and complaints from the employees of the company.
- Upgrading the company's various locations to provide the appropriate atmosphere for the employees, so that they can give their best in the field of water production, distribution and quality as well as customer service.
- Standard operating systems were applied for the collection and analysis of samples within a comprehensive development plan according to Egyptian standards, and were applied in all laboratories of the company.
- Obtaining the ISO 17025 certification for the Central Laboratory and applying standards of the German TSM management certification.
- Implementation of comprehensive quality procedures in the operation and maintenance of the stations, which contributed to the application of the Ministry of Health decision No. 458 for the year 2007.

The Applied Policy for Partnering with the Private sector

In the framework of cooperation between the public and private sectors in the management and operation of water utilities, the Cairo Water Company is cooperating with a number of private sector companies in matters of maintenance of a number of stations and cranes, as well as assisting in the establishment of a number of projects at the company. It also is a engaged in contracts with the private sector for infrastructure development to provide the underprivileged with services. The company makes an optimal choice of a private sector company in order to choose the optimal conditions for the establishment of projects (such as: experience, good performance, most economical, the speed of completion of projects, accuracy and thoroughness), in order to achieve successful projects that would serve the country and deliver a good quality service to the public. The forms of partnerships applied in Cairo Water Company include: construction, replacement and renewal contracts, operation and maintenance contracts, supply and financing contracts with gears, equipment and chemicals used in the water sector, as well as training contracts.

Partnerships with the private sector have resulted in excellent and very important outcomes. Rehabilitation and replacement processes are based on a sound scienti□c foundation, with the highest quality gear and equipment, as well as the bene□t of gaining experience and skills in the □eld of operation, maintenance, training and so on. These partnerships are evaluated depending on the contract type through the sector concerned with the subject of contract, sectors for □nancial and legal a□airs as well as the procurement and contracting sectors.

s PECIFIC t ECHn ICAL As ECPt s OF CAIRO WAt ER COMPAn Y MAn AGEMEn t

Applied t ari□

Tari□s are set for all water companies in all governorates upon the approval of the competent authority. Generally, the average charge is much less than the average cost of service, taking into consideration the social dimension. Any tari□ change is considered based on changes in the cost of service taking into account the social dimension on the one hand, and changes for non-residential use on the other hand. This results in a balance between the costs and the revenues; given it has the approval of the competent authorities. The Company follows policies that work based upon community participation and the social dimension, taking into account the underprivileged, as well as the geographical areas with low-income by making them accountable for certain sums and not for quantities. The consumption is estimated according to the size of the apartment and this correlation changes with the tari□ system set by the company. The □gure below shows the tari□ used by Greatest Cairo Water Company based on the water usage:

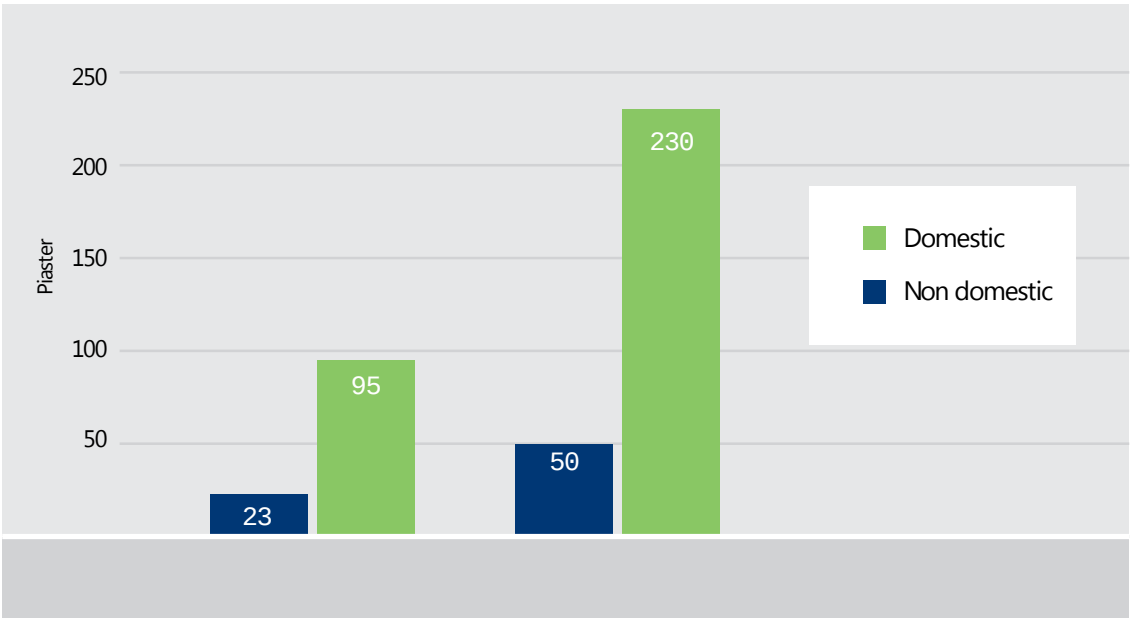

Figure 2: purpose based tari□
(Source: Cairo Water Company, 2012)

Co□□Recovery

The company's costs can be categorized as follows:

- Operation and maintenance costs without depreciation: This includes the raw material costs and wages. The company recovers these costs through the application of certain water pricing mechanisms in order to encourage cost recovery taking into account the quality of water.
- Operation and maintenance costs with depreciation: These costs include operating costs plus depreciation expenses for machinery, equipment and buildings.

- Investment costs: The costs sustained by the company in order to develop new projects such as expansions in pumping stations and networks in order to ensure service delivery to all citizens.

The figure below shows the percentages for cost recovery at Cairo Water Company

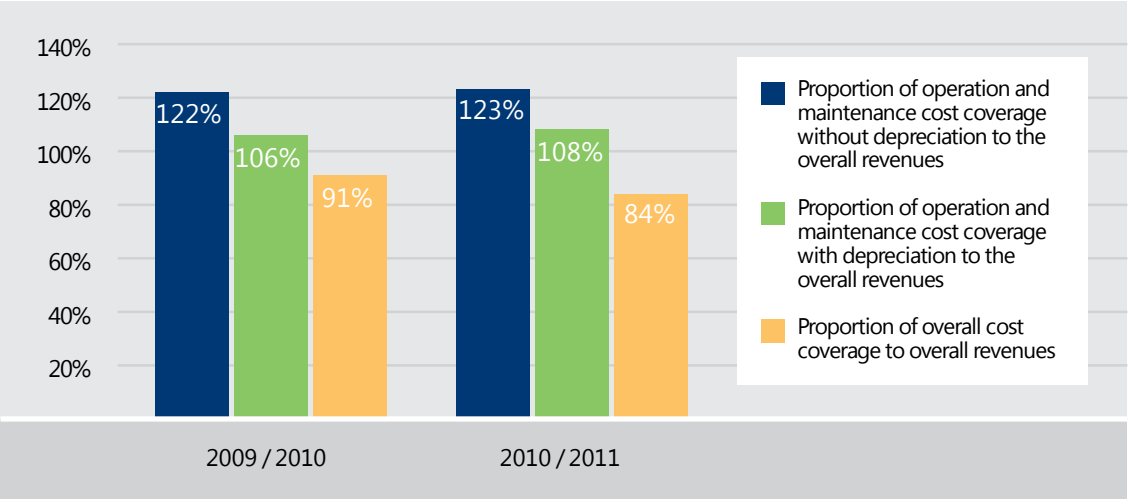

Figure 3: Cost Coverage Rate
(Source: Cairo Water Company, 2012)

non-Revenue Water

Non-revenue water (NRW) is one of the fundamental problems facing the Greater Cairo Water Company, since all distribution network components are considered a possible source for water leakage and increasing water loss. There are two types of losses; physical (leakage through pipes and valves), and commercial (errors in meter reading, level of sensitivity of meters, illegal connections, leaks within internal connections).

Cooperation is ongoing between the asset management and all maintenance management systems to establish a scientific method to reduce NRW according to a set of measures:
- A program is developed for leakage detection.
- Establishing isolated zones within the network.
- Utilizing leakage detection techniques and equipments within those zones.
- The relevant maintenance crew is informed to repair the leaks.
- The amount of water that has been saved this way is estimated (using the water pressure – diameter of discovered opening).

Some of the factors that have been relied upon to reduce water loss:
- Installing high sensitivity meters for the subscribers to measure every drop of water consumed, and developing a system to detect illegal connections, and installing meters for the latter and including them in the list of subscribers.
- Developing a special valves maintenance program that conducts periodic maintenance of the valves, as well as the renewal and replacement if necessary.
- Using modern methods to reduce NRW through the involvement of hydraulic analysis management studies.

Energy Efficiency

The table below shows the energy cost for drinking water production Greater Cairo Water Company.

Table 1: The cost of energy for the years 2009 – 2011
Source: (Greater Cairo Water Company, 2012)

Indicator	Fiscal Year 2009/2010	Fiscal Year 2010/2011
Operation and maintenance costs	972,663,555	1,089,248,898
Overall costs	1,398,313,663	1,498,047389
% of energy cost to overall operating and maintenance costs	30%	28%
% of energy cost to total costs	21%	20%

- As for systems that are used to increase the efficient use of energy, there are systems put in place to improve and correct the power factor in Al-Rawdah Water and Al Mu'adi pumping stations, to increase energy efficiency. In addition, the Supervisory Control and Data Acquisition (SCADA) system are being used to monitor and control the amounts of water pumped into the distribution network. This in itself results in increased energy efficiency. There are also various initiatives that are being implemented to improve energy efficiency such as using variable speed pumps in New Cairo.
- Revising the contract in place between the Company and the electricity companies in order to reduce penalties applied for over-consumption of energy per the old contracts.

Advanced Maintenance Management

There is an asset registry and database for all assets owned by Cairo Water Company, based on a Geographical Information System (GIS) platform that is used for the management of the company's assets.

The presence of asset management systems based on parameters related to financial, geographical and maintenance systems in place, as well as the comprehensive information technology systems in asset management helps manage water networks through undertaking review and assessment and analysis of all parameters to support the decision making process in terms of repairs, rehabilitations and replacements of assets. Asset management units and GIS units are cooperating to be able to achieve this.

Billing systems are currently being linked to other systems (network maintenance and hydraulic analysis) to improve asset management and reduce NRW in the networks. Currently those links are manual, but on their way to become automated through the internal company network, servers, information systems and databases. In addition, plans are now I place to upgrade company servers such that the number of users in the central location become 80, and those in branches become 35 users—all working on meters, collection, subscriptions, customer service and financial.

Various Initiatives Utilities Management

The Minister of Housing, Utilities and Urban Communities has adopted the internal regulations of HCWW and its subsidiaries as well as the preparation and adoption of by-laws/regulations governing HCWW. It was then planned to upgrade the working environment within these subsidiaries through the development of new working methods to improve the quality of services in accordance with international requirements.

One of the first initiatives undertaken by HCWW to control and evaluate the performance of subsidiaries was the development of the Monitoring, Analysis, and Reporting System (MARS) program through which it monitors the performance of its subsidiaries through:

1. Financial Indicators: Preparation of the financial statements for each subsidiary, the aggregate financial statements for all subsidiaries, calculation of balance sheets and budget of operation and maintenance for stations and networks monthly and annually. (Example: the percent of total costs to total revenues).

2. Commercial indicators: Measuring the performance of commercial management and reporting on collection, which is the main source of revenues for the company (for example: the percent of collected amounts to the total disbursements within a speci□c time period).
3. Service and customer satisfaction indicators: Daily follow-up of the amount of complaints and those resolved (example: the average time to resolve a complaint).
4. Quality Indicators: daily and weekly follow-up of the samples for quality control in plants, stations, water networks (example: the percent of samples in compatibility with speci□cations to all samples).
5. Technical indicators: Measuring the performance of production facilities and distribution of drinking water in networks (example: NRW compared to the total amount of produced water).

Additionally, there are other initiatives within the company, including forming crews for maintenance (responsible for the maintenance of valves that are exposed, raised and repaired through the knowledge gained from records has been signed for real and codi□ed on the company`s maps in all sectors). This is in addition to the leakage crew (the program for comprehensive mapping of the networks in Greater Cairo Water for leakage detection that aims at detecting leaks and reducing physical water loss according to modern methodology and increasing the rotating work of employees on call, operating 24 hours daily to receive the networks' noti□cations and short notice calls). Meters crew is another initiative that worked on reading the networks meters (installation and replacement) and setting up a hotline (125) in order to speed up the reporting of citizens' complaints, and making sure they are resolved as soon as possible, in case of any of the following: (broken pipe, water leakage, interruption of water service, high water bill, weak water pressure, quality issues, etc.). The receiver of the complaint reports promptly to the relevant unit and follows up to make sure that the customer has his issue solved. The company also initiated a crew for the disinfection of networks and reservoirs and tanks for customers against a very small fee, by specialized teams and with the permission of the Ministry of Health. In addition to upgrading laboratories to ensure the quality of water by sampling pumped and treated water and analyzing those samples to eliminate the possibility of any quality issue. This is in addition to upgrading the central laboratories and the training center and contracting out capacity development programs.

Coordination takes place on a daily basis between the laboratories, the hotline, research center and HCWW regarding customer complaints and resolving them immediately. This is done by sending mobile laboratories to the location and immediate sampling from complaint sites, which leads to increased trust between the customers and the company. A survey is carried out periodically for the public in all areas that are served with water to measure the extent of satisfaction with the service and receive constructive suggestions. This helps in the process of reforming the water utilities and attaining customer satisfaction.

servi□g □he U□derprivileged

A number of governmental initiatives have been implemented to provide service to underserved areas through constructing the necessary infrastructure for service in these areas. Examples of such areas are Ezbet Al Zabbalin and Milaat Helwan. The private sector is participating through private contracts to construct the infrastructure.

The company always strives to reduce the gap between the cost of water production and revenues received from this service due to the high cost of raw materials, di□erent production requirements and the clear di□erence between the high costs and low water tari□s. Therefore, the company resorts to obtaining the necessary funds for the implementation of targeted infrastructure development and capital investment projects by obtaining the support of the state in the form of grants and subsidies, in order to improve water services and water delivery for disadvantaged areas and overall.

REFERENCES

1. Regular meetings of the heads of the various sectors.
2. Strategy of Water Resources of the Ministry of Irrigation until 2050.
3. The basics of cost accounting.
4. Reports of the Central Auditing Organization.
5. Follow-up reports of the Greater Cairo Water Company.
6. Institutional structure for companies.
7. Recommendations of the Higher Coordinating Committee of the Holding Company for Drinking Water and Sanitation.
8. Road map for the "groundwater", Academy of Scientific Research.
9. Companies Law 1997.
10. Law of civilian workers in the country.
11. Decision of the Egyptian Ministry of Health 458 for the year 2007 for the standards and specifications of drinking water.
12. Financial Statements for the year 2010 of the holding company.
13. Internal regulations of the subsidiaries.
14. Master plan for the year 2008.

YEMEN

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ACRONYMS

GARWP	General Agency for Rural Water Projects
GDP	Gross Domestic Product
GIS	Geographic Information System
GIZ	German Corporation for International Cooperation
MCM	Million Cubic Meters
MDGs	Millennium Development Goals
NRW	Non-Revenue Water
NWRA	National Water Resources Authority
NWSA	National Water and Sanitation Authority
NWSSIP	National Water Sector Strategy and Investment Program
OMMS	Operation and Maintenance Management System
PRS	Poverty Reduction Strategy

In t RODUCt IOn

Water and wastewater utilities around the Arab countries are confronted with many di□ culties and challenges as they strive to make organizational improvements. Water sector utility managers must consider a wide range of issues in their management improvement initiatives. General economic conditions, sta□ turnover, communication between internal management and external stakeholders, involvement of sta□ across the organization, aging and occasionally decaying infrastructure, applied rate issues, and limited sta□ resources are some of the issues managers address.

This case study aims to re□ect on utility management approaches that have been applied in Yemen, and understanding the technical sides of it, including costs and revenues based on applied tari□s, non-revenue water, asset management and energy e□ ciency.

Cou□□ry Backgrou□d

Yemen is situated in an important and strategic location to the southwest of the Arabian Peninsula. It overlooks the Arabian Sea from the south, the Red Sea from the west and has a coastline up to 2,500 kilometers. However it faces signi□cant challenges in several □elds, like water resources □eld for example. Yemen is one of the most water scarce countries in the world, with only 125 cubic meters of renewable water per capita per year. This goes hand in hand with an increasing population growth rate, reaching as high as 3%. With dispersed settlement of population, settlements, it becomes much more di□ cult to provide services. In addition to that there is a severe weakness in the national economy and political instability.

Geographical Loca□o□, Area a□d Popula□o□

The Republic of Yemen is located to the south of the Arabian Peninsula. It is bordered from the north by Saudi Arabia, from the south by the Arabian Sea and the Gulf of Aden, from the east by the Sultanate of Oman and from the west by the Red Sea. The area of the Republic of Yemen comprises 555,000 km^2. The population according to estimations for year 2011 based on the General Census of Population in 2004, is 24,312,000 inhabitants with a population growth rate of 3.04%, spread over 21 governorates including the capital.

Figure 1: Map of Yemen
(Source: http://en.wikipedia.org/wiki/Yemen)

topography a□d Geology

Topographically, Yemen is divided into □ve regions (mountains, plateaus, coasts, the Empty Quarter (Rub' Al Khali) and the Yemeni islands):

1. Mountainous areas: the mountains of Yemen were formed from the lava as a result of the Great African Rift Valley caused by the gorge that led to the formation of the Red Sea and Gulf of Aden, with a north-south axis parallel to the Red Sea and a west-east axis parallel to the Gulf of Aden producing what appears to be an L shape. Their geologic components include sedimentary volcanic rocks. The elevation at the sea level ranges between 1,000m to 3,666m. The highest mountain peak on the Nabi-Shoaib Mountain is 3,666 m, which is the highest peak in the Arabian Peninsula. The watershed division line is located in these mountains. The water descends to the east, west and south towards:

   - Valleys (Wadis) □owing into the Red Sea, notably: Wadi Haradh, Wadi Maur and Wadi Zabid.
   - Valleys (Wadis) □owing into the Gulf of Aden and the Arabian Sea, notably: Wadi Tuban, Wadi Bana and the Hadramout valley.
   - Valleys that descend to the north and north-east, including: Wadi Khabb, Wadi Al-Sadd, Wadi Athnah, Wadi Rama' and Wadi Shuaith.

   The mountain range is full of □at riverbeds and basins along its extension, which allow the creation of barriers and dams for torrents that feed vast agricultural areas through irrigation canals. The most important of these basins are Saada Basin, Al Boun Basin (Imran), Wadi Bayhan (Shabwa), Aywa Basin (Hadramout) and Shaith Basin (Al Mahrah).
2. Plateaus: Are located to the east and north of the highlands and parallel to them, but they are wider towards the Empty Quarter then they gradually decrease and reach a maximum height of 1,000 meters. They include: Saada, Al-Jawf, Shabwa, Hadramout and Mahra. Peripheries of these areas overlap at the northern borders of the Empty Quarter.
3. Coastal plains: include the coastal plains bordering the Red Sea, Gulf of Aden and the Arabian Sea. They are connected to each other and form the coastal strip stretching from the Omani border towards the south-west to the Bab el Mandeb. The direction changes northward until the borders of Saudi Arabia. The plains are 2,500 kilometers in length and have a width ranging between 30 - 60 kilometers.
4. Empty Quarter: one of the Yemeni desert areas that is interspersed with some wild plants, such as dune shrubs. Some □at lands are scattered in parts of the Empty Quarter, such as Shiqat Al Kharita and Almaaatif, etc. Seasonal valleys (oases) constitute a suitable habitat for grazing in settlements of nomads. Through various historical periods the Empty Quarter (Alrub' Alkhali) was given a number of names – such as Al Rajraj Sea, Al Sa□ Sea, Great Yemeni Desert and Al Ahqaf Desert, etc.
5. Yemeni islands: These are spread in the territorial waters of Yemen in the Red and the Arabian Seas. They have their own distinctive climate, weather and environment, as well as speci□c natural terrain characteristics. They are mostly distributed in the Red Sea alongside the Yemeni shore. The most important and largest island is Kamaran, a populated island with some rare wild animals, in addition to the Hanish Archipelago. The Mayyoun Island (Perim) has a special signi□cance due to its strategic location that overlooks the Strait of Bab el Mandeb. As for the Yemeni islands in the Arabian Sea, they are located closely together, of which the most famous is the island of Socotra for being home of the Dragon Blood Tree and endemic aloes with signi□cant economic and therapeutic value. There is also a group of small islands near the previous island, of which the most important is the island Abd Alkuri, the "Brothers Island" (Samhah and Darsah).

La□d, River□ Lake□a□d Dam□

Yemen is a water-scarce country that is located in a dry area with no permanent rivers. That is why historically the population relied on rainfall, springs, wells, as well as collecting rain in ponds, barriers and dams of varying sizes. The wells were not exceeding a few tens of meters in depth and the water would be raised by the physical e□ort of animals and humans in limited quantities. The use of mechanical drilling rigs and pumps was not familiar until the sixties of the last century.

The state has adopted the implementation of several programs to build dams early on. Their implementation entailed investing massive amounts of money, and currently it is estimated that there are more than 1,000 facilities with a storage capacity of about 80 million cubic meters (MCM) and costs of about 16 billion Yemeni Riyals. This means that the average capacity of one facility is 80 thousand cubic meters and the average cost is about 16 million Riyals, at a cost of 200 Riyals per cubic meter. Although Yemen annually receives an average of about 50-60 billion cubic meters of rain, the nature of rainfall and its timing during the summer, limits the amount of generated torrents and causes most of the rain to be retained in the surface soil for the plants

to use directly or to evaporate into the air. Therefore it is scientifically impossible for the amount of flowing torrents in the valleys to exceed 10% of the rainfall as an average, which is about 3-6 billion cubic meters. The water resources on which Yemen depends in supplying the population in rural and urban areas are two main sources:

1. Surface water: A surface flow of valleys; waterfalls represented in streams and torrents that run on the surface, as well as the constructed barriers of water. The amount of renewable water is estimated at 1,478 million cubic meters per year. Yemen is divided into four watershed regions: Red Sea watershed, watershed of the Empty Quarter, watershed of the Arabian Sea and watershed of the Gulf of Aden.
2. Groundwater: representing the water stored since millions of years in ground basins. It is the main supply source for the urban areas, cities and other populated areas. This source suffers from severe pressure due to unlimited extraction for agriculture and irrigation, as well as randomly drilling in water basins. The amount of renewable water for 14 basins at the level of Yemen is 1,030 million cubic meters per year and most of the basins are suffering from a deficit between the renewable water and water abstracted from the basin.

Non-conventional water resources include the treated wastewater, which is being used in a limited and unsystematic manner in irrigation, in addition to desalinated seawater which has not been exploited completely. There is a project under construction to supply the cities of Taiz and Ibb, due to depletion of groundwater resources supplying the two cities.

Climate and Climate Change

The climate is hot and humid in the coastal plains, moderate in the highlands and typical desert climate in desert areas. Rain falls throughout all seasons of the year on the territory of Yemen, and the amount of rainfall varies from season to season. It is less in the winter and increases in the summer and spring. It reaches its highest levels in three months (June, July and August). Yemen is one of the countries in the world that has been affected by climate change and the increase of temperature, causing a significant change in the climate, delaying rainy seasons and the occurrence of unexpected rainfalls that cause natural disasters.

Economy, Population and socio-economic Development

Yemen is classified as one of the developing countries with deteriorating economy. Local studies show that the annual per capita income is less than $600. The economy depends mainly on extractive industry and the manufacturing industry, agricultural sector, livestock and fishing, transport and communications sector, for wholesale and retail trade as well as tourism services, real estate and construction sector, production sector and government services.

The Government's report for the year 2011 shows that 2011 witnessed a decrease in the real gross domestic product (GDP), with about 15% - 20% compared with the growth rate it experienced (8.7 %) in 2010. It shows also a decline in average per capita of the real available national income by at least 21% compared to an average decline of not more than 2.0% in 2010. In 2011, Yemen witnessed an increase in rate of inflation to at least 20% compared to 6.12% in 2010; this is in addition to a decline in the exchange value of the local currency compared to the US dollar by 6.6% compared to 6.7 % in 2010. The report also shows a decline in reserves in foreign assets for the banking system by 7.18%, compared to a decline of 9.7 % in 2010. It also indicates an increase in the budget deficit ratio to GDP to 5% in 2011 compared to a rate of 8.3 % in 2010, in addition to an increase in the net cash deficit rate of the budget to 2.4 % of GDP in 2011, compared to 9.3 % in 2010. The internal public debt has exceeded the safety threshold by up to 131% of the total revenues in 2011, while the interest rate amounted to about 11% of the total exploitation. Reports also indicated that formal unemployment figures have increased due to current political instability in the country; it was forecasted that unemployment would rise up to 36 – 40% of the total workforce in 2011, which a much higher than number recording in the latest survey of the Social Fund in 2010, where unemployment was recorded at 6.18%.

The population growth rate increases in Yemen to reach up to 3%, which threatens the resources available in the country and increases the poverty range. The population of Yemen is distributed between rural and urban areas with 70/30 % respectively. The poor are concentrated in rural areas.

Achieving the Millennium Development Goals Indicators

The national water sector strategy (NWSSIP) has set the Millennium Development Goals (MDGs) as key targets through agreeing from the beginning to assign an investment program of a five years duration (2005-2009), which aims at achieving the MDGs, with the exception of the rural water sector. Here the target was set on the basis of achieving half of the aimed rate in the MDGs. The reason for this is due to the vast size of

funding required to achieve the MDGs in full there. In addition to the awareness of the team that prepared the investment program of the difficulty to overcome administrative obstacles in implementing projects even with availability of funds, because of the large number of these projects required in the thousands or even tens of thousands of villages and population communities, as well as due to the technical and social difficulties associated with their implementation. Hopefully the experience of the coming five years will help accumulate and strengthen the expertise and institutional and administrative capacities that help attracting additional funding for the sector on one hand, and help overcoming administrative obstacles on the other hand, in a manner that hopefully will allow catching up with achieving the MDGs during the remaining period (2010-2015).

sector Overview

Yemen faces one of the most complex problems of development and the most important of challenges, namely the problem of water resources scarcity and depletion of groundwater reservoirs. This happens as a result of the water deficit that is increasing year after year in the absence of a balance between the annual renewal of supply and the growing demand on water. This leads to the depletion of groundwater in several areas and basins. To meet this challenge, the water sector has been restructured and divided into four sub-sectors as can be illustrated in the following:

- Sector of water and sanitation for urban areas-Ministry of Water and Environment,
- Sector of water and sanitation for rural areas-Ministry of Water and Environment,
- Sector of water resources management-Ministry of Water and Environment
- Irrigation sector-Ministry of Agriculture and Irrigation

All four sectors work to achieve the objectives of the national strategy, the investment program for the water sector, as well as the MDGs, through the expansion of sustainable water supply and sanitation services for tariffs that take into account the underprivileged and providing sanitation services as well.

Institutional Framework of the sector

The figure below depicts the institutional setup of the water and sanitation sector in Yemen:

Institutional Setup

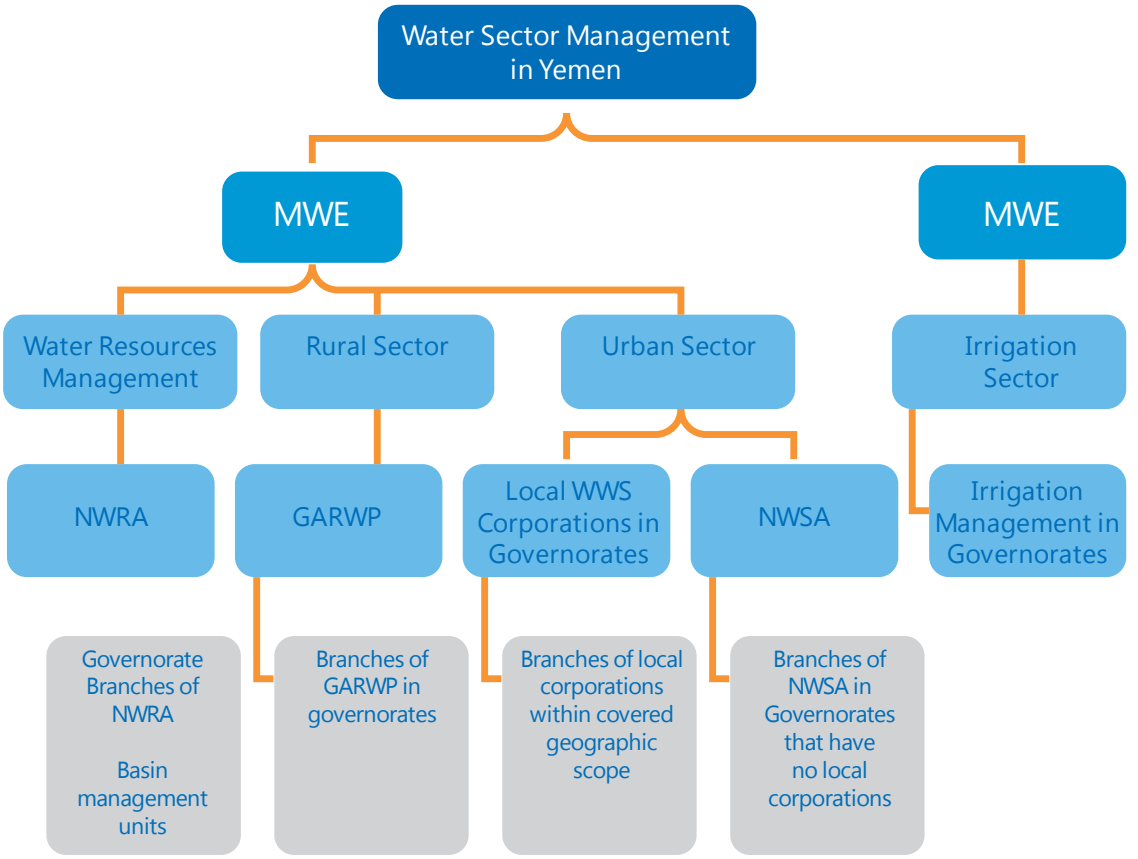

Figure 2: Institutional Setup of of the Water and Sanitation Sector in Yemen
(Source: Statistical Yearbook 2008)

Since the re-uni□cation of Yemen in 1990, signi□cant progress has been made towards improving the management of the water sector. This progress is represented in integrating water management functions under the Yemen National Water Resources Authority (NWRA), which was formed in 1995, and the establishment of the Ministry for Water and Environment in 2003. These contain most of the administrative bodies and institutions that manage the water sector as follows:

1. Urban water and sanitation sector: This sector represents 29% of the population of Yemen. It is run by NWSA, which supervises the branches in the governorates that do not have a local corporation. There are 15 such local corporations in the governorates and nearly 36 water utilities in smaller cities, district centers and governorate centers that have not yet established a local corporation. Most of the corporations and utilities are □nancially and administratively independent. Additionally, each local corporation has a board of directors chaired by the Governor, and in the capital Sanaa by the Mayor of the capital. The same goes for the branches, whereas each branch has an advisory committee headed by the branch Director. Such committees or board of directors review and approve the plans submitted by the executive management as well as discuss and approve tari□s. The corporation's local management answers directly to the Minister and the Board of Directors concerning the conduct of daily □nancial, administrative and technical business as well as implementation of new projects. Each local corporation or independent water utility has a special organizational structure, and water and sanitation tari□ divided into segments that vary from one institution to another. The tari□ must cover costs for operating and maintenance as well as depreciation cost for electromechanical equipment for pumping water that is used in sanitation treatment. The government supports the new projects through an annual investment program that re□ects the objectives of the national strategy for the water sector. Although a number of aspects have been taken into consideration in the sector to achieve the principles of good governance and water governance, however some tasks still remain to be carried out in the aspects of institutional structuring, completing the restructuring in some institutions and utilities as well as preparing regulations based on

a sound approach in order to achieve greater transparency and e□ ciency in the execution of the tasks.

2. Rural water and sanitation Sector: This sector represents 71% of the population of Yemen, where approximately 80% of the poor live in rural areas. This sector is managed by the General Agency for Rural Water Projects (GARWP). The mechanism of action for the Agency consists of □nancing and implementing projects of water and sanitation in rural areas, provided that these projects are managed by a steering committee from the local community. Due to the lack of attention and follow-up of the management for some of these projects, a number of them have failed to provide service to the poorest segments of society. The decisions taken regarding the provision of water and sanitation to certain villages and choosing a suitable alternative or appropriate technological package for each project must be based on the demand and full transparency. In addition to that, the technical aspect should be given greater importance to ensure successful implementation of projects that are able to provide sustainable service.
3. Water resources management Sector: This sector is run by NWRA, which assumes the functions of control over well drilling, follow-up of random drilling violations, implementation of awareness and control programs in the management of the water basins. However, the Authority did not properly ful□ll the role assigned to it, as random drilling continues to increase steadily, while the Authority was unable to reduce the violations. The local entities also need water and sanitation services in urban and rural areas to develop its connection with NWRA in order to be able to coordinate e□orts in two areas, namely; reallocation of water resources when needed, and proper drainage of wastewater, which represents potential environmental and health risks if left without treatment. It also represents an opportunity to be used as an additional resource if treated and re-used properly. Finally, it is imperative to strengthen the relationship between the Ministry of Water and Environment and NWRA on one hand and local corporations especially the local councils on the other hand, in order to achieve decentralized implementation of the water management plans and policies as well as to enhance water law enforcement.
4. Irrigation sector: this is an important sector, which consumes approximately 95% of water resources. It is managed under the umbrella of the Ministry of Agriculture. The establishment of the Ministry of Water has contributed to achieving a considerable representation for the water sector as a whole and water management in particularly at the level of the Council of Ministers. However the responsibility for irrigation remains under the jurisdiction of the Ministry of Agriculture and Irrigation, which was and still is active in developing irrigation infrastructure such as dams. There continues to be a need for promoting understanding between the ministries of water and environment and ministry of agriculture and irrigation about their respective responsibilities and mandates with regards to infrastructure for surface water and torrents. It is therefore important that decisions are made concerning the location and design of water infrastructure from the perspective of integrated water resources management on the water basin level. On the other hand, with the established principles of the urban water sector reform, there is a need to establish an institutional guideline relating to regulatory responsibility for independent water institutions that were founded in the past years.
5. Local corporations: with the need for them to be monitored and evaluated in terms of performance through preparing reports about their progress level in achieving the MDGs.

Legal a□d Regula□bry Framework of □he sec□br

After a long process of consultation to reach a consensus, Yemen enacted a water law in 2002 that provides a legal basis to control the abstraction of groundwater. It includes measures such as licensing and registration of wells and drilling rigs as well as strict regulations to control the depleted basins. The water law also supports the trend towards decentralization by encouraging formation of water basins committees and through working closely with local councils to implement water management procedures.
Below is a set of laws and decrees that constitute the regulatory and legal framework:

1. In February 1997, the Council of Ministers issued Decree No. (237) for the year 1997 approving the program for water and sanitation sector reform policies, which was based on a study (Kelbermarten, 1996) and funded by the World Bank to reform the water sector in urban areas.
2. In 2000, Law for local authorities law was passed (Law No. 4). It states that the local authorities law shall be based on the principle of administrative and □nancial decentralization, as well as on the basis of expanding local participation in decision-making processes and management of local issues, such as socio-economic and cultural development. Due to a lack of understanding and comprehension of the law by members of local councils in the governorates and districts, there have been confusions in the work of water utilities.
3. The issuance of the Water Law No. 33 for the year 2002
4. Within the framework of the institutional reform program which is supported by donors, a new Ministry of Water and Environment was created through a Presidential Decree No. 105 for the year 2003. It aimed at unifying most of the water institutions under one umbrella. However the irrigation and watershed

management continued to report to the Ministry of Agriculture and Irrigation.
5. Republican Decree No. 218 for the year 2004 concerning the Ministry of Water and Environment.
6. The issuance of the Water Law No. 41 for the year 2006, which amended some articles of the water law No. 33 for the year 2002.

Key Documents that Direct sector Performance

A set of national policies that guide the water sector in Yemen are:

1. The National strategy and investment program for the water sector 2005-2009 and an updated version thereof 2010-2015.
2. Council of Ministers Resolution No. 237 for the year 1997 concerning the program for water and sanitation sector reform policies.
3. The National Poverty Reduction Strategy (PRS).
4. Water and sanitation sector reform strategy in urban areas and the implementation of decentralization in the sector.

At this point we can address the NWSSIP. The motives behind developing the strategy can be summarized as follows:

1. Develop a uni ed vision for the sector that is agreed upon between all relevant parties and is based on an objective assessment of the situation of the sector with its various subsectors. It shall take into account previous experiences in the development and implementation of strategies and policies for the sector. To set clear quantitative and qualitative targets in order to accomplish institutional, legislative and investment achievement that is required from the Ministry, the institutions, a liated bodies and related parties in the coming years. These shall work together towards carefully de ning the role of various related parties in order to ful ll these goals.
2. Contribute to the creation of suitable environment and conditions for achieving MDGs by 2015, as re ected in the strategy for combating poverty. This is done through the clear identi cation of required actions that were agreed upon nationally, acquiring the support from relevant state institutions and donors within a clear set of objectives, actions and investment program for a period of 5 years towards achieving these goals.

The national strategy was developed based on principles that can be summarized into ve foundations and fundamentals which were taken into account:

1. Emphasizing the fact that the implementation is the most important aspect: it is known that the previous years have witnessed the preparation of many valuable strategies. Therefore, it has been the focus of the national strategy and investment program for the water sector to move from vision to action through the supplement investment program aiming at implementation of the strategy.
2. Importance of bene ting from the lessons learned from successful reforms that have been achieved in the last few years: successful reforms in the urban water sector for example have produced lessons that could be used for other sub-sectors, where some of the most important reasons for success were clearer objectives and plans that are discussed and agreed upon at all levels. Together they focus on implementation, acquiring support from donors, as well as comprehensive technical assistance, monitoring and follow-up. The strategy that will be applied for other sub-sectors, and in particular the strategy for the water sector and sanitation in rural areas, could develop similar programs with clear goals and plans agreed upon and accompanied by benchmarks to measure and evaluate progress.
3. The close connection between the availability of water and sanitation services should be highlighted and exploited on one hand, and on the other hand actions should be taken to reduce poverty, create jobs as well as achieve the MDGs. This connection could be exploited to acquire investments and appropriate reforms in the sector, because the MDGs are strongly focusing on the reduction of poverty, as is the national strategy. Therefore the national strategy for the water sector could be considered as an operational plan for water-related aspects in the Yemeni poverty reduction strategy.
4. The water sector strategy is based on a long-term integrated approach. It represents an investment program for ve years from 2005 to 2009, and is updated regularly. It is designed to be used by all the partners as a uni ed and coherent framework.
5. Finally, the identi cation of the most important priorities is essential and important: the strategy is focusing on commencing the processes and measures that will have a great impact on achieving the main objectives. It has also been considered to make the strategy realistic in terms of implementation.

sPECIFIC tECHnICAL AsPECts OF UtILItIEs MAnAGEMEnt

Water Utilities in Yemen are supplying urban areas with water and providing them with sanitation services. Most of the corporations and utilities are □nancially, technically and administratively independent. They all operate in order to achieve the objectives for which they were created, mainly to provide the current and future needs of su□ cient and safe water that is suitable for domestic, commercial and government use, as well as protecting the environment against pollution by treating wastewater with high e□ ciency. All utilities are operated to achieve a set of goals and indicators that re□ect level of performance, such as; continuity of service according to available sources, achieving the lowest amounts of Non-revenue water (NRW), achieving the highest collection rate, covering operational costs and the costs for maintenance and depreciation, achieving the highest rate for e□ cient sanitation treatment, achieving an increase in service coverage for water and sanitation in order to achieve the objectives of the National Strategy NWSSIP, and achieving satisfaction of the public and donors.

Applied t ari□ for Wa□er a□d s a□i□a□o□ s ervice□

A tari□ is the mechanism for calculating the value of water used during a speci□ed period, using a water meter that is installed in front of the property of the bene□ciary. Billing periods can vary from one utility to another depending on region, topography, abundance as well as closeness to water sources, and the type of treatment in sanitation plants. The expenses to be covered (to recover the cost) when designing tari□s include the following:

1. Total operating and maintenance costs that are required to produce a cubic meter of water connected to the property of a subscriber.
2. Depreciation of electromechanical equipments engaged in the production and distribution of water, and in wastewater treatment with a rate of 10% of the assets' value.
3. Sanitation service fees as a percentage of the calculated value of water consumption by the subscriber's meter. It is calculated by 50%-80% based on the type of treatment plant.
4. Fees for other services with 2%-10% of the total value of the bill for both water and sanitation services. These vary from one utility to another.

In specifying the price per block and per type of use, the underprivileged are always taken into account, especially in the case of water for domestic use. A cross subsidy allows the □rst two blocks to remain subsidized and transfers recovering the cost to the remaining blocks. This also encourages proper water demand management. In terms of infrastructure development and capital investment projects, utilities and corporations receive □nancial support from the government in order to be able to expand the scope of their coverage and improve their services. And in order to recover the cost entailed, the average charge per cubic meter water produced should not be less than the average operation and maintenance cost plus depreciation for electromechanical equipments that are used in the interim.

Co□□Recovery

All water and sanitation utilities in Yemen operate according to the principle of recovering cost, speci□cally in terms of recovery of operation and maintenance costs and a portion of the investment cost by covering part of the electromechanical equipments depreciation that is directly linked to processes of pumping and transferring of water from its sources. For the electromechanical equipments operating in sanitation treatment, the annual installment of 10% of the original value is paid to the bank account as depreciation. However, in reality many utilities fail to pay the de□ned depreciation installment because of the □nancial crisis that they experience, as well as continuous in□ation, increase in prices and operating costs. The government contributes to □nancing investment projects for the implementation of necessary projects aiming at further expansion in the coverage of water supply and sanitation services, as well as assets rehabilitation and replacement projects or the development of new water sources. There is an initiative that considers transforming water and sanitation utilities to public companies operating by the principle of full cost recovery, which shall lead to increasing the current value of the tari□ and consequently a□ecting the poor segments of the society.

Types of costs which are necessary for the operation and maintenance of water utilities vary, and include

the employees costs: salaries, bonuses, insurance, training, in addition to maintenance cost including spare parts and maintenance fees. Administrative expenses are another additional cost including stationery, communications, renting properties and assets. The costs also include cost of chemicals, rehabilitation and project expenses, and cost of capital expenditure (electromechanical equipment depreciation).

As for revenues, the water and sanitation utilities receive different types of revenues from different sources, including the billed water sales revenues, the sanitation service revenues as a percentage of water consumption, the capital revenues for property renting, equipment or tenders fees and other revenues such as fines and service fees.

non- Revenue Water

Although Yemen suffers from severe water scarcity, yet NRW constitutes a very high percentage ranging between 20%-60% on the level of the utilities in urban areas. In rural areas, NRW is estimated to range between 40%-60%. This is according to random samples of some rural projects, and auditing of water utilities reports in the urban sector where the amount of NRW has reached, approximately 42.97 million cubic meters in 2008. This quantity is costing the utilities approximately 22 million US Dollars. The causes for NRW include; damaged and old networks of pipes and valves and spare parts, the use of pipes with poor specifications leading to random breakage in pipes in the distribution networks and hindering monitoring and tracking NRW in the networks, low efficiency of the meters, errors in meter reading and data entry, illegal connections, direct connections with the pumping lines, and the general feeding points, lack of awareness among the management and staff about the importance of minimizing NRW, lack of awareness of the material yields as a result of reducing NRW and the economic feasibility of it. NRW generally can be classified into two types; namely; the physical (technical) and the commercial (administrative) losses.

NRW is calculated based on two main variables, namely; the amount of produced water and the amount of the billed water. Whereas the water produced is calculated from the readings from meters installed on the water sources (wells or pumping stations) and entered into the performance indicators system manually (This method can be manipulated), the amount of water billed can be calculated by taking it automatically from the billing system to the performance indicators system.

Yemen is implementing several measures for the reduction of NRW, Periodic maintenance programs are implemented for the meters with zero reading and extracted from the billing program reports and performance indicators system. In addition to the replacement of the old networks, maintenance of the network and the main valves in some large institutions, it also reviews and monitors NRW by using performance indicators program monthly. However, technology is still a long way off at the moment because of mismanagement.

Follow-up and evaluation of the programs for maintenance and monitoring NRW are also implemented, whereas most of the institutions and utilities use performance indicators system, which helps departments and supervisory authorities to monitor the performance of the utilities. The performance indicators System helps in the process of tracking and monitoring NRW related indicators in monthly reports. This system is linked automatically with other systems that are considered to be the source of data, such as the billing system, accounting system and complaints system. The rest of the data is entered manually, such as water production, quality and investment projects.

Generally, it is a well-known fact that the reduction of NRW can have technical and economical effects, which are considered as incentives and motives for reducing water losses. Those include providing water source that cover the shortfall caused by the scarcity of resources, and earning customer's satisfaction, in addition to increasing sales revenue, and relieving the pressure on water resources. In this context, worthy to mention is that reducing NRW by 50% means saving 15% of energy costs.

Water for the Poor

One of the objectives of the national strategy for the water sector at the level of rural and urban sub-sectors is securing quantities of safe water at affordable prices for the poor. This can be ensured when designing the tariff, where the first two blocks are subsidized; the first (1-5 units) and the second (6-10 units) have low prices that take into account the income of the poor. On the other hand, the tariff for the other blocks and types of use (household, government, commercial) is raised to cover the deficit.

The government also contributes to supporting the investment projects to expand service and increase coverage and number of bene□ciaries of the water supply and sanitation services, as well as the implementation of new projects to ensure the delivery of the service to the poor and achieving the MDGs. The donor community and organizations have adopted the Millennium Declaration and its objectives as a base or as a guiding framework for the assistance provided to the developing countries, in terms of the strong coherence between water availability on one hand and health, unemployment, poverty, girls' education and development in general on the other hand. Based on this, Yemen can receive a good amount of support to achieve these goals. Impure water is well known to be the cause of about 80% of diseases. Furthermore the availability of water for agriculture, for example, creates more jobs opportunities and therefore helps in combating poverty. The lack of drinking water in rural areas hinders the enrollment of girls in education.

E□ergy E□ cie□cy

Energy cost is the most important challenge faced by water utilities. The average energy cost for water and sanitation services amounts to 30-55% of the total costs for operation and maintenance costs. Until now there are no specialized systems put in place to improve the e□ ciency of energy use, nor any speci□c initiative to improve e□ ciency at the sector level.

A□□e□a□d Mai□□e□a□ce Ma□ageme□□

The programs used in managing the operation and maintenance of assets so far include the Operation and Maintenance Management System (OMMS) of assets program and the Geographical Information System (GIS), which is being implemented in four local corporations with the support of the German Corporation for International Cooperation (GIZ) (Sana'a, Aden, Ibb, Hadeedah). This project is still in the process of preparation and there are many obstacles that prevent any further progress due to the lack of interaction coming from the corporation toward achieving this, as well as the absence of the Ministry's role in supporting the introduction of automation and automatic systems in the operation and maintenance management of utility assets. The rest of the utilities (10 local corporations + 38 water utilities) are limited in their asset management to using accounting assets software that determine the place of the asset, calculates depreciation and manages warehouse accounts only.

RESULTS OF THE STUDY

Yemen suffers from scarce water resources, and is classified as one of the ten water-poorest countries in the world, where the individual share of available water does not exceed 125 cubic meters per capita per year. The total amount of water available from various surface and groundwater sources amounts to 2,500 million cubic meters, compared to the total demand of 3,500 million cubic meters with a deficit of 1,000 million cubic meters of water drawn from the non-renewable groundwater reserves. This comes along with a high population growth rate of more than 3 %, with scattered communities, which doubles the cost for the implementation of water supply and sanitation projects.

The negative impact of the weak national economy, the lack of financial allocations planned in the national strategy for the water sector, as well as the negative impact of the social dimension (tribal) and the unstable political dimension, all of these challenges face the water sector in Yemen in general, and the management of water utilities and sanitation in particular. This has led to functional instability at the level of the sector and facility management, as well as deviation from achieving positive performance indicators, with the inability to achieve the goals set by the National Strategy for water sector NWSSIP and the MDGs. This comes along with poor technical capacity and the absence of modern tools, equipment and software to manage and reduce NRW, as well as manage assets in most water and sanitation utilities in Yemen. In addition, there are no initiatives to reduce the energy consumption at the sector level.

REFERENCES

1. National Water Sector Strategy and Investment Program NWSSIP
2. The Annual Statistics Book for year 2008.

JORDAN

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ACRONYMS

AMM	Asset and maintenance management
AW	Aqaba Water
BOO	Build-own-operate
BOT	Build-operate-transfer
CIS	Customer Information System
FAS	Financial Accounting System
GDP	Gross Domestic Product
GIS	Geographical Information System
GIZ	German international development agency - Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
JD	Jordanian Dinar
JVA	Jordan Valley Authority
KAC	King Abdullah Canal
m^3	Cubic meters
MCM	Million cubic meters
MENA	Middle East and North Africa
mm/yr	Millimeters per year
MWh	Mega Watt hours
MWI	Ministry of Water and Irrigation
NRW	Non-revenue Water
O&M	Operation and Maintenance
PMU	Performance Management Unit
PPPs	Public-private Partnerships
PSP	Private Sector Participation
SCADA	Supervisory Control and Data Acquisition
Sq km	square kilometers
WAJ	Water Authority of Jordan
WUA	Water Users Association

In t RODUCt IOn

Water and wastewater utilities around the Arab countries are confronted with many challenges as they strive to make organizational improvements. Water sector utility managers must consider a wide range of issues in their management improvement initiatives. General economic conditions, sta turnover, communication between internal management and external stakeholders, involvement of sta across the organization, aging infrastructure, rate issues, and limited sta resources are some of the issues managers address. In this case study, we will focus on the important factors of Cost recovery; Non-revenue water, Serving the underprivileged, energy e ciency and Assets management. For the sake of better understanding for the case study, this chapter will illustrate the country back ground.

Cou ry Backgrou d

The Hashemite Kingdom of Jordan (also known as Jordan) is an Arab Kingdom in Asia, on the East Bank of river Jordan, hence its name. The Capital is the city of Amman, and the o cial language is the Arabic language.

Geographical Loca o , Area a d Popula o

Jordan is located in the southwest part of Asia. Its total area is 89,342 square Kilometer (sq km) (land: 88,802 sq km, water 540 sq km). It is comprised of 12 Governorates (Irbid, Mafraq, Ajloun, Jerash, Balqa, Amman, Zarqa, Madaba, Karak, Ta leh, Ma'an and Aqaba). It is bordered by Saudi Arabia to the south, Syria to the north, Iraq to the east, and Palestine to the west. It has access to the Red Sea via the port city of Aqaba, located at the northern end of the Gulf of Aqaba.

t opography, Wa er Re ource a d Clima e

Jordan's terrain is mainly characterized to be mostly a desert plateau in east, highland area in west. The Great Rift Valley separates East and West Banks of the Jordan River. The Dead Sea (the lowest point on earth) is in the Great Rift Valley (-408 m), and the highest point is at 1,854m. Jordan is a non- oil producing country; its main natural resources are phosphates, potash and oil shale. Jordan is considered as one of the four most water scarce countries in the world. High population growth, the in ux of refugees due to political instabilities in the region, the depletion of groundwater reserves and the impacts of climate change are likely to aggravate the situation in the future. The high population growth rate together with the country's rapid economic development has been accompanied by an increase in water demand, while the available water resources are limited and decreasing. Water resources in Jordan can be categorized into:

- Surface water resources: the Jordan River and the Yarmouk River, which are shared with Israel and Syria leaving only a small amount of water for Jordan.
- Groundwater resources (12 renewable and non-renewable aquifers) those are overexploited and over-abstracted in an unsustainable manner.
- Reclaimed water. In general, more than 97% of Jordanians have access to an improved water source and 67% have access to improved sanitation. This is one of the highest rates in the MENA, and the government is working to maintain the access to water and increase access to improved sanitation to 85% during the next 10 years.

Jordan's climate is semi-arid; 90% of the country receives an average precipitation of less than 200 millimeters per year (mm/yr) and only the highlands receive more than 300 mm/ yr of rain. Precipitation rates decrease drastically to the east and to the west of the highlands. 92% of rainfall quantities are lost through evaporation. About 5% of the rainwater in ltrates into the ground and replenishes the aquifers while 3% is transformed into direct ood ow. Rainfall exceeding the limit for reliable rain fed-agriculture (300 mm annually) covers only 4% of the land area in the North, North Western Highlands and in Jordan Valley.

Eco omy, Popula o a d s ocial Develope

The population of Jordan is 6,508,887 as of July 2012 with a growth rate of about 2.2%. Urban population is estimated at 79% of the total population, with Amman accounting to almost half of the population of Jordan.

Jordan's economy is among the smallest in the Middle East, with insu cient supplies of water, oil, and other natural resources, underlying the government's heavy reliance on foreign assistance. Other economic challenges for the government include chronic high rates of poverty, unemployment, in ation, and a large budget de cit.

Since assuming the throne in 1999, King Abdullah II has implemented signi cant economic reforms, such as opening the trade regime, privatizing state-owned companies, and eliminating some fuel subsidies, which

in the last decade spurred economic growth by attracting foreign investment and creating some jobs. The global economic slowdown and regional turmoil, however, have depressed Jordan's Gross Domestic Product (GDP) growth, impacting export- oriented sectors, construction, and tourism.

Jordan's finances have also been strained by a series of natural gas pipeline attacks in Egypt, causing Jordan to substitute for it with more expensive heavy fuel oils to generate electricity, creating an energy crisis that the country is facing and that the Government has to address. An influx of foreign aid, especially from Gulf countries, has helped to somewhat offset these extra budgetary expenditures, but the budget deficit is likely to remain high.

sector Overview

As mentioned earlier, Jordan is considered as one of the four most water scarce countries in the world, on a per capita basis at 147 liter per capita per day for 2011 (ranging between 71 liter per capita per day in Jerash and 230 liter per capita per day in Ma'an). A range of technical and financial challenges face the ministry as follows:

Table 1: technical and financial challenges that confront the water sector in Jordan
(Source: Water Authority of Jordan, 2013)

technical Challenges	Financial Challenges
• Limited water resources. • Uncontrolled population spread. • Old water networks. • High rate of water loss.	• Inability to cover the capital and operating expenditures within the currently applied tariffs. • Limited resources of funds. • Deceasing government support. • High cost of searching and developing new water resources. • Current tariffs are non-dynamic and are not connected with service delivery costs. • Increasing cost of service delivery due to increasing cost of production inputs. • Problems with cost recovery

In order to deal with these challenges, the Ministry of Water and Irrigation (MWI) vows through the adoption of a long-term plan to:

1. Improve the provided services through restructuring and rehabilitation of networks.
2. Reduce Non-Revenue Water (NRW) through procedure improvement.
3. Provide new resources and to maximize the efficient use of available resources.
4. Rely on loans, grants, service charge collections, and on Government support to cover the shortfall caused by low cost recovery of Operation and Maintenance (O&M) costs and total cost in all the governorates in Jordan.

In order to address the gap between the demand for and supply of available of water, the Ministry is working on increased use on non-conventional water resources, such as; Wastewater reuse, Disi Water Conveyance Project (320 km long) from the non-renewable Disi aquifer to the capital Amman and other parts of Jordan, and desalinated water, including part of the Red Sea-Dead Sea canal. Agriculture consumes about 60 to 70% of all water use. The domestic demand of water is estimated to be 25% and only 5% is used for industrial sector. Jordan's water resources are located far away from its population centers, in particular the Greater Amman area where almost half of the country's population lives and which lies at about 1,000 meter above sea level. To address this challenge, Jordan has developed extensive water supply infrastructure to provide water for both irrigation and municipal uses. The key elements of Jordan's overall water infrastructure are:

- The Al Wahda Dam on the Yarmouk River.
- The King Abdullah Canal (KAC) in the Jordan Valley which is fed primarily by the Yarmouk River, the Mukhaibah springs near the Yarmouk River and a number of wadis draining into the Jordan Valley.
- The As-Samra wastewater treatment plant that treats most of Greater Amman's wastewater and discharges it to the Zarqa River.
- The King Talal Dam on the Zarqa River from where the water returns to KAC downstream of Deir Alla for irrigation in the Lower Jordan Valley.

I□□□□u□o□al Framework of □he sec□or

Three main organizations comprise the Jordanian water sector:

1. The Jordan Valley Authority (JVA), which is an autonomous organization under the Ministry and responsible for water management in the Jordan Valley (construction, operation and maintenance of dams, supplying irrigation water to farmers, bulk supply of water to municipal and industrial sectors, and overall development of the Jordan Valley including land planning and development of tourism).
2. The Water Authority of Jordan (WAJ), which is responsible for supplying water to the municipal and industrial sector as well as wastewater collection and treatment across Jordan. It works on groundwater development and use and the operation of municipal utilities, and owns the three limited liability companies corporatizing water utility operations in several governorates:
   - Miyahuna, covering the Amman Governorate.
   - Aqaba Water Company (AW), covering the Aqaba Governorate.
   - Yarmouk Water Company, that is 100% owned by the Water Authority of Jordan and serves four northern governorates (Irbid, Mafraq, Ajloun and Jerash).

   The remaining six governorates are served by WAJ itself. Noteworthy is that water is produced in one company / governorate and transferred across boundaries in most cases.
3. The MWI, which is responsible for formulating water strategies and policies; performing water resources planning and developing national master plans; monitoring and evaluating water resources; and conducting water, wastewater, and irrigation studies. Under the Ministry a Performance Management Unit (PMU) is working to monitor the performance and audit the corporatized utilities; and develop public private partnerships (PPPs) and promote private sector participation (PSP) in water services and management.

   The Minister of Water and Irrigation is the head of both organizations (WAJ and JVA). Each of these organizations has its own organizational structure, responsibility, and mission.

Legal a□d Regula□ory Framework of □he sec□or

The MWI was established in 1992 (By-law No.54/1992) issued by the executive branch of the Government under the Jordanian Constitution. The establishment of MWI was in response to Jordan's recognition of the need for a more integrated approach to national water management.

WAJ was created in 1988 by virtue of Law No.18/ 1988 and its amendments as an autonomous corporate body with □nancial and administrative independence, responsible for the provision of water and wastewater services and the management of water resources and regulating ground water use.

JVA was created by virtue of Law No.19 / 1988 amended by new Law No.30/ 2001. As explained previously it is responsible for developing the Jordan Valley and the area south of the Dead Sea and for developing water resources there for irrigation and for operating the multi-source supply system for Amman and the KAC in coordination with WAJ.

Docume□□□ha□Direc□□he sec□or

Though there is no one water law governing the sector and setting its policies, however, several policy and strategy and planning documents exist that provide the direction and guidelines for the section:

1. Water policies for the following key areas:
   - Irrigation water policy: This policy is compatible with the Water Strategy and is in conformity with its long-term objectives. It addresses in more detail water-related issues of resource development: agricultural use, resource management, and the imperative of technology transfer, water quality, e□ ciency, cost recovery, management and other issues.
   - Water policy: Sets the principles guiding the performance of the water sector. It addresses the issues of the water strategy in the sector; its institutional development; private sector participation; water pricing and cost recovery; human resources; water resources management; water quality and the environment; service levels related to water distribution; public awareness; and conservation and e□ ciency measures.
   - Groundwater policy: It sets out the Government's policy and intentions concerning groundwater management aiming at development of the resource, its protection, management and measures needed to bring the annual abstractions from the various renewable aquifers to the sustainable rate of each.
   - Wastewater policy: the principles guiding the development of wastewater management. It addresses developing and managing wastewater as a resource; wastewater collection and treatment; reuse of treated e□ uent and sludge; pricing of services and other miscellaneous issues.

2. Water Strategy in Jordan- MWI (2008-2022): It establishes the vision for each of the major areas of the Water Sector. It identifies plans for Jordan's future water and the actions that will be taken to ensure that water is available for people, businesses and nature. It sets the vision of what Jordan wants to have by 2022. It looks at all aspects of the water cycle from rainfall to collection, treatment and discharge, the practical steps needed to take including an effective water demand management, an efficient water supply operations and a well developed institutional reform process.
3. WAJ Strategy (2008-2013): It sets the strategic directions and objectives of WAJ that are in alignment with sector policies and overarching strategy. It is developed based on the balanced score card approach, addressing the areas of customer satisfaction; financial aspect; operational aspect and human resources aspect.
4. JVA Strategy (2011- 2014): It sets the strategic directions and objectives of JVA that are in alignment with sector policies and overarching strategy. It addresses the development of conventional as well as non- conventional water resources; improving irrigation water management; surface water resources management; socio-economic development of the Jordan valley; protecting the Red Sea and the soil in the Jordan Valley; investment promotion in the area; and performance improvement.

Role of private sector

The Government is committed to securing water services at affordable prices and acceptable standards. It is also committed to extending these services to remote and less developed areas. It intends, through private sector participation, to transfer infrastructure and services from the public to the private sector, in order to improve performance and ensure the delivery of services to citizens.

The role of the private sector is being expanded with management contracts, concessions and other forms of private sector participation in water utilities being considered and adopted as appropriate. The concepts of Build-Operate-Transfer (BOT)/ Build-own-operate (BOO) are implemented. The private sector role in irrigated agriculture is also encouraged and expanded through Water Users Associations (WUAs).
WAJ has been responsible for all wastewater treatment and disposal throughout the kingdom, but handed over responsibility for this function to the corporatized companies in their respective Assignment Agreements. AW and Yarmouk were given title to the assets in the Assignment Agreements but Miyahuna was provided only with the right to use the assets.

The major As-Samra wastewater treatment plant is a BOT project serving both Amman and Zarqa governorates, and is managed by WAJ. The remaining parts of Jordan are served by WAJ administrations.

PSP also has been applied through outsourcing services and the involvement of the private sector in different functions/ business processes in operation and maintenance of water supply and wastewater network and infrastructure, whereas service contracts on billing and revenue collection and network operation & NRW, have been put in application. Such contracts have been developed to be contracted out on a Performance based concept.
One example for private sector involvement is the Improvement of energy efficiency Program supported by German Corporation for International Cooperation (GIZ) where the MWI and WAJ developed an approach for performance based energy service contracting in the water sector.

sPECIFIC UtILItIEs MAnAGEMEnt IssUEs

As explained earlier, water and wastewater services in Jordan are the responsibility of public (WAJ) as well as private entities (water companies, PPPs and PSPs) across the country. Although managed through differing approaches, utility management aspects are in many cases common. In the sections below we take a look at cost recovery, NRW, serving the underprivileged, energy efficiency and asset management.

Cost Recovery

In spite of efficiency improvements from corporatization and projects to modernize infrastructure, and internal and donor-supported programs to enhance revenues, the financial performance of WAJ and the companies collectively has been deteriorating during the last seven years. The sector entities have not been able to raise revenues to match increases in operating and capital costs.

While WAJ and the water companies have been able to cover operating costs; salaries, wages and operations and maintenance, full cost coverage has decreased as operating costs have increased. Operating costs increased significantly in 2011 and 2012 as electricity costs increased substantially. The current cost coverage

shortfall will grow as electricity costs increase and the Disi water starts □owing with its higher bulk rate cost. The Disi project, when it comes online in 2013, will also increase the □nancial burden on the water sector. The cost of water (expected to range between $0.90 and $1.05 per cubic meters ($m^3$)) will signi□cantly exceed the current costs of bulk water (around 0.30 JD to 0.35 JD per m^3).

Capital cost recovery also poses a signi□cant challenge. As a policy position, operating revenues are usually considered to cover operating costs, and capital expenditures are expected to be funded by the government and donors (equity as capital contributions and grants) and by national and foreign loans (as debt). Capital expenditures have been quite substantial, considering the sector's □nancial capacity. Between 2005 and 2010, WAJ has invested over 900 million JD ($1.3 billion) to rehabilitate and construct new infrastructure. This amount excludes the BOT investment in As-Samra and Disi. As a result, total cost recovery is not achieved and if the cost increase cannot be passed on to the customer, it will □nancially hurt either the utility companies or WAJ— or require increased budget support from the Government.

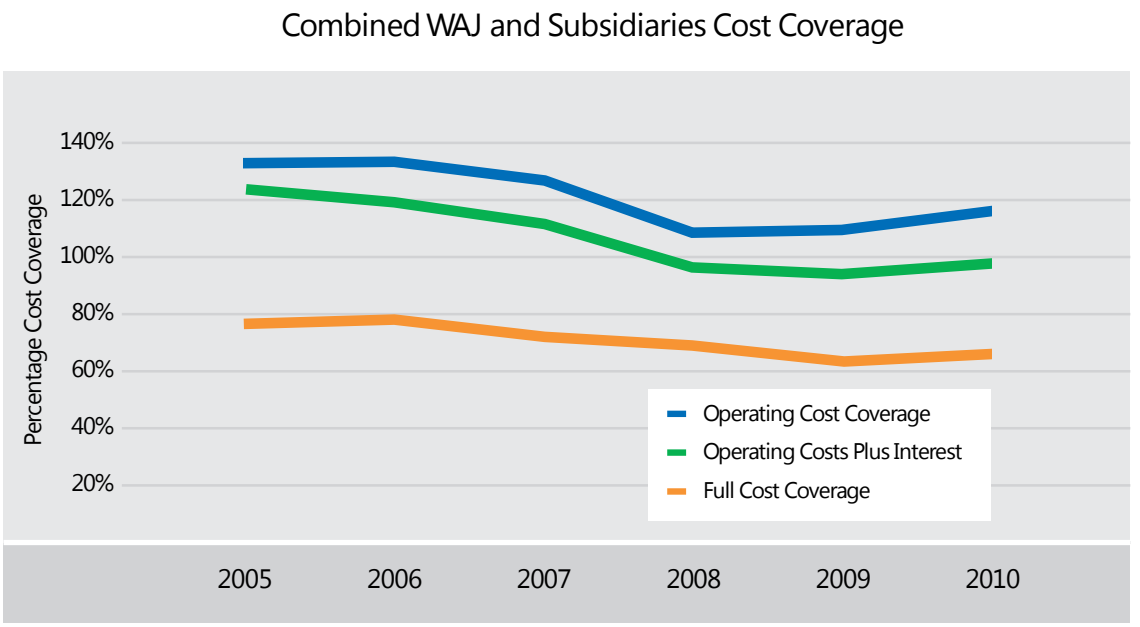


Figure 1: Combined WAJ and Subsidiaries Cost Coverage
Source: Audited consolidated □nancial statements for WAJ and subsidiaries (2006–2010)

n o□-Reve□ue Wa□er

One very important aspect re□ecting the utility performance is NRW, which is divided into the technical (physical leakage) as well as commercial (non-metered use, illegal connections, meter inaccuracies) loss. The NRW percentages for the three main water distribution companies are presented in Table 2. Total estimated average annual water losses to NRW for the three companies are about 80 Million Cubic Meters (MCM)/ year. In a water-scarce country such as Jordan, where the marginal cost of new supplies is between $0.90 and $1.05 (Disi project and desalinated water), the economic bene□t of reducing real losses should be of correspondingly high value.

Table 2: amounts of NRW by year

Compa□y	n RW by Year (%)					
	2005	2006	2007	2008	2009	2010
Aqaba	29.92	27.24	28.38	23.57	23.3	20.68
Miyahuna	45.7	42.1	39.8	36.8	35.3	34.3
Yarmouk	-	42.9	39.0	43.5	40.8	-

There is no accurate accounting of technical vs. physical loss, so it is assumed that 50% of NRW is technical– although it is believed that in reality and from the results of some studies and evaluations, commercial losses exceed technical losses.

In both Yarmouk and Miyahuna, water supply is currently intermittent. In Miyahuna, the number of hours of water supply per week available to each area has decreased over the last five years from 66 in 2005 to 36 in 2010. Intermittent supply has a number of negative impacts, including damage to the network, increased probability of meters under-reading because of air entrainment, increased NRW, due to high pressure while pipes are live, and public health risk.

In recent years, Micro PSPs were developed that outsourcing commercial functions to private sector companies (billing, collection and even Geographical Information System (GIS) mapping) with substantial improvements achieved on commercial NRW. The first pilot PSP in Madaba reflected improved billings and collection of at least 30%. Such PSPs still operate in the governorates of Madaba, Karak and Balqa.

serving the Underprivileged

As previously noted, MWI's objective of maximizing water and wastewater service coverage areas has been so far successful (97% for water and 67% for improved sanitation); no distinction is made between urban or rural areas, ensuring that even the underprivileged have the chance for the best of the provided services.

However, there is no specific mechanism where the underprivileged gets the benefit of the subsidy that the government is providing to water sector except through the tariff in place, which is a volumetric block tariff that in effect is subsidizing the rich equally as it is subsidizing the poor. This issue is currently under investigation in MWI and a comprehensive analysis of the cost recovery, applied tariff and subsidies is underway to better target the subsidy to be well deserved and serving the actually underprivileged. Several mechanism are under consideration, including adding an index to the water price that reflects the socio-economic standing and consequently the price to be paid and the subsidy involved, or even paying the subsidy directly to whomever is well deserving.

Energy Efficiency

Jordan has extremely limited primary energy resources and is forced to depend to a large extent on imported oil and natural gas. WAJ is the largest single consumer of electricity in Jordan at about 14% of the total energy demand in the country (in 2007 measured at 979 Mega Watt hours (MWh). Renewable energy, though available in abundance (solar and wind) does not play a significant role in electricity generation, due to the missing institutional arrangements and lack of incentives. The recently approved Renewable Energy Law No.3 of 2010 is the first step to overcome this.
The reason behind this high number of energy consumption rates for WAJ is because fresh water has to be pumped around 1,400 meters from the Jordan Valley up to the consumers in the cities. One of the other main reasons for the high electricity consumption is the operational inefficiency of the water pumps used to do this. To reduce the burden on the national electricity supply and avoid electricity blackouts, there is an urgent need to tap into potential power savings within WAJ. In relation, recent energy audits in a number of WAJ pumping stations revealed an energy saving potential of between 25- 30%.

With the current energy crisis Jordan is witnessing nowadays, several projects targeting energy efficiency in the water sector have been initiated or are in the works. These projects address upgrading the water supply network to assist in saving energy consumption in water transmission and distribution systems by replacing and/or rehabilitating pumping facilities and equipments as well as capacity building and technical assistance for the energy improvement management and O&M measures.

Asset Management

In Jordan, there is no specific Asset Management (AMM) policy, strategy or plans that are conducive of implementing AMM best practices (except in AW which is considered ahead of all other utilities and service providers in that respect). The utilities themselves currently lack the integration and cross-functional utilization of whatever existing asset data there is. In this respect and except for AW, no complete and accurate asset registries are available as a first step to implementing AMM best practices. This is also applicable in Miyahuna, the largest utility in Jordan in terms of scope coverage.

In the best case scenario and considering the unavailability of asset registries, but there are in the water

utilities stand alone systems and applications that constitute the base for any AMM implementation, however, this lacks the proper institutional, functional and electronic integration and synchronization.

However, sector leadership is highly motivated to make improvements, conscious of budgetary restrictions, and attentive to the needs of end consumers, whereas poorly motivated and moderately quali□ed sta□ is immersed in traditional roles and procedures, this is in addition to lacking su□ cient budget for assimilating major changes conducive of AMM best practices.

Functional systems that are in place include GIS, Customer Information System (CIS), Supervisory Control and Data Acquisition (SCADA), billing systems and □nancial accounting systems (FAS). However, those need not only be integrated, but functionally synchronized, and business processes that adopt best practices in AMM be established and institutionalized.

Miyahuna is currently embarking on a comprehensive AMM improvement plan that includes developing asset registry, an asset management plan and the procurement of components of asset management systems for both rotating and □xed assets.

LEssOns LEARnED

In an environment similar to what Jordan is experiencing in terms of water scarcity, unavailability of energy resources, inconsistently growing population and thus the need for broader service coverage area, and □scal and budgetary challenges, Jordan has achieved substantial strides towards developing its water sector. In fact, the need to accommodate such challenges yet at the same time provide the public with services drove several development initiatives in the sector whether on the governance, institutional, □nancial and even socio-economic levels. Still more is to be done and the improvement and development process is never-ending.

In terms of cost recovery, Jordan has to focus on increasing □nancial sustainability in the face of rapidly increasing energy and bulk water supply costs. Solutions are needed beyond the current dependence on volumetric tari□s, considering that total subsidies need to be reduced and whatever remain needs to be optimally redirected to serve the underprivileged. Also to be considered is the imminent increase in bulk water costs as the Disi project goes online, which would exacerbate the cost recovery issue even more. MWI/ WAJ should work to design ways to raise revenue by tari□ restructuring that re□ects capital recovery charge based on property taxes for example.

In terms of NRW, there is huge potential of improvement, and MWI/ WAJ should bene□t from improving management practices as well as considering water resources development and capital investment. Engaging private sector has proven to be very e□ective when it comes to improved management practices. Furthermore, close investigation of cost vs. bene□t for infrastructure projects vs. improved management techniques should be undertaken to determine the most cost e□ective approach that can address NRW reduction.

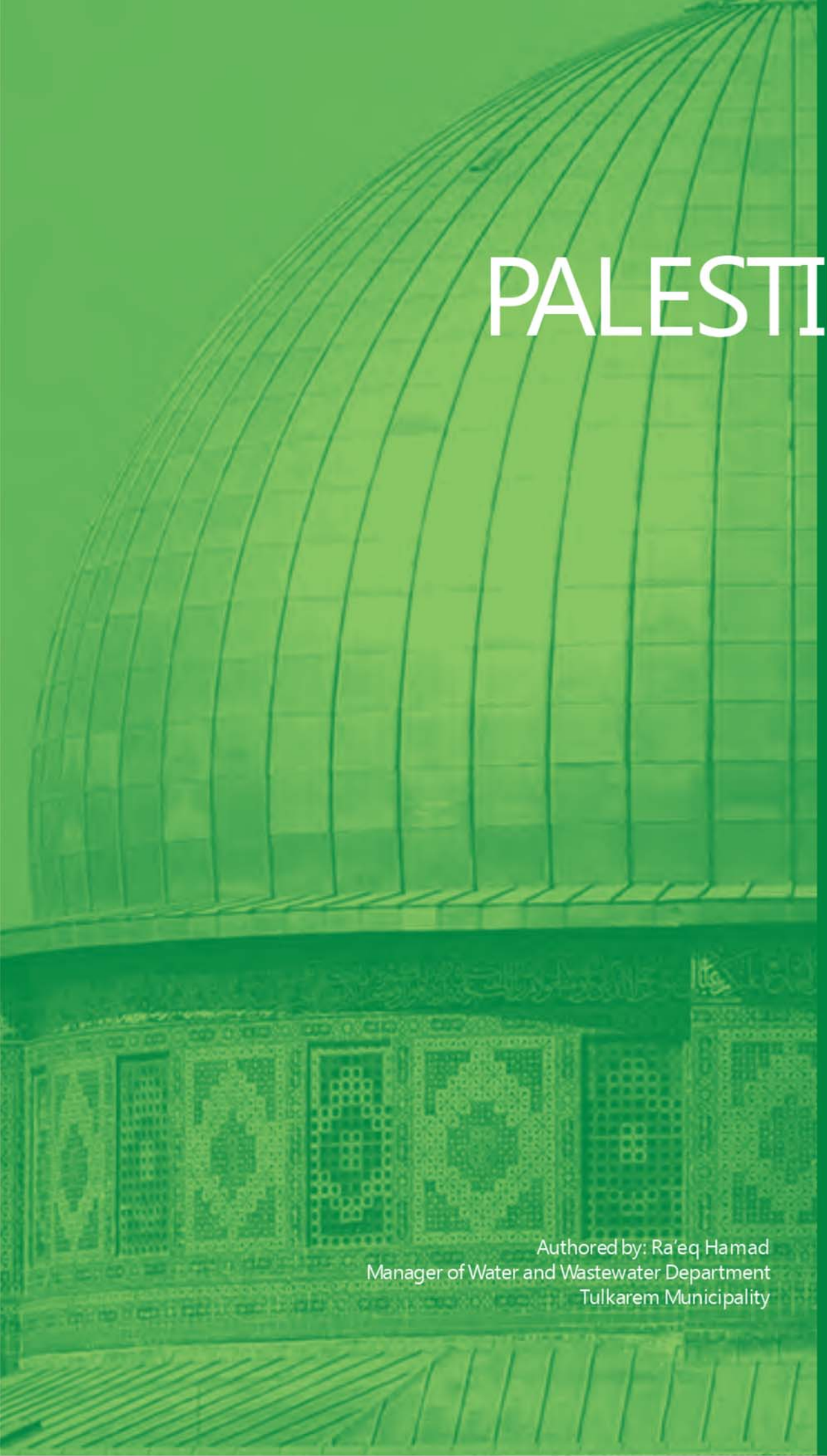
In terms of serving the underprivileged, so much can be done whether by facilitating connections to the network, or by redirecting sector subsidy to actually cater for the poor, or by continuing to work on individual initiatives bene□ting the poor.

In terms of energy e□ ciency, the topography of the country and the types and geographical dispersion of available water resources along with the lack of energy resources in Jordan, are all the more reason to encourage research in energy e□ ciency and utilizing renewable energy for service provision. This is achievable either through less cost intensive management practices, as well as through capital investment. Jordan has to work heavily on this issue to mitigate the two intertwined factors of no energy resources as well as budgetary constraints and low cost recovery.

Implementing AMM best practices is a huge big area that not only would bene□t Jordan in improving level of service provided, but does that most cost e□ectively. However, this does not entail working on availing sophisticated systems and automation techniques; rather it requires proper institutional restructuring, organizational transformation and functional streamlining, alignment and integration--all to be supported by the proper IT infrastructure. Jordan still is at the doorsteps of achieving all this, and still needs to stride along to realize it.

REFERENCES

1. BGR 2004, Water Sector Planning Support Project.
2. Central Intelligence Agency (CIA), The World Fact book, The Office of Public Affairs, Washington, <https://www.cia.gov/library/publications/the-world-factbook/geos/jo.html>.
3. Ministry of Water &Irrigation (MWI) 2010c, Groundwater Policy, viewed on 4th Dec 2012, <http://www.mwi.gov.jo/sites/en-us/SitePages/Water%20Policies/Ground%20Water%20Policy.aspx>
4. Ministry of Water &Irrigation (MWI) 2010a, Irrigation Water Policy, viewed on 4th Dec 2012,<http://www.mwi.gov.jo/sites/en-us/SitePages/Water%20Policies/Irrigation%20Water%20Policy.aspx>
5. Ministry of Water &Irrigation (MWI) 2010d, Wastewater Policy, viewed on 4th Dec 2012, <http://www.mwi.gov.jo/sites/en-us/SitePages/Water%20Policies/Waste%20Water%20Policy.aspx>
6. Ministry of Water &Irrigation (MWI) 2010, Water Budget 2010, Jordan.
7. Ministry of Water &Irrigation (MWI) 2010b, Water Policy, viewed on 4th Dec 2012,<http://www.mwi.gov.jo/sites/en-us/SitePages/Water%20Policies/Water%20Policy.aspx>
8. Royal Water Commission (RWC) 2009, Water for Life: Jordan`s Water Strategy 2008-2022, Ministry of Water &Irrigation (MWI), Jordan.
9. Humpal, D. et al. 2012, A Review of Water Policies in Jordan and Recommendations for Strategic Priorities, USAID, Jordan.
10. Khashman, K. 2011, Best Practices in Decentralizing the Management of the Water Sector in the Arab States, UNDP, Jordan.
11. Svendsen, M. et al. 2010, Mena Regional Water Governance Benchmarking Project_ Country Profile: Jordan, USAID, Amman.
12. Saidam, M. &Ibrahim, M. 2006, Institutional and Policy Framework Analysis of Water Sector_ Jordan, Royal Scientific Society &Environmental Monitoring and Research Central Unit.
13. International Resources Group (IRG) 2011, Institutional Support &Strengthening Program_ Institutional Assessment Report, USAID, Jordan.
14. International Resources Group (IRG) 2012, ISSP Water Valuation Study_ Summary Report: Disaggregated Economic Value of Water in Industry and Irrigated Agriculture in Jordan, USAID, Jordan.



PALESTINE

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ACRONYMS

JWU	Jerusalem Water Undertaking
Km	Kilometer Squared
m^3	Cubic Meters
MDGs	Millennium Development Goals
NRW	Non-revenue Water
NWC	National Water Council
PNA	Palestinian National Authority
PWA	Palestinian Water Authority
WSSA	Water and Sewage Authority

In t RODUCt IOn

Water and wastewater utilities around the Arab countries are confronted with many di□ culties and challenges as they strive to make organizational improvements. Water sector utility managers must consider a wide range of issues in their management improvement initiatives. General economic conditions, sta□ turnover, communication between internal management and external stakeholders, involvement of sta□ across the organization, aging and occasionally decaying infrastructure, applied rate issues, and limited sta□ resources are some of the issues managers address.

In this case study, we will focus on the important factors of Cost recovery; Non-revenue water, Serving the underprivileged, energy e□ ciency and Assets management.

Figure 1: Map of Palestine

Cou□□ry Backgrou□d

Geographical Loca□o□, Area a□d Popula□o□

Palestine is located in the south-west of the Asian continent in the southern part of the eastern coast of the Mediterranean Sea. Palestine is bordered by Lebanon and Syria from the north, Mediterranean Sea from the west, the Arab Republic of Egypt and the Gulf of Aqaba from the south and by Jordan from the east. The total area of the historic Palestine comprises 27.009 km^2. The West Bank's area comprises 5,844 km^2, and forms 21.6% of the area of Palestine. The Gaza Strip area comprises 365 km^2 and constitutes 1.35% of the area of Palestine. The number of inhabitants of Palestine reached 4,293,313 divided between Gaza Strip 1,644,29 inhabitants and West Bank 2,649,020 inhabitants.

Pale□□□e'□t opography a□d Geography

Palestine is known for its various topographical features. It can easily be divided into four distinctive regions: moving from the coast of the Mediterranean Sea in the west of Palestine towards the east, its topography begins with the coastal plains that extend from north to south along the shoreline until the south of Gaza. The plain widens as one heads south, followed by the inland hills and mountains such as the Galilee Mountains, the mountains of Nablus and the mountains of Jerusalem and Hebron. In the northern highlands of Nablus lies the fertile Jezreel Valley (Marj Bin Amer), and is separated from the coastal plain by Mount Carmel. In the east runs the Jordan River - the main river in Palestine, that is fed by the fresh water of Lake Tiberias (Sea of Galilee) through a sinking basin that is known as the Jordan Valley. It runs towards a lake characterized by its very high salinity which prevents any form of marine life –the Dead Sea. It extends to the south with a desert rift called Arabah Valley (Wadi Arabah). The southern adjacent region to Wadi Araba contains the Negev desert plateau. Thus Palestine consists of four distinctive natural regions: the coastal plain, the highlands (the mountains of Galilee, Nablus, Jerusalem and Hebron), the Jordan Valley and the Negev desert.

Elevations range from 423 meters below sea level at the shores of the Dead Sea - being the lowest point on land in the world- and 1,208 meters above sea level at the top of Mount Meron and 1,020 meters at the Hebron mountain peaks.

s pri□g□ River□a□d Lake□

s pri□g□a□d s □ream□

These wells and springs are distributed in Palestine as follows: Hula area until the Sea of Galilee basin, with nearly 135 springs; high and low Galilee areas, with nearly 261 springs; Acre plain area and the Western Galilee, with 11 springs; the Mount Carmel area and that of Umm al-Fahm, with 150 springs; Nablus Heights with about 53 springs; Jerusalem, Ramallah and Hebron mountains, with 227 springs; Palestinian coastal plain, with 33 springs; Jordan Valley, south of Lake Tiberias with nearly 50 springs; the coasts of the Dead Sea and Wadi Araba, with 42 springs; and the Negev with 10 springs. The most famous springs is the Al-Dan and Ras al-Ain River body of springs, located on the Palestinian coast east of the city Ja□a, as well as Tabiqa springs, Ain Alkardana spring southeast of Acre, salty Bisan springs, Awja springs northwest of Jericho, and Capri spring northeast of Acre. The water of these springs di□ers in the degree of its salinity compared to valleys and rivers.

There are two basic networks of riverbeds in Palestine, namely; Mediterranean riverbeds Network and the Rift Valley Network. They are separated by a drainage line, which extends from north to south and which □uctuates in length from north to south. The rivers that head towards the Mediterranean are longer than rivers heading towards the Rift Valley.

All the rivers in Palestine share common characteristics, of which the most important are: change in amount of water □ow and its annual water drainage as well as □ow velocity until the coastal areas. In fact all that fall under the category of rivers in Palestine are actually small water streams if compared to the major rivers in the world. The following list displays the river networks in Palestine.

Medi□erra□ea□ river□□e□work

1. Wadi Al Qarn, which is characterized by a continuous annual □ow, during which it drains a water basin of 137 km^2, which covers most of the Galilee mountains area. It is 42 km long.
2. Wadi Al Mafshoukh: is 22 km long and starts at the western foot of Upper Galilee mountains, near a town called Tarshiha, where it is known as Wadi Al Sa'ouq. It then crosses a settlement about 15 km from the Palestinian-Lebanese borders.
3. Al Na'amin River, whose basin is about 322 km^2 and is 9 km long, is situated in the southern part of Acre

plains. The average river flow is 45 million m^3.

4. Al Maqta'a River: Has a constant flow and covers about 1,069 km^2. It covers parts of Lower Galilee Mountains, Jezreel Valley (Marj Bin Amer), Jenin Mountain, Um El-Fahm region and the southern part of Acre plains. The river is 56 km long.
5. Al Zarqaa River: covers an area of 181 km^2, is 25 km long and flows into a location northern of Al Khadira. It stretches south-west of Al Carmel Mountain and flows 4 km northern of Al Qaisariah. Its average flow is 115 million m^3.
6. Wadi Al Khadira River (Al Mujez): Appears in the northern parts of Nablus Mountains in the villages Zababdah, Raya and Qabatia. It is about 66 km long and has an average flow of 10-15 million m^3.
7. Eskandaronah River: The basin is about 561 km^2, is 37 km long and flows northern of the Israelian town Netanya.
8. Al Faleq River: is a small river of 13.5 km and a basin area of 113 km^2. It is constant in flow for about 3 km. The river appears at the coastal plain north west of Qalqilia and flows into Al Haram Village for 8 km, about 26.1 km north east of Jaffa.
9. Al 'Oja River: is ranked second after the River Jordan in width and water amount. Its basin is 1752 km^2 and its annual flow is 220 million m^3.

Rift Valley River Network

1. Jordan River, which is the most important river. It reaches 320 km in length starting from Alhasbani River on the Palestinian-Lebanese borders till the Dead Sea. It is constant in flowing and its sources consist of three main groups of springs: Al Hasbani - Al Dan - Banias, plus a fourth group: Braghith River, though it is less significant than the first three. Al Hasbani River springs group, with an average flow of 153-162 million m^3. Al Dan River springs group, with an average annual flow of 240 million m^3. Banyas River springs group, with an average annual flow of 120 million m^3
2. As for the Braghith River, its average monthly flow amounts to 5 million. There are also a few tributaries to the Jordan River: Al Yarmouk River, with an average annual flow of 460 million m^3, Wadi Al Fari'a, Al 'Oja, Al Qalt, in addition to a number of valleys that supply the Jordan River from the eastern side in Jordan. The average flow of Jordan River amounts to 875 – 1,250 million m^3

Lakes and stagnant Water Bodies

This includes lakes, ponds, swamps, pools, different water reservoirs. Al Hula Lake which was dried will be excluded as well as the Dead Sea due to its salinity. In this section the discussion shall be limited to Lake Tiberias (Sea of Galilee). Lake Tiberias (Sea of Galilee) is situated in the northern part of the Rift Valley, to the south of Al Hula Plain. It has an oval form of 21.5 km in length and maximum width of 12.3 km. It has a total area of 162 km^2 and a water storage capacity of 4,239 million m^3. This amount fluctuates according to rainfall amount. The lake's deepest point is at 44m.

Climate

The climate in Palestine is influenced by the surface and location factors. In general, Palestine is located within the territory of the Mediterranean climate which is characterized by moderation, whereas it is hot and dry during the summer and cool &rainy throughout the winter. In Palestine the climate varies with the diversity of its surface. This diversity is represented in: the temperature with an average annual of 25 ºC in the valley region, 15º C in mountainous regions and 20º C in the coastal regions, as well as the amount of rainfall which varies from one region to another and from one year to another. In Palestine three major climatic regions prevail:

1. The rainy moderate Mediterranean Region: This region is represented in the coastal plains and the western slopes of the highlands, and is characterized by its warm climate, dry summers and mild wet winters. Rainfall amounts range between 300 - 700 mm per year, which allows diverse agriculture in this region.
2. Semi-arid region (sub-Saharan): This region is situated in the northern and middle parts of the Wadi Araba and the northern Negev. It is characterized by hot summers and semi-dry warm winters. It has rather scarce rainfall ranging between 15-300 mm per year; which makes the reliance on irrigation water in this region of great importance in agriculture.
3. Dry (desert) region: This region prevails in the Negev Desert, Wadi Araba, the Dead Sea and the southern Jericho and the Jordan Valley. It is characterized by its hot and dry climate in summer, and warm winter. Rainfall amounts range between 50 - 150 mm per year. This area is semi-arid and contains limited resources of flora and marine life.

Economy and socio-economic Development

Economic development in Palestine is one of the priorities that occupy the minds of Palestinians throughout the different stages they have gone through. It seems that the issue of development in Palestine and the circumstances that prevailed imposed a special characteristic both on the nature of the activities or development plans and programs, and thus it gained the notion of "development" especially in connection to what is happening in the region and its relationship with the events of the economic, social and political life. The development process in Palestine has been exposed to many difficulties and obstacles that have prevented its continuity, limited its results and negatively affected the standard of living for the majority of the population, due to the instability and direct interventions of the Israeli occupation authorities, destroying vital elements of infrastructure and public facilities and expansions of production in all activities.

There is no doubt that the residents of the Palestinian territories suffer from low levels of income and interrupted means of living and earning a living in the country, so it is imperative to work on attracting direct foreign investments, especially those that are looking for efficiency considerations that are available in the Palestinian economy. These are established through high skills and manpower supported by a rise in the level of education, training and aspirations of the various working groups in Palestine. The Palestinian Authority receives foreign aid from Western and Arab countries in solidarity with the Palestinian people facing the occupation and siege conditions, which have prevailed in the Palestinian territories. The statements of the ministries of planning and finance in the Palestinian Authority indicate, that the total amount of aid that the donors have committed to during the period (1994-2004) amounted to approximately $ 7,500 million at a by-passing annual rate of $ 670 million.

Achieving the Millennium Development Goals Indicators

This year (2013) The Ministry of Planning and Administrative Development has launched the National Strategy for achieving the Millennium Development Goals (MDGs) by 2015, as part of the national planning process and cannot be separated from it in any way. It aims mainly to identify integrated options, policies and interventions that link its priorities with the priorities set by the agenda of national policies. The Palestinian National Authority (PNA) has expressed its full commitment to work towards achieving the MDGs, and worked on the preparation of national reports for monitoring the status of progress on these goals.

The strategy also noted that the national effort to achieve the MDGs by 2015 is still strong and that the progress that has been made since the establishment of the PNA in 1994, could continue and be enhanced by putting an end to the occupation, and the establishment of a sovereign Palestinian state that provides the necessary conditions for further progress towards achieving the MDGs. The strategy also summarizes the possibilities and current trends towards achieving these goals, though some are unlikely to succeed in light of the continued occupation.

A main objective of the strategy is the eradication of extreme poverty and poverty alleviation. After all there are low participation rates in the labor market in the occupied Palestinian territories, and this has a direct impact on poverty rates and the level of food security for the population. The poverty rates remain high in spite of the efforts and programs that are implemented within the framework of poverty elimination. The same applies to the status of food security related mainly to poverty.

Furthermore it worked on ensuring the ways and methods to protect and sustain the environment, being the most important key factor for development—especially for the sake of future generations. Palestine has been able to achieve significant progress in terms of the legal environment designated for the protection of the environment. For this purpose a number of policies have been put in place to protect the environment in cooperation with and through the coordination between all ministries, as well as the preparation of a number of strategies, such as solid waste strategy, the overall plan for hazardous waste, the emergency plan for the protection of nature, the national strategy for combating desertification and the national strategy for coping with climate change.

It also worked on the development of objectives and policies to preserve the environment, such as environmental resources control, natural resources and their sustainable and integrated management, reducing the loss of biodiversity and the protection of cultural heritage. Furthermore it seeks to reduce the proportion of individuals who do not have access to safe drinking water. Finally it seeks to reduce the impact of climate change and natural disasters.

The strategy is facing difficulties and challenges. Since the preparation of the strategic plan depended on the principle of partnership, the Ministry of Planning and Administrative Development coordinated its efforts

to prepare the latter in partnership with relevant government as well as institutions of civil society, private sector representatives and international partners, especially the United Nations agencies. However the ability to implement this agenda was and still is limited because of the restrictions and obstacles imposed by the Israeli occupation by deepening the occupation, the continued building of settlements on the territory of the West Bank, the construction of the wall, racial expansion, the continuous imposition of the blockade on the Gaza Strip and separating it from the West Bank as well as separating Jerusalem from its Palestinian surrounding, control of Palestinian natural land and water resources and finally the deployment of military checkpoints in the West Bank, which as a whole hinders real development.

Despite the difficulties facing the government, it managed to achieve significant achievements in all key sectors during the past years. In the government sector it was able to strengthen the security and safety situation in the Palestinian society. In the social sector it continued to promote building the sectors of education, health and social safety, etc. In terms of the economic sector it was able to develop the legal environment that enabled the growth of the private sector and guiding it to its natural role in driving the economic growth. As for the public infrastructure, several private projects have been completed by developing the sectors of water, wastewater, energy projects and projects for internal and external roads, etc. However as mentioned previously, the Israeli violations keep all these accomplishments under their political control which limits the possibility of their enforcement.

sector Overview

The issue of water and wastewater in Palestine is an essential part and component of the Palestinian economic, social and political complex. Water and earth represent the basic components of the sovereignty, and an important element to ensure real independence. Water represents the symbol of clinging to the land and water on its surface and inside it. It represents a key for any economic and social development. The PNA realized the importance and the need to develop plans and strategies for the water and wastewater sectors. It worked in this field through the Water Authority and the various relevant institutions in order to improve water and sanitation services, and to facilitate the life of Palestinians.

Institutional Framework of the sector

The process of organizing the water sector in Palestine, which began to draw the main lines of the sector's restructuring, was immediately followed by the creation of the Palestinian Water Authority (PWA) in accordance with the provisions of Law No. 2/1996. From that moment on the PWA took upon itself to start a journey of a thousand miles to build the authority institutions and departments, to rebuild and repair the decaying infrastructure of the water sector through the execution of projects; attracting the necessary funding for them; providing services to people who have been deprived of them for decades of occupation; addressing schemes of the Israeli occupation and the preparation of Palestinian files based on Palestinian information and numbers that support Palestinians' rights and help them obtain their water rights. The figure below shows the institutional framework of the Palestinian water sector.

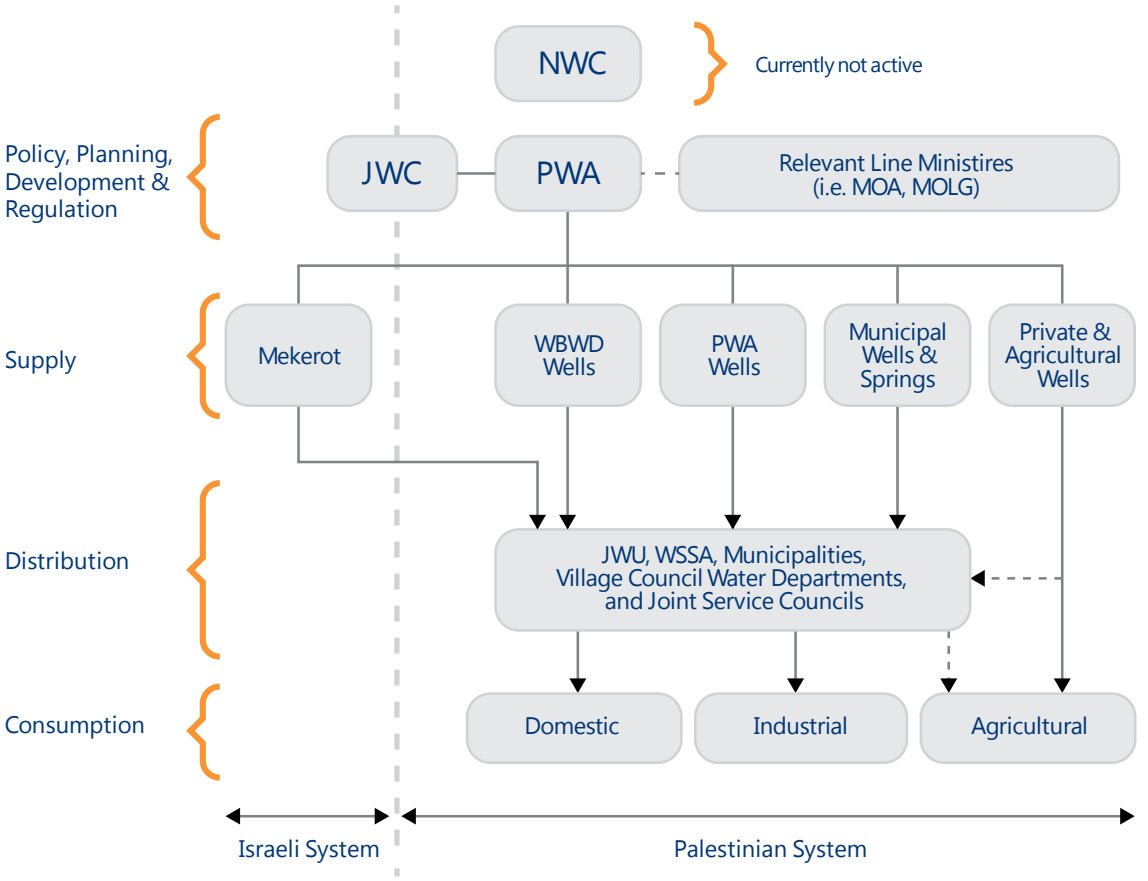

Figure 2: Institutional Frame for the Water Sector in the West Bank
(Source: PNA, 2008, World Bank Water Governance Program, 2007)

Since the establishment of the PWA, hard and diligent work started in order to formulate our national water policies, to determine the political reference for this sector, organize tasks and those performing them on the basis of a modern law, issued as No. 3 of 2002, upon which the National Water Council was formed as a high political reference for decision-making purposes in this sector.

The structure of the water sector in Palestine relies on the following principles:

1. Segregation of regulatory and operational duties;
2. The division of the institutional structure of the water sector into three levels:
   - The political level (National Water Council): is the water policy-making level.
   - The organizational level (PWA): is the level of implementation of water policies.
   - The operational level (water utilities): is the level of service delivery and water supply.
3. Standardization of water services institutions in the regional water Authorities at the provincial level, provided that these utilities have financial and administrative independence;
4. Integration of water supply and sanitation services in the utilities of the proposed territorial waters, as a confirmation that treated wastewater is a source of water; and
5. The establishment of the National Water Authority to provide wholesale water supply services to the regional water Authorities, by turning the West Bank Water Department to a bulk water utility.

The role of ratifying policies has been given to a ministerial body represented by the National Water Council (NWC). The role of developing policies regulating and planning for the sector was assigned for the PWA along with other ministries--above all the ministry of Agriculture. Up to now, NWC has been inactive, and no policies to strategic instructions have been adopted or developed for the water sector, especially when it comes to the sanitation sector.

The role of water distribution is coordinated through several institutions--of which, West Bank Water

Department, PWA and several municipalities that own some springs and wells, in addition to several agricultural operators for the wells and springs from the private sector.

Jerusalem Water Undertaking (JWU), Water and Sanitation Services Authorities (WSSA), the responsible Municipalities, Joint Service Councils, Village Council Water Departments and Water Users Associations, are responsible for the distribution of water to their beneficiaries, local customers from the industrial, commercial and agricultural sectors.

Legal and Regulatory Framework of the sector

The most significant local Palestinian legislations that govern the water and sanitation sector include:

- Water Law No.3/2002 and the Amendments suggested.
- Environment Law No.7/1997.
- Local Authorities Law No.1/1997.
- Internal Regulations of the PWA, Decree No.66/1997.
- Agriculture Law No.2/2003.
- Environmental Assessment Policy, approved 23rd Apr 2000.

Key documents that Guide sector Management

The PWA has drafted the main principles which are essential elements of the water policy that was developed in 1996. It constitutes an important framework for the role of the PWA as a regulator for the water sector.

The principles of this policy were adopted in all aspects of the legislative, regulatory and administrative mechanisms of the water resources management. The most important principles of the Water Policy are:

1. Ensuring the sustainability of water supply services at the best possible levels: The main wager for the management and development of water resources effectively is linked to the extent of meeting the current and future water needs in a sustainable manner, based on the principles of sustainable development. The key elements of the national water policy constitute the basis for making decisions on the structure and functions of the institutions involved in the water sector and legislations issued for this sector. This policy provides a solid foundation for the management of water resources in an integrated manner, and emphasizes the sustainable development of all available water resources, including wastewater.
2. Water resources management at the national level: It is necessary that the development and management of water resources is coordinated at the national level, and that it is implemented at the local level in a suitable manner. Thus, it is possible to verify that all of the development processes and domestic investment, both industrial and agricultural, are consistent with the amount of water available from accessible sources, as well as economically feasible.
3. Regulation of water supply services: The national water policy (as shown in the following principles) will represent the basis for making decisions concerning the structure and functions of the institutions involved in the water sector, in addition to legislations and the management strategy for this sector.

Elements of the National Water Policy can be summarized as follows:

- All water resources are considered to be public domain.
- Water has a unique value for life, and all citizens enjoy the right to access affordable high quality water.
- The process of water supply and local development in the fields of industry and agriculture should be in line with the available water resources, and based on the principles of sustainable development.
- Water has a social, environmental and economic value.
- The process of development and management of water resources in Palestine should be coordinated at the national level, and implemented at a suitable local level.
- Only one institution should hold the responsibility for managing the national water sector, with an emphasis on separation of institutional responsibilities for regulatory tasks and those related to water policy, from the tasks related to water supply services.
- Public participation should be ensured in the management of the water sector.
- Water management should include the integration of quality and quantity at all levels.
- There should be integration between the management of water and wastewater at all levels.
- The optimal development of water resources should be supported by a coordinated management of water demand.
- The protection of water resources and pollution control should be ensured. For this purpose, the following principle should be applied: "the polluter bears the consequences of contaminating these resources."
- The conservation of water resources and the optimal use of water should be promoted.

- Following-up on the Palestinian interests in terms of obtaining water rights from the resources in common with other countries.
- The government will cooperate with regional and non-regional organizations to encourage optimal use of water resources, to find and develop new and additional resources, and to gather the appropriate information and data and share them with others.

Investment Program for the Development of the sector

The PNA showed great concern for the water sector in the Palestinian territories, creating thereby the PWA, which in turn has taken upon itself the implementation of several water-related projects. This led to improved performance and increased water distribution networks. It carried out the maintenance of available water reservoirs and wells, as well as establishing more of the latter in the various Palestinian provinces, whether in the West Bank or in the Gaza Strip. It also supervised the extension and repair of water supply systems, treated drinking water using chlorine, carried out projects for rainwater drainage and sanitation, as well as created several desalination plants in the Gaza Strip in order to take advantage of the sea water for different purposes, in addition to providing municipalities with computers and special programs for the management of water networks.

sPECIFIC UtILItIEs MAnAGEMEnt IssUEs

The scarcity of water in Palestine is a matter of great interest, whereby according to the World Bank (2009), the Palestinians have the right to access 20% of the mountainous groundwater resources in the West Bank and extract 20% of the groundwater in the West Bank and Israel. It is worth mentioning that the growth in population caused the expansion of economic activities in construction, agriculture and industry, causing a significant increase in water use, resulting in a pressure on wastewater quality and quantity, in conjunction with the lack of adequate services networks.

Till this day, there is still no standard tariff system in the West Bank and Gaza Strip, for calculating the costs of drinking water and agricultural water, even though the Palestinian water law No. 3/2002, gave permission to the PWA to develop a unified tariff system for drinking water, industry, agriculture, and sanitation services. Accordingly, a number of studies should be conducted focusing on setting up a unified and efficient mechanism, taking into account the objectives that can be achieved by this, especially the equal distribution of water in terms of quality and quantity, and the ability to recover the cost, taking into account the disparity in access of citizens, as well as achieving a sufficient economic viability.

Applied tariff for Water and sanitation services

The first article of the Water Law No.3 of 2002 defined the water tariff system as: a thought-through standard-based system for the purpose of imposing the water pricing. The new water tariff is based on the following principles (PNA, 1998):

- Sustainability of water and sanitation services.
- Merging sanitation and water fees.
- The new structure shall encourage savings in water resources, by raising the price for users with high consumption of water.
- Provision of basic needs of water supply and sewerage services at low cost, provided that:
- The loss is compensated for by wealthier groups with high consumption (cross subsidy).
- Pollution fees are identified and imposed according to the severity of the source of pollution.

There is a visible disparity in the prices of water between the West Bank and the Gaza Strip:

1. While the highest price for 100 cubic meters of water in the Gaza Strip reaches 198 Shekel in the area of Abasan, it goes up to 900 Shekel in the West Bank governorate of Nablus.
2. There is a big difference in the price of water between the governorates of the West Bank itself, as the price of 100 m^3 ranges from 101 Shekel in Jericho to 900 Shekel in Nablus.
3. There is a difference in the billing cycle between different governorates in the West Bank. In some governorates the water bill is monthly, such as in: Nablus, Hebron and Tubas, and in others it is bi-monthly, such as in: Ramallah, Salfit and Bethlehem. This means that the method of calculating the minimum water

consumption di□ers from one governorate to another. For example, the price of the □rst 5 cubic meters of water in the Nablus governorate is 26 Shekel, while the price of the □rst 5 cubic meters in the city of Tubas is 14 Shekel.

4. There is no di□erentiating in the price of water that is consumed for di□erent purposes such as drinking, agriculture, industry, public parks, etc.

Co□□Recovery

Everyone who consumes water has to pay for it. This is the main principle upon which water tari□ is built. Therefore the water tari□ has to recover the costs in each of the utilities, so that revenues are slightly higher than the costs. The water utilities should increase their revenues until it reaches the full recovery for the costs as shown in the following stages:

1. Phase I: the revenues cover operating and maintenance costs.
2. Phase II: the revenues cover operating and maintenance costs as well as the depreciation of □xed assets based on the true value.
3. Phase III: the revenues cover operating and maintenance costs as well as the depreciation of □xed assets based on the true value, in addition to the investments loan interests.

The cost recovery is important for the continued operation of water utilities. Without the necessary revenues to cover the required costs, e□ ciency shall be reduced, production shall be delayed and di□erent water utilities will end up adopting di□erent cost recovery methods. Some utilities might retrieve the costs of the □rst phase, others of the □rst and second, and some all three stages. This depends on the state policy and the extent of its contribution to the protection of poor families.

Many countries are concerned with focusing on the adoption of the principle of cost recovery as a base to establish a water tari□. The PWA for example is seeking to adopt a water tari□ system which aims to recover the full cost (□rst phase) without recovering the interests through tari□s, since there is no speci□ed interest rate for this purpose in Palestine.

n o□ Reve□ue Wa□er

Non Revenue Water (NRW) refers to the amount of water that was pumped but not billed, where amounts that are produced and pumped into the network are more than the amounts billed. To cover NRW costs, the local organizations and institutions working in the water sector usually impose the costs onto consumers. The higher the loss is, the higher the prices. Losses can be of two main types:

1. Technical or physical losses: this kind of water loss occurs due to damaged pipes, especially in old pipe networks, leakage from pipe junctions, wrong installation of networks, junctions and water meters, meter inaccuracies in measuring the real quantity consumed.
2. Commercial losses: water loss due to theft, illegal connections and unrecorded quantities of water.

The loss in the West Bank and Gaza Strip presents one of the main problems. NRW reached 40% in 2010 or more in some municipalities, such as Tubas and Jenin. The commercial losses reached up to 30% in some places such as Hebron and Bethlehem for the same year. The losses rose signi□cantly during the uprising "Intifada" because the occupation forces damaged networks and water reservoirs, and created obstacles for those in charge of repairing these reservoirs and networks.

Although the utility or municipality usually bears the costs of commercial NRW, however the Palestinian institutions operating in the water sector are imposing the commercial NRW on the consumer, thus contributing to the increase in prices of water and their discrepancy between governorates, due to di□erent losses in each region on a practical level. In order to reduce the volume of water losses, the PWA started developing appropriate solutions, in cooperation with non-governmental organizations and with the help of donor agencies, through developing networks and main pipes in high-loss areas such as Bethlehem and Hebron.

It is worth mentioning in this regard that the reduction of water loss requires high □nancial investments, due to the bad shape the water infrastructure is in, in addition to the need to obtain the approval of the (Israeli - Palestinian) Joint Water Committee before initiating any project that aims at rehabilitating water networks

and detecting illegal connections on main pipes. The PWA is also working on reducing commercial losses by reducing water theft from the main water pipelines.

In general, there is a need to intensify e□orts in terms of addressing the problem of water losses, thus reducing the cost of water on the one hand, and reducing di□erences in prices on the other. To that end, it is necessary to carry out the following actions:

- The use of modern equipment for leakage detection in water pipes.
- Continuous monitoring of the water networks and meters.
- Speedy repair of the damaged pipes.
- Maintenance of water networks and meters according to an approved program.
- Ensuring the good shape of pipelines and networks before operating them.
- Recording all actual consumed water quantities, even if some bills are exempted from payment for di□erent reasons.
- Disconnecting illegal connections, and taking deterrent legal action against violators.
- Repairing any errors in meter reading or billing.

E□ergy E□ cie□cy

The type of energy used in the production and distribution of water highly a□ects the cost, especially since the majority of wells in the West Bank, are deep and require a huge amount of energy for lifting water to the ground, pumping to the main reservoirs, and then pumping through the network. The greater the depth of the well is, the higher the energy consumption, and consequently the higher the cost. Furthermore, the greater the elevation in the areas to which the water is pumped, the higher the cost is. On average, the cost of production per cubic meter using electricity is about 0.4 Shekel less than the production cost per cubic meter using diesel.

It is worth mentioning that most municipalities still use diesel driven motors and old electricity generators in the production of water, in which case a number of obstacles prevent from connecting up all the wells to the electricity grid.

The quality of the water production and distribution methods also explains the disparity in prices. The higher the e□ ciency of the water production methods and modern technology used, the lower is the cost of water. And the other way around; whenever inappropriate and complex technology is used, the more complicated the process of maintenance and operation becomes, and therefore the cost increases.

The use of old equipments and machinery, such as generators, motors and pumps, raises the cost of maintenance for these devices and make them in continuous need for repair, which is subsequently re□ected in the prices of produced water. Along with old machinery, some wells use modern equipment, but do not have local parts, or that their repair needs foreign expertise which is di□ cult to provide in a speedy manner.

REFERENCES

1. PWA study" Water for a Viable Palestinian State: An Independent Palestinian State in Years '' June, 2010.
2. Non-revenue water reduction strategy May, 2012-05-26.
3. PWA presentation, Kamal Isa" Tari Policy in Palestine as a Tool to Achieve Cost Recovery" December, 2010
4. The world bank report No. 47657-GZ " ASSESSMENT OF RESTRICTIONS ON PALESTINIANWATER SECTOR DEVELOPMENT" April, 2009
5. Palestinian central bureau of statistics www.pcbs.gov.ps

SYRIA

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ACROnYMs

CIS	Customer Information System
GDP	Gross Domestic Product
GIS	Geographic Information System
GIZ	German international development agency- Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
JICA	Japanese International Cooperation Agency
m^3	Meter Cubed
MDG	Millennium Development Goals
mm	Millimeter
NGO	Non-governmental Organization
NRW	Non-revenue Water
SYP	Syrian Pound
UNDP	United Nations Development Program
WSS	Water Supply and Sanitation
yr	Year

In t RODUCt IOn

Water and wastewater utilities around the Arab countries are confronted with many di□ culties and challenges as they strive to make organizational improvements. Water sector utility managers must consider a wide range of issues in their management improvement initiatives. General economic conditions, sta□ turnover, communication between internal management and external stakeholders, involvement of sta□ across the organization, aging and occasionally decaying infrastructure, applied rate issues, and limited sta□ resources are some of the issues managers address.

In this case study about Syria, we will focus on the important factors of Cost recovery; Non-revenue water, Serving the underprivileged, energy e□ ciency and Assets management.

Cou□□ry Backgrou□d

Geographical Loca□o□ a□d Popula□o□

The Syrian Arab Republic is located on the east coast of the Mediterranean Sea and is bordered by Turkey to the north, Iraq to the east, Palestine and Jordan to the south and Lebanon, Palestine and the Mediterranean Sea to the west. It is classi□ed as a semi-arid area, where the semi-continental climate prevails. It is characterized by short and cold winters and long and hot summers. Syria has an area of 185,180 km^2 and has a total population of 24.504 million inhabitants as registered in the civil status records until the 01.01.2011, including those residing outside the territory of the Syrian Arab Republic. 12,309,000 of the population are males and 12,195,000 are females. The population density is 96 inhabitants/ km^2, according to the statistical year 2004. The statistics also indicate an annual decline in the population growth rate from 0.033 during the period (1981-1994) to become 0.027 during the period (1995-2000) and □nally 0.0245 during the period (2000-2010).

Cou□□ry Geography

Syria is divided administratively into 14 governorates. Each governorate is generally divided into districts and each district to sub-districts. A sub-district includes a group of villages, and the village is the smallest administrative unit. As for the geographical nature Syria, it is divided into four areas: the coastal area which is the area between the mountains and the sea, the mountainous area which includes mountains and highlands stretching from north to south parallel to the shore of the Mediterranean Sea, the interior area or the plains which include the plains of Damascus, Homs, Hama, Aleppo, Hasakah and Daraa. All are located east of the mountains and Badia region: consisting of the desert plains in the south-east of Syria on the Jordanian and Iraqi borders.

River□ Lake□a□d Dam□

The total area of Syria is 18,517,971 hectares, of which about six million hectares is agricultural land and the rest consists of mountains and the desert. The Syrian Desert is characterized by being suitable for growing grass and is used as a grazing □eld when the amounts of rain are su□ cient. The total renewable water resources in Syria amounting to approximately 16,800 million m^3 can be divided into two main types:

- Ground water resources, which are represented by water wells and springs, constituting 35% of the total water resources.
- Surface water resources, which are divided to rivers, lakes and dams, and constitute about 65% of the total water resources.

Based on the above, the individual share of water resources in Syria reaches approximately 730 m^3 per capita per year, which is less than the water poverty line of 1000 m^3/year. The average per capita of drinking water is 103 liters per capita per day according to actual produced quantities for 2011. While the tenth □ve-year plan was designed to achieve (80 liters/day) per capita as a minimum after adopting programs for water demand management and sustainability of water resources.

The steady population growth, urban development and rapid economic development have resulted in increasing pressure on natural resources. Furthermore, the statistics indicate rapid groundwater depletion. This occurs due to a decrease in water table levels in many areas of Syria. The following table displays the most important rivers, lakes and dams in Syria.

Table 1: Most Important Rivers in the Syrian Arab Republic
(Source: Own, 2013)

River	Length within syrian territory (km)	Average Annual Flow m^3/sec
Euphrates	610	583
Khabur	402	2.09
Jaghjagh	100	0.36
Balikh	116	-----
Sajur	27	0.79
Orontes (Asi)	366	4.80
Afrin	74	1.67
Quweiq	155	5.13
Northern Great River	96	5.7
Alsin	6	5
Barada	81	0.91
Awaj	70	0.95
Yarmouk	48	1.73
Southern Great River	56	14.47
Sybrani	32	0.28
Abu Qubeis	6	0.3

table 2: Major Lakes in syria
(Source: Own, 2013)

Lake	Location
AlAsad	Alraqqa
Jabbul	Aleppo
Tishreen	Aleppo
Quttaineh	Homs
Otaiba	Damascus
Khatoniah	Hasakah
Mzairib	Daraa
Baath	Alraqqa
Masada	Kenitra

table 3: Major Dams in syria
(source: Ow, 2013)

size	Dam	Location
Large dams	Euphrates Dam	Alraqqa
Medium dams	Rastan Dam	Homs
	Quttaineh Dam	Homs
	Tildou Dam	Homs
	Mouhardeh Dam	Hama
Smalll dams	There are about 80 superficial dams within the seven water basins	Most of the Syrian governorates

Climate and Climate Change

Syria is classified as a semi-arid area where rainfall varies dramatically. It exceeds 1,000 mm in coastal areas, and declines to 100 mm in the desert and eastern regions. Syria is divided into five rainfall regions:

1. Very humid region: concentrated in the highland areas of the coastal mountains and the highest part of the Golan Heights. Rainfall here exceeds 1,000 mm.
2. Sub-humid region: extending from Homs to the Turkish border and from the Lebanese border to Damascus. Rainfall ranges between 350 to 400 mm per year.
3. Region 3: stretches across most of the interior plains. Rainfall average here does not exceed 250 mm.
4. Region 4: comprises the area between the desert and the western plains. Rainfall average reaches up to 200 mm.
5. Region 5: extends from the middle of Syria to the east up to the borders of Iraq and includes the Syrian Desert. Rainfall average is around 100 to 150 mm.

Average rainfall in Syria is estimated between 43.5 to 46.4 billion m^3/ year.

Based on the first national announcement on climate change in Syria and following the results of several studies, as well as due to Syria's geographical location in the arid and semi-arid areas, it is bound to be one of the most vulnerable countries facing the potential impacts of climate change. Initial information has shown a presence of disorder in the system of rainfall and fluctuation in temperatures during the past five decades. Rainfall has significantly decreased in major agricultural areas over the past years and resulted in the succession of ongoing drought as well as resulting in negative impact on agricultural production and the migration from the north-east of the country in 2009. Some indicators of health and education also declined in the region. In addition, the recurring drought and its increased severity have led to a decline in available water resources.

To cope with this situation, which represents an obstacle to the process of sustainable development in Syria, a national action plan has been developed to adapt to climate change, within the framework of national plans for economic and social development, as well as public environmental policies, and according to the indicators for the 10th and 11th five-year economic and social development plans. There are many measures taken by Syria in accordance with the available financial and technical resources to reduce the impacts of climate change. Currently the focus lies on new and renewable energies because they are the perfect solution to mitigate the emissions, and the most important factor in reducing environmental degradation and pollution, as well as to meet the challenges of the depletion of energy sources and climate change.

Economy and socio-economic Development

The Syrian economy depends on different economic sectors, such as agriculture, oil, industry and tourism. The agricultural sector usually constitutes around 25% of the Gross Domestic Product (GDP) in Syria, however the bad climatic conditions (drought) has impacted the sector negatively, leading it to contribute to the economy with only about 17% of the GDP in 2008. As for the oil sector, it constitutes about 23% of the government revenues and about 22% of the GDP in 2008. The industrial and manufacturing sector (extraction, processing of materials and natural wealth such as phosphate and cement, as well as construction and oil industries) amounted to about 23% of the GDP in 2010. It could be said that the service sector in general has comprised about 45.3% of the GDP in 2009. The tourism sector represents an important reserve for the economy in foreign currencies and a significant source of economic growth in Syria. Tourism has comprised around 6% of the GDP in 2000, where many procedures were undertaken to improve the sector revenues. This caused the emerging of many investment projects under Law No. 10 for the year 1991.

The estimates for 2011 on the contribution rates of economic sectors in GDP indicate that the agricultural sector shall contribute about 16.9%, industry 27.4% and services 55.7%.

The Syrian community is prevailed by a majority of young people. Some statistics indicate that about 65% of the population is less than 35 years of age. 200,000 enter the labor market every year seeking jobs, a matter that overwhelms the national economy. The estimated labor force in Syria in 2010, for example, amounted to about 5.5 million inhabitants. About 67% of them are working in the services sector, including government jobs, 17% work in the agricultural sector, and about 16% were employed in industry.

sec□or Overview

There are several ministries that are responsible for the management and distribution of water in Syria. The Ministry of Irrigation is responsible for the management of water resources, in addition to the Ministry of Agriculture, Ministry of Housing and Construction and the Ministry of Industry. The agricultural sector consumes about 90% of Syria's water resources, while drinking water represents a share of about 8%. The Ministry of Housing and Construction is responsible for the management and distribution of drinking water. The share of water used for industrial purposes is about 2%.

The management and distribution of drinking water in Syria is carried out by 13 water institutions that are distributed upon 14 governorates in Syria under the supervision of the Ministry of Housing and Construction (central administration), which plays a supervisory and regulatory role in the drinking water and sanitation sector. The water institutions are responsible for the tasks related water supply, investment and maintenance through the economic water units that are distributed in di□erent cities and regions in each governorate. The drinking water coverage rate in Syria has reached about 95% until the end of 2011.

The water and supply and sanitation (WSS) sector is considered to be essential for all other development sectors. It is based on the principle of meeting the needs of subscribers at the lowest cost. Due to the scarcity and the limitation of water resources in recent years, the principle of water demand management has been adopted. Despite the fact that this is a non-pro□t sector, it is supposed to be able to recover the costs of services provided to citizens, in addition to the environmental sustainability of water resources for drinking purposes. Therefore, the water institutions in Syria are considered to be non-pro□t service organizations aiming at serving the citizen and providing clean and safe water in su□ cient quantities to citizens when needed.

Financially, the WSS sector is considered to be a service sector and despite being non-pro□t, it is however supposed to be able to recover the costs of services provided to citizens. Currently the current budget for water institutions and sanitation companies is □nanced through revenues of provided water and sanitation services, while the investment budget is □nanced by the government, represented by the Ministry of Finance, which o□ers necessary □nancial support for each water institution and Sanitation Company. This is carried out according to the company's annual investment plan for projects to be implemented, and upon common agreement between the water institution, the Ministry of Housing and Construction, Planning and International Cooperation Commission and the Ministry of Finance.

The percentage of drinking water coverage in Syria in 2011 reached about 95%. The coverage rates for sanitation that same year varied between governorates: In the governorate of Damascus - 77%, in Aleppo - 79%, in Hama - 80%. At the national level the estimates indicate that the percentage of the bene□ciaries of sanitation networks in the governorate urban centers until the year 2011 reached 94%, while the percentage of the bene□ciaries of the sanitation networks in rural governorates about 62%. The number of sewage treatment plants implemented and invested in to that date amounts to 26 treatment stations.

A steady population growth, urban development and rapid economic development resulted in increasing pressure on natural water resources, and increased depletion of the resources as well. This happens due to low water table levels in many areas. Some statistics indicate that the water de□cit lies between 2 to 3 billion cubic meters per year. The following are a number of the most signi□cant problems as well as technical and administrative challenges facing the water sector in Syria:

- Imbalance between the high population growth rate, which re□ects in an increase in water demand, and the limited capacity of the water resources to regenerate enough supply.
- Limited water resources and their inconsistent geographical distribution vs. the population distribution across the Syrian governorates.
- Growing economic activity (in the □elds of agriculture, industry and tourism), which is an additional burden on the available water resources.
- Available water resources are vulnerable to potential pollution from both sewage or chemicals (pesticides) used in agriculture, and other types of pollutants.
- High percentage of non revenue water (NRW), which reached an estimated average of around (35.56%) in drinking water institutions in Syria for the year 2010.
- The need to raise the level of awareness about the importance of water, and the need to manage the demand.

t he I□□□□u□o□al Framework of □he sec□or

The WSS sector is managed by 13 water institutions distributed in the governorates of the country which in their turn have a number of economic units following each governorate. These units manage the operations, investment and maintenance of water projects in cities and di□erent areas of the governorate. The Ministry of Housing and Construction supervises the work of the water institutions. Thus the ministry plays a supervisory and regulatory role of the water sector.

As for sanitation, it was previously run by the municipalities that are part of the local administration. Later on wastewater management was handed over to water institutions in the Ministry of Housing and Construction, which later established a sanitation company in each governorate that is □nancially independent and follows the water institution in the same governorate administratively.

Sanitation companies vary in terms of sta□, equipment and e□ ciency, depending on the date of their establishment. Some are still under construction, due to the lack of sta□ and equipment, in which case the water institution and the concerned municipality in the governorate are performing the sanitation services. Other sanitation companies possess the needed sta□ and equipment; therefore they operate sanitation treatment plants in the governorate and main collection pipes within the networks, while municipalities manage all or part of the collection networks. The third case represents old sanitation companies which manage the sanitation sector in the governorate completely.

It is worth mentioning that the sanitation companies follow the institutions of water administratively, whose work is supervised by the ministry with regard to drinking water and sanitation. It should also be noted that the large-scale wastewater projects such as treatment plants are still being studied, □nanced and carried out by or under the direct supervision of the central administration of the Ministry of Housing and Construction.

It should be mentioned that the institutions of drinking water and wastewater companies, which were previously following the Ministry of Housing and Construction, have been handed over to the Ministry of Water Resources, founded by the Legislative Decree No. 44 dated June 23rd, 2012 to replace the former Ministry of Irrigation.

As for the issue of water supply and bulk supply, and according to the governing investment system, water institutions are responsible for providing utilities and industrial cities with water through private networks and according to a private water tari□ for industrial purposes.

Legal and Regulatory Framework of the Sector

The following laws, regulations and standards guide the WSS sector in the Syrian Arab Republic in terms of legal and legislative issues:

1. Consolidated Investment Regulation for year 2005: regulates the relationship between the water institution and the citizen subscribed to the water service in all respects (subscription, house connections, additional services, fees and wages of water delivery, water tari□, expenses and revenues of the institution, the applicable tari□, o□enses and □nes ...).
2. Water Law for year 2005 and its executive regulations: regulates water resources management (water resources investment, deprivation of water sources, water wells, permits, violations and □nes for infringement of water resources, water control, water users associations ...).
3. The amended Syrian standard speci□cations for the year 2007: determines the quality of drinking water, its speci□cations and necessary tests to be carried out.
4. Revised tari□ for drinking water for the year 2007: determines water consumption tari□ sections/levels.

Key Docume□□□ha□Guide □he sec□or

The national □ve-year plan is the main guide to all policies and strategies related to the WSS sector. It is the source from which emerge all the phase objectives of the policies. These seek to achieve the overall objectives related to the sector speci□ed by the relevant □ve-year plan.

The future vision of the Tenth Five-Year Plan manifested, among other things, in the following: providing safe drinking water and wastewater treatment and collection services to all communities and their expansions in the countryside and cities, recovering operating and maintenance costs, managing water demand and reducing water loss, and cooperating with the private sector.

Investment Program for Developing the sector

The public institutions for drinking water and sanitation are working on expanding, investing and maintenance of water and sanitation networks, as well as providing citizens with water and sanitation services. In addition to that, there are many important projects, both funded locally and financed by loans or external grants, some ready with planning and some under construction. Following are some of the projects planned until the end of 2010: (Sewage treatment plants in Aleppo, Banias and Damascus, water supply and sanitation project in the camps of Khan Dannoun and Khan Al Shaikh, the development of new water resources for Damascus, Zarqaa Spring water project in the Idlib governorate, water loss reduction project in Aleppo, a project for protecting Al-Fija spring in Damascus, rehabilitation and expansion of the drinking water network for Damascus and its suburbs, project for development of the drinking water sector in Syria, institutional development project in the Damascus Water Authority and its countryside as well as Latakia Water Authority and others ...).

the Role of the Private sector

The WSS sector in Syria is still fully governmental and is managed by the public sector. One of the distant goals of the tenth Five-Year Plan is represented in encouraging the cooperation with the private sector by performing functions and activities that increase the efficiency of institutions technically, financially and administratively, after developing legislative governing frameworks for this participation. However until now there is no real partnership in the field of WSS between the public and the private sectors, especially in the field of management, because of the special service status of the WSS sector and the absence of legislations that govern the partnership between the public and private sectors in this area until this day.

The private sector participation is still in its beginnings. Its contribution in general falls under the implementation of service contracts through tenders issued by the public sector in the field of studying, designing and implementation of projects the field of WSS. The field of wastewater treatment actually represents the greatest opportunity to participate with the private sector.

There are some simple examples of the partnership between the public and private sectors, among which is the sewage treatment plant in the new village of Yebus, which was established in 2009 by the German company IPP in cooperation with the German International Cooperation Agency (GIZ) where the IPP in collaboration with GIZ participated with design, implementation and operating costs, while the Ministry of Housing and Construction provided the required land for the implementation of the project.

sPECIFIC Ut ILIt IEs MAn AGEMEn t Is s UEs

In this section we shall go through some basic technical aspects in utilities management such as tari and pricing policies for WSS services, NRW, its causes and the measures taken to minimize it, providing drinking water and sanitation services for the poor, cost recovery, energy e ciency and asset management.

Applied t ari for Wa er a d s a i a o s service

In 2007, the Ministry of Housing and Construction issued a new adjusted tari for the water using an ascending volumetric block system as a deterrent to large consumption of water. Also worth mentioning is the support that targeted the underprivileged and the poor by the size of the rst block with a low tari . This modi ed tari has become ever since implemented and applied uniformly in all water institutions. It is represented in the following table:

t able 4: wa er egme t ari applied i dri ki g wa er i t u o i syria
(Source: Ministry of Housing and Construction, 2007)

type of U e	Block	Qua ty (M3)	Value (sYP)
Household	1	1-15	2.5
	2	16-25	7
	3	26-40	15
	4	41-60	22
	5	≥ 60	30
O cial departments			14
Commercial-Industrial-tourism			30
The value of one cubic Meter of water for all the segments equals 22 SYP if the consumption exceeded 40 M3. The value of one cubic Meter of water for all the segments equals 30 SYP if the consumption exceeded 60 M3.			

As for the sanitation tari (for sanitation services), it is added as a percentage to the drinking water tari blocks according to the table 5 (below). The water institution in the same governorate collects the fees that are added to the water blocks, and transfers those amounts to the relevant sanitation company.

t able 5: a i a o service co t a a perce age of dri ki g wa er egme t

Fir Block	(source: Mi i ry of Hou g a d Co truc o, 2007)5%
Second Block	10%
Third Block	15%
Fourth Block	20%
Fifth Block	55%
	The upper limit of sanitation cost for the blocks is determined at 500 Syrian Lira

servi g he U derprivileged

The ve-year plans of the Syrian government including the most recent one (the tenth ve-year plan), form the general direction of the government, upon which all the policies and strategies are based in the eld of WSS. By tracking the objectives of the tenth ve-year plan it can be clearly recognized that the government seeks to secure WSS services for all social segments, especially the poor, which helps to raise the standard of living of the population, the reduction of poverty, stabilizing the population in their areas and reducing migration from the countryside to the cities. This has been demonstrated in the objectives of the tenth ve-year plan that de ned the following among the basic quantitative goals of the plan: ensuring safe drinking water for 99% of the urban population and 93% of the rural population, ensuring sanitation for 98% of the urban population and 65% of the population in rural areas. In addition, the water tari s, through the size of the rst block which has a rather low and subsidized tari , represents the government's orientation towards securing services for the poor at a ordable prices.

Co□□Recovery

The operating costs in Syria vary signi□cantly between the di□erent water institutions for administrative and technical reasons related to the institution and other causes beyond the control of the institution, such as the di□erent geographical nature of each governorate, the level of the water table and whatever consequences that causes in matters of di□erent water production, pumping and distribution costs. On the other hand, the revenues vary between di□erent water institutions, depending on the e□ ciency of billing and collection, and they also vary within a single institution from one year to another because of backlogs from previous years. These may be levied in bigger or less amounts and frequency than the previous year which a□ects the general trend of the chart line that shows the development of the average cost recovery in an individual institution. The table below shows the approximate values of the average cost recovery in some of the key water institutions, which represent samples from various regions in Syria in 2010. It should be noted that the values in the table do not include the value of government subsidies provided to those institutions, nor interest amounts either.

t able 6: Average co□□recovery i□ □bme wa□er i□□□□u□□o□□i□ syria i□ 2010
(Source: Ministry of Housing and Construction,2010)

Public I□□□□u□□o□ i□	Average Co□□Recovery
Damascus	102%
Aleppo	93%
Hums	73%
Dara'a	65%
Tartous	49%
Deir El Zour	62%

n o□-Reve□ue Wa□er

The table below shows the values of NRW in drinking water institutions in Syria in 2010.

Table 7: Non-Revenue Water in Water Institutions in Syria in 2010
(Source: Ministry of Housing and Construction, 2007)

Wa□er I□□□□u□□o□	n RW%
Damascus	53.5
Quneitra	34.94
Daraa	25.16
Alsweida	25.21
Homs	40.52
Al-Hasaka	41.20
Hama	28.2
Idlib	30.5
Tartous	39.37
Aleppo	35.68
Dier el-Zour	40.11
AlRaqqah	32.29

And by calculating the average of values in Table 7 we conclude that the percentage of NRW in Syria is 35.56%. The somewhat high percentage of NRW in Syria is caused by several reasons, of which the most important are:

1. The real loss from the network (leakage): the leakage is often caused by technical reasons and problems in the water systems, whether in terms of the design that is represented by higher pressure, or bad execution, insu cient valves, sectoral water meters and re nozzles, bad technical condition of the pipes because of old age and the occurrence of rust problems, in addition to the tectonic problems that sometimes occur.
2. Water meters problems: these are caused by the existing old meters and slow action in replacing them due to the lack of su cient quantities of meters and inadequate replacement plans, in addition to errors in reading the meters and inaccuracies and low sensitivity in the meters themselves.
3. Illegal connections: this refers to the violations on water networks and lines. This problem often spreads in random housing areas and is caused by the low awareness among water users and weakness in enforcing water laws and legislations.
4. Administrative problems: This happens due to weaknesses in the executive plans for the maintenance and rehabilitation of water networks, as well as periodic survey of water systems to detect leaks and repair them early on. In addition, there is the lack of reliable plans and drawings for the pipes that often help in the process of detecting leaks, a problem caused by the weakness of documentation and archiving, as well as the problem of existing old hardware that should be detecting leaks, and nally insu cient employees for water meter readings.

Procedures taken to reduce NRW and implementation mechanisms can be summarized as follows:

1. At the level of central management (Ministry of Housing and Construction): In 2002 a central o ce was created in the Ministry of Housing and Construction to follow up on topics related to the reduction of water loss and rationalizing consumption through developing executive development plans to reduce water loss in coordination with the water institutions. In addition, it shall follow-up on the implementation of recommendations taken with all public authorities in accordance with the approved plans. The o ce shall follow up with the implementation of measures for reducing water loss, an issue carried out by water institutions. Further actions are: tasks related to replacement and expansion of water supply systems, installation, tasks of replacement and maintenance of water meters, tasks of controlling violations of water use, controlling networks and detecting leaks, monitoring and rationalization of consumption and public awareness.
2. At the level of water institutions in the governorates: Each water institution in the individual governorates has an o ce or department to implement the issues of reducing water loss and rationalize consumption. It also employs eld teams equipped with vehicles and equipment to detect water leaks. The O ce executes all the mentioned points in the preceding paragraph, which is then followed up by the central o ce, but at the institution level. The institutions also perform all the activities to render people aware about the importance of water and the need to preserve it, whether it is at the governorate level or even at the national level. It is worth mentioning that about 30% of the investment budget for water institutions is devoted to the work of replacement, renewal and maintenance of water networks, which serves as part of the campaign for the reduction of NRW.
3. Legislative procedures to reduce NRW: The Water Law as well as its executive regulations, which were issued in 2005. It regulates the relationship between the supervising authorities and water consumers. It includes a number of actions that help reduce NRW, including the formation of a control unit in all the water institutions. The checks carried out by this unit shall have a legal characteristic and sent to the Attorney General to proceed with the necessary actions therein. The water control unit aims to eliminate violations and infringements performed on water and sanitation networks. It also includes penalties for stealing water from the public network or tampering with it.

Measures to reduce NRW are implemented in collaboration with donors and those who o er monetary support or donation in kind, such as providing the necessary pipes for the rehabilitation of networks, or in the form of soft loans, or assistance in conducting studies and designs. One example of this is what was done by the Japanese Agency for International Cooperation (JICA), as it carried out a study on NRW in the Damascus governorate and followed by rehabilitation of the water network in Damascus Water Authority. This project continued about eight years through which JICA presented Damascus Water Authority with a grant in the form of pipes for the replacement process. The rehabilitation of the network in addition to the numerous technical and administrative procedures resulted in reducing NRW (the physical leakage) from 36% to 20%.

The e ectiveness of the implemented measures to reduce NRW can be re ected in the following:

- By measuring the amount of produced water through water production meters and the amount of billed water through billing information.

- Through monitoring performance indicators of water institutions.
- Follow-up on customer satisfaction and decreasing the number of complaints.
- Reducing the number of leaks detected when mapping the network.
- Continued su cient of the limited water resources despite the signi cant increase in population.

E ergy E cie cy

It is rather di cult to obtain accurate expressive gures for the recent years concerning the energy expenses that include operating, maintenance and overall costs, due to the recent rise in the price of fuel and energy as well as the di culty to separate energy expenses from other types of costs, and the need for nancial specialists to analyze that data, in order to give a realistic idea of this aspect.

Several laws have been enacted regarding the increase of energy consumption in the water and sanitation utilities, whereas in 2009, Law No. 3 (the law of conservation of energy) was issued and is aiming at the conservation of energy and rationalization of its use to contribute to the sustainability of the development process through the dissemination and application of the concepts of energy conservation and rationalized consumption, raising the e ciency of its use in all areas that have a lasting impact on the energy consumption rates, as well as to revert to using renewable energy sources in their various forms.

The law of conservation of energy applies to all energy producing, distributing and consuming parties of various kinds, both government, private and joint, manufacturers, importers, trade unions, institutions, engineering o ces, government and private educational institutions, scienti c research centers, folk organizations, Non-governmental Organizations (NGOs) and religious bodies. These entities are committed to applying several measures of which the most important is energy conservation by rationalizing its consumption, raising the e ciency of its use over short, medium and long terms, bene tting from the application of renewable energies and adopting the concepts of energy conservation during the design, implementation and usage phases in all areas. The law of conservation of energy led to establishing the National Centre for Energy Research in the Ministry of Electricity. Its mission is to monitor the implementation of the provisions of this law, monitor how well it is adhered to, and the development of policies and strategies in the eld of energy conservation. It shall also create an organizational unit for conserving energy in every public and private institution, to work as the link between the National Centre for Energy Research and the institution that it follows.

It shall as well create a central unit for energy e ciency in the Ministry of Housing and Construction to act as a link between the ministry and the National Centre for Energy Research. It shall also have sub-units for energy e ciency, reporting to the central unit in the ministry in all water institutions and sanitation companies for purposes of implementation of measures to conserve energy.

The organizational sub-units for energy e ciency in water institutions and sanitation companies propose projects and studies to be conducted in collaboration with the central unit of the energy e ciency in the Ministry of Housing and Construction, and send these proposals to be discussed with the National Center for Energy Research. The latter implements these projects, provided that costs can be recovered from the resulting savings from the implementation of these projects to the relevant authority, with a portion of the savings as determined by the Board of Directors, based on the proposal of the director of the centre.

A study was conducted at the level of the Ministry of Housing, the utilities and water institutions, where energy consumptions was monitored for the wastewater treatment plant in the city of Adra, that works for the bene t of the sanitation company in Damascus. The same was done with the pumping station Barzeh that works for the Damascus Water Authority, as well as for management buildings of the ministry. Currently technical measures and solutions are being implemented to improve the energy e ciency in the previously mentioned areas.

A e a d Mai e a ce Ma ageme

Water and sanitation utilities in general lack a comprehensive system for asset management as well as its practical application in the Geographic Information System (GIS). There are some simple attempts in this regard, but it does not constitute a general disposition. In general, asset management in water and sanitation utilities in Syria is mainly performed from a nancial perspective, through calculating the depreciation

according to the main financial law No. 30 defined by Legislative Decree No. 54 of year 2006 and its amendments. It defines depreciation as the distribution of the long-term asset costs that are in danger of depreciation onto their production life. A production life is defined as the period, during which the assets remain in use, and performing the purpose for which they were designated. Production life is determined by the assets productivity period and not by the duration of its existence. The production life depends on many factors, including operating or investment duration, technical skill of the workers, and the degree of maintenance.

Water and sanitation utilities in Syria use some automated applications and computerized systems such as (Customer Services Systems, financial and billing systems, accounting systems, human resources management systems, etc.) The availability and usage rate of those systems are different in different utilities; this affects work integration and often makes them operate separately.

It is worth noting that many of the water and sanitation utilities in Syria are effectively - though to a varying extent - applying the computerized system for Customer Information System (CIS). To mention a few of such utilities: water institutions in the governorates of Damascus and its countryside, as well as Aleppo and Hama. As for the billing systems used in water institutions, some of them such as Damascus and Aleppo water authorities, for example, use a system called Soft Net which is linked to other systems (such as hydraulic system analysis, databases, spatial data, etc.) through using the GIS as a work platform.

The supply system in most water institutions in Syria is intermittent, either for the purpose of rationing due to the lack of sufficient quantities of water, or because of the inability of the wells to continuously pump, since water sources are mostly underground. Another possible reason is to reduce water loss by reducing the period in which pipes are compressed. In the majority of cases the intermittent supply is explained by all the above reasons combined. The continuous pumping period varies according to the availability of water and rainfall amount.

As for the water systems, in most water institutions, it is often taken into account that networks are divided into sectors (zones). In the Damascus Water Authority, for example, the network is divided into areas of pressure where pumping zones may not correspond with the billing and collection zones. As a result, the billing entries are decentralized, while the collection is automated and is open from any collection center. Billing operations however are conducted only centrally, i.e. in the central administration of the institution. This situation cannot be generalized for all water institutions in Syria though, as there are other water institutions and even some areas in the Damascus countryside, which follow the Damascus Water Authority and where their pumping zones match the billing and collection zones.

RESULTS OF THE STUDY

1. The first national announcement on climate change in Syria clearly indicates that Syria will be among the most vulnerable countries to the potential impacts of climate change, due to its geographical location in the arid and semi-arid areas. Furthermore as the gap occurring between available water resources and the growing water demand widens, the situation calls for preserving the current available resources in all drinking water and sanitation institutions, as well as rationalization of consumption in parallel with the search for new water resources, while focusing on the non-conventional water sources (desalination, reuse of wastewater for agriculture, artificial rain, rain-based harvesting, etc.) The field of energy on the other hand should take advantage of new and renewable energies such as solar and wind power.
2. Based on the third report of the United Nations Development Program (UNDP) on the progress achieved in the Syrian Arab Republic regarding the achievement of the MDGs, it is necessary to note that the concerned authorities should make a greater effort to achieve the set goals, especially those related to the achievement of environmental sustainability, reducing greenhouse gas emissions, and covering the water deficit.
3. The distribution ratios of water resources are as follows: 90% for irrigation, 8% for drinking, 2% for the industry. While the drinking water sector suffers a lack in available resources, there is also lack of harmony in the management of the water sector as well as the multiplicity of supervising authorities in this sector. Perhaps the Decree Legislative No. 44 dated June 23rd, 2012 is a good step in the right direction. It states that drinking water institutions shall follow the Ministry of Water Resources, which replaced the Ministry of Irrigation.
4. The high NRW (35.5%) in the face of limited water resources requires necessary measures be taken to

reduce this rate to economically acceptable levels, both through spreading awareness and encouraging water consumption rationalization, or by resolving technical problems related to water meters, a periodic water network inspection and detecting leaks and repairing them quickly.

5. The participation of the private sector in the field of water and sanitation is still in its beginnings, and to develop this partnership it is required to find and develop legislations that guide the partnership between the public and private sectors in this area.
6. Low rates of cost recovery in some water institutions in Syria indicate the need to undergo necessary measures to improve recovery rates of investment and maintenance costs.
7. The issues of energy efficiency and asset management remain from a technical point in the early stages for the water and sanitation sector in Syria. A matter that requires a lot more effort in this regard.

REFERENCES

1. Tenth Five-Year Plan (2006-1010)
2. Basic financial law specified by the Legislative Decree No. 54 of year 2006 and its amendments.
3. Study of water sector tariffs in Syria in 2006 prepared by GTZ.
4. An analytical study of the financial statements of some water institutions and sanitation companies - a consulting firm and GTZ financing.
5. Performance indicators project database.
6. A report following up an issued legislation by the Directorate of Planning and International Cooperation at the Ministry of Housing and Construction in 2011.
7. Annual Statistical Abstract, Sixty-fourth edition, for the year 2011 - the Central Bureau of Statistics, CBS.
8. The development of drinking water sector management to promote economic and social security - Geologist Ali Al Kahlil.
9. The first national announcement on climatic changes in Syria – Tashreen Newspaper.
10. Syria Wikipedia.
11. http://tishreen.news.sy/tishreen/public/read/227805
12. http://en.wikipedia.org/wiki/Economy_of_Syria
13. www.syria-today.com/.-third-millennium-development-goals-progress-report-released

LEBANON

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ACRONYMS

BMLWE	Beirut and Mount Lebanon Water Establishment
BWE	Beka'a Water Establishment
GDP	Gross Domestic Product
NLWE	North Lebanon Water Establishment
NRW	Non-revenue Water
SLWE	South Lebanon Water Establishment

In t RODUCt IOn

Water and wastewater utilities around the Arab countries are confronted with many di□ culties and challenges as they strive to make organizational improvements. Water sector utility managers must consider a wide range of issues in their management improvement initiatives. General economic conditions, sta□ turnover, communication between internal management and external stakeholders, involvement of sta□ across the organization, aging and occasionally decaying infrastructure, applied rate issues, and limited sta□ resources are some of the issues managers address.

In this case study presenting Lebanon, we will focus on the important factors of cost recovery; non-revenue water, serving the underprivileged, and energy e□ ciency.

Cou□□ry Backgrou□d

The Lebanese Republic is an Arab country located in the Middle East in Southwest Asia, overlooking the Mediterranean from the west. Lebanon is a democratic country comprised of various sects, rich in its demographic multiplicity of cultures and diversity of civilizations. Most of its population consists of Muslim and Christian Arabs. Many of its inhabitants have spread around the world since the days of the Phoenicians; in fact the number of Lebanese immigrants is estimated to be twice the number of Lebanese residents.

The nature of the mountainous Lebanese land, like most of the Levant heights, has imprinted its climate and natural beauty which attracts tourists from surrounding countries, reviving its economy even in the darkest crises. The Lebanese economy depends on tourism and banking services, which together constitutes more than 65% of the total Gross Domestic Product (GDP). Lebanon is one of the most important banking centers in Western Asia, and is also famous for its pioneering yet deep-rooted educational system, which allows for the establishment of educational institutions based on di□erent cultures, and encourages education in di□erent languages in addition to Arabic.

Geographical Loca□o□, Area a□d Popula□o□

Lebanon is located in Western Asia. It is bordered by the Mediterranean Sea from the west with a coastline of 225 km in length, occupied Palestine from the south and Syria from the east and north. The country's total area is about 10,452 km^2 and the population is estimated at about 4,425,000.

Cou□□ry Geography a□d t opography

Most of the Lebanese territory is mountainous, except for the coastline and the Beka'a Valley. There are two mountain chains that cross Lebanon from north to south, namely; Anti-Lebanon Mountains, which form the eastern borders with Syria, as well as Mount Lebanon range, which overlooks the Mediterranean Sea. The most important of which is Mount Al-Mukamel with its peak Al-Qurna Al-Sawda being the highest mountain peak in Western Asia. The two mountain ranges are separated by the Beka'a Valley. Lebanon has a number of rivers that are formed from melting snow; the most famous are the Litani River and the Orontes River.

La□d, River□ a□d Dam□

The water resources in Lebanon are mainly dependent on precipitation. Therefore water sources consist of surface water and groundwater. The surface water storage is limited to two dams, which are Qaraoun dam and Shabrouh dam. There are several rivers in Lebanon; some empty in the Mediterranean Sea in the west, and others in the Beka'a Valley. Some □ow heading towards the North and then West emptying in the Mediterranean Sea, while others □ow towards the South and then West also emptying in the Mediterranean Sea. The most important of these rivers is the Litani River, which □ows from south of the Baalbek Plateau. Another important river is the Orontes River, which □ows for a distance of 46 km before it enters the Syrian territory. Also the Jordan River descends from Lebanon Heights and □ows towards the south outside the borders of Lebanon. In addition to these, a number of other rivers □ow through the coastal plain in Lebanon, including: Southern Great River, Nahr al-Bared, the Zahrani River, and Ibrahim River. All of these are small fast mountain rivers that rise from the western slopes of Mount Lebanon, and drop severely towards the Mediterranean Sea to empty in it. Other rivers include: Khraybe, Qadisha, Aljoz, Beirut, Damour, and Awali.

Clima□e a□d Clima□e Cha□ge

Lebanon is characterized by a mild Mediterranean climate, whereas at the coast, winters are cold and rainy, while the summer seasons are humid and hot. On the mountains, the winter is cold with temperatures

dropping below zero, and possibility of snowfalls. During the summer, temperatures are moderate and there is no humidity. There is high precipitation compared to the surrounding region, except for the north-east, because of the western mountain range that prevents the arrival of rain to that region. Lebanon has been a□ected by the climate change, as evident in the decline in rainfall, and the hotter and drier summers.

Eco□omy a□d s ocio-eco□omic Developme□□

The Lebanese civil community is known to be a commercial and entrepreneurial community. The spreading of the Lebanese in the world has allowed the building of global business relationships. Lebanon has a high proportion of skilled labor equivalent to the level of European countries, and is the highest among Arab countries. The population growth is about 1.8%, while the population density of Lebanon is 423 inhabitants / km^2. 87% to 90% of the Lebanese live in cities, of which more than 1,100,000 inhabitants - equivalent to about a quarter of the population - are in the capital Beirut and its suburbs. The literacy rate amounts to 87.4%. The population speaks Arabic and many of them also French and English. Lebanon depends mainly on the services sector, as well as tourism, construction, industry and agriculture. Although the nature of Lebanon is highly suitable for cultivation due to abundant water supply (the highest among the Arab and Asian countries) and fertile land, the percentage of investment in the food industry is however low and attracts only 12% of the labor force. Furthermore the agricultural production does not exceed 11% of the GDP, which is the lowest compared to other economic sectors. Some of the main Lebanese agricultural products include: apples, peaches, oranges, lemons and olives. Lebanon lacks natural raw materials and ores and depends on other Arab countries for oil supplies. Therefore it is not pro□table to establish production industries, so the Lebanese industrialists focus on processing industries and the reassembly of imported products. Some of the most important industries include: food industries, textiles, chemicals, cement, wood products, metal manufacturing, jewelry and oil re□ning. There are other natural resources such as limestone, iron ore and salt. Some of the main craftsmanship include: straw industry, porcelain, pottery, glassblowing, copper, fabric, wood, Marzipan industry, knives and smelting of bells, ornaments of silver and the manufacture of soap and embroidery. Lebanon's most important economic sector is the service sector, especially tourism and banking. The capitalist system of Lebanon and the applied bank information security procedures have attracted many capitals. Furthermore the nature of the country and its touristic and cultural activities attracts tourists, especially from the Gulf area, and who visit Lebanon even during periods of crises. About 65% of the labor force works in the services sector, which contributes to about 67.3% of the GDP.

s ec□or Overview

Lebanon is facing critical problems in various □elds related to the water sector. For example the country is using up three quarters of its available water resources while demand is growing rapidly. Furthermore it is witnessing a shortage of water during the dry seasons, as well as the deterioration in water quality. The institutional capacities that manage water resources are rather weak. Despite the institutional reforms and the high level of investment, service levels of the public distribution network in matters of water supply remain low. The amount that families spend on buying water from private sector suppliers equals three times the cost of public utility services. Water institutions lack the necessary autonomy, technical capacities and □nancial resources in order to improve service levels. Despite huge investments in this area, the percentage of treated wastewater is still low, causing serious environmental issues. The investment program has also su□ered from poor coordination, in addition to only implementing part of the necessary reforms for the transfer of institutional and □nancial responsibilities of wastewater management to water institutions. The irrigation sector is bene□ting from product-related comparative advantage with high-value in local and regional markets. However it is essential to carry out institutional reforms, as well as the need for investment in both infrastructure and development of products and markets.

t he I□□□□u□o□al Framework of □he s ec□or

The water sector in Lebanon underwent major restructuring in the past ten years. The government has taken signi□cant actions in 2000 to reform the sector after recognizing the di□ culties in obtaining the necessary investments. The □rst step was establishing law No. 221 in 2000 (and subsequent amendments under law No. 337 and law No. 241 of the same year), which provided for the integration of 21 previous water Authorities within four regional water Establishments, namely; Beirut and Mount Lebanon Water Establishment (BMLWE), North Lebanon Water Establishment (NLWE), South Lebanon Water Establishment (SLWE), the Beka'a Water Establishment (BWE):

1. North Lebanon Water Establishment (NLWE): The establishment covers a geographical area of approximately 1,988 square kilometers and a population of 858,100 inhabitants. It was divided into eight

administrations, as well as the Tripoli investment utility and its surroundings. The administrations are spread over two investment utilities: North area Investment utility (which provides service to Akkar, Al-Muniah, Qobayat and Daniyyah) and South area Investment utility (which provides service to Zagharta, Bashri, Koura and Batroun). North Lebanon Water Establishment serves 109,444 subscribers. The service coverage ratio amounts to 51%.

2. Beirut and Mount Lebanon Water Establishment (BMLWE): It provides services of drinking water and wastewater management for about two million people in the areas served by the previous water utilities that the establishment comprises: Baroque, Beirut, Ain Aldalbeh, Byblos, Kesrouan, and Metn. BMLWE was established under Law No. 221, and amendments (laws 241 and 377) which was approved by the House of Representatives in May 2000. The Establishment began operating according to its regulations after it was ratified by the Council of Ministers on July 5th, 2005. Its scope of coverage includes a geographical area of almost 2,023 km^2 with a population amounting to nearly two million inhabitants. The total number of registered subscribers amounts to around 475,000, and the total annual water production is about 176 million m^3.
3. South Lebanon Water Establishment (SLWE): It covers the services of the previous four water utilities: Sidon, Tasa Spring, Sour and Jabal Amel. The Establishment provides service within a geographical area of about 2,130 km^2 divided into seven Administrations: Sidon, Zahrani, Nabatieh, Jezzine, Tyre, and Marjayoun - Hasbaya and Bint Jbeil. The total number of registered subscribers amounts to about 140,000, and the daily production rate is estimated at 294,680 m^3. The domestic service coverage rate is nearly 85%.
4. Beka'a Water Establishment (BWE): Beka'a Water Establishment was established following the merger of the previous three water utilities in the Beka'a Valley: Zahle, Shamsein and Baalbek Al Hermel. The area of the Beka'a region constitutes 40% of the Lebanese territory (4,169 km^2) and a population of about 510,000 inhabitants. BWE provides about 83,000 m^3 per day and serves nearly 67,000 subscribers. The establishment is divided to four Administrations: Zahle (including the Leryaq and Shtura), Baalbek (including Deer Al Ahmar and Shamstar), South Beka'a (Rashya, Jab Jenin and Mashghara) and northern Beka'a (Laboua and Hermel).
5. Litani Undertaking: The National Undertaking of Litani River was established under a law issued on August 14, 1954, and its amendment on December 30, 1955. It has been considered ever since it was founded a public institution, with its functions set as follows: Project Litani was intended for purposes of irrigation, drying, drinking water and electricity. Later new tasks were added in adjacent basins after the issuance of Decree No. 9631 dated December 13th,1996, which ordained commissioning the utility with tasks of planning, studying, management and investment of irrigation water in central and North Beka'a, including the projects Yamuna and Wadi Massa-Yahfufah. Furthermore all smaller projects to the south of Beirut-Shtura line to the southern border with occupied Palestine were merged, while Basri and Ibl al-Saqi dams on the Hasbani River were to be studied.

Figure 1: The Institutional Framework of the Water sector in Lebanon
(Source: Ministry of Energy and Water, 2011)

Legal and Regulatory Framework of the sector

Law No. 221 dated May 29th, 2000 concerning the organization of the water sector, and its amendment under law no. 241/2000, is considered to be the first Lebanese legal framework for the water sector. The Law was then amended under law no. 377 dated December 14th, 2001. This law mainly addressed the protection and development of the natural water resources, within the framework of preserving the environment and the balance of nature, within the scope of public interest (Article 1). The competencies of the Ministry of Energy and Water were specified in Article 2. The establishment of public investment institutions for water and sanitation was addressed in Article 3. Article 4 specified the competencies in the field of water projects for the distribution of drinking water, irrigation, collection, treatment and disposal of wastewater, as well as proposal of tariffs for services including drinking water, irrigation and discharge of wastewater. The first thing that draws attention to this law, is the connection between providing water, and protecting it from pollution,

as well as the establishment of public investment institutions for the water and wastewater sector. This means that it was decided to maintain the indirect management of the water sector.

Law 221 summarizes the role of the Ministry of Energy and Water, and limits it in the development and implementation of a national policy for water and a master plan for the sector, planning and implementation of major projects in the field of water resources development at the national level, and the supervision of public policies and activities of new regional water establishments.

The responsibilities of the four water establishments were identified as follows; general management of water resources, planning and implementation of water development projects, operation and maintenance of distribution networks, and cost recovery through individual tariff plans

Documents that Govern the Water sector

1. Law 221/2000. As illustrated below.

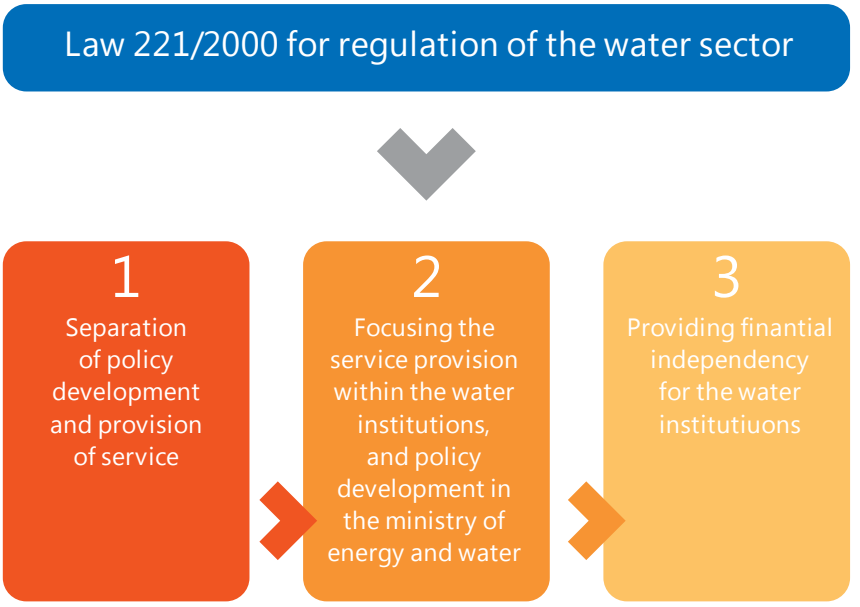

Figure 2: Regulatory Law for the Water Sector in Lebanon
(Source: Ministry of Energy and Water, 2011)

2. National Strategy for Water Sector prepared by the Ministry of Energy and Water and approved by the Council of Ministers under the record No. 46, Resolution No. 2 dated March 9th, 2012, which includes among other issues: the use of surface water resources such as springs in an optimal manner, artificial recharge of aquifers, surface water storage in dams and lakes, the establishment of transmission and distribution lines for drinking water and water reservoirs, installation of water meters for customers in various regions of Lebanon, wastewater collection and treatment on a broader scale, reconsidering organizational structures in water institutions and improving their performance, reorganization of the Ministry of Energy and Water and development of a performance evaluation mechanism in the sector, providing the required level of human resources and development of skills, urging planning and specifying spending responsibilities, management of the irrigation sector and ensuring its sustainability, restructuring of tariffs for drinking and irrigation as well as the application of wastewater tariffs, supporting and preparation for the process of involving the private sector and completion of adopting the Water Law (Code de l'eau).
3. The investments program for the sector development: The Ministry of Energy and Water (the Directorate for Hydraulic and Electric Resources) developed a ten-year plan for the integrated management of water (providing additional water resources, including drinking water projects: transport lines, tanks, networks, mountain dams and lakes, as well as irrigation water projects that include: new irrigation projects and rehabilitation of existing projects, projects for improvement of river beds to protect from the dangers of flooding as well as wastewater projects), reusing treated wastewater for irrigation and feeding aquifers, as well as examining mountain dams and lakes (27 dams and lakes) and implementation of the plan. This

plan received a major approval from international institutions like the World Bank, the European Union and the European Bank, therefore the ministry immediately began studying several dams, contracting and carrying them out. So far the Shabrouh dam project has been carried out (8.5 million m^3) with full distribution of the dam water to the Kesrouan area, which led to savings in the electricity used for pumping electricity, and contracting of the Orontes, Buq'ata, Yamuna and Qaysmani dams, as well as a final study for 12 projects ready to be contracted.

sPECIFIC UtILIt Y MAn AGEMEn t Is s UEs

The four establishments were given more responsibilities in order to address local problems, and provide services aiming at raising the level of services provided, in addition to paying adequate attention to the issue of private sector participation in the provision of water services. The following is an analysis of some technical aspects that reflect the level of management and operation of these establishments.

Level of service Coverage

The level of coverage in water network connections is higher than the overall rate in the countries of the region, and amounts to about 78% of the population (ranging from 65% in North Lebanon, 93% in Beirut and Mount Lebanon). However, the supply is intermittent, ranging from 3 to 22 hours a day. Only the city of Tripoli enjoys continuous supply of water. This was caused by raising the efficiency of the establishment after the involvement of the private sector through a management contract.

Applied tariffs for Water and sanitation services

Currently two types of tariffs are applied: The first are tariffs set according to the agreed amount of subscription, the second are tariffs that are calculated according to the actual consumption, when the amount surpasses what the subscriber is entitled to according to his subscription. After the administration had realized that the service of providing water to the citizens should be against a fee that covers the cost of delivery according to the required quantity and free of any contaminants, it was necessary to inform the citizen that the price does not represent the value of water itself, but was applied to cover the costs of water storage, delivery, treatment and reducing the level of contamination. In addition to that, raising the price of water had to be done to reach the full coverage of costs. It is worth mentioning that the tariffs used in their current form enables the establishments to cover the cost of operation and maintenance in the event of applying them in the proper form. Applying a new water tariff system contributes to creating the proper investment climate that attracts private sector participation in matters of financing and management of water and wastewater establishments, including agricultural projects. This requires an effective legal framework in order to apply the water policy in practice. It must take into account setting rules that govern the management of water activities, and instructions concerning the exploitation and investment of water at the national level. Furthermore it should provide guidance about alternative investments for water (reusing of wastewater, desalination of sea water - surface water). It should also show ownership of water, controlled use, protection, pricing and useful implementations of water.

Table 1: Current Tariff Structure
Source: Own, 2013

Current tariff structure	
Drinking water	• Unified structure of the tariffs in all establishments with slight differences in prices. • Fixed tariffs based on the amount of subscribed water, not linked to actual consumption.
Irrigation water	Basically two kind of tariffs are applied: • Subscription prices according to the irrigated area. • Tariff based on the consumed amount, according to meters.
Wastewater	No tariffs have been applied yet

Table 2: The Tari Price of Cubic Meter
Source: Ministry of Energy and Water, 2011

tari per O e sub cribed m^3	
Yearly ($)	1 m^3
North Lebanon Water Establishment: 140	0.38
South Lebanon Water Establishment: 147	0.40
the Beka'a Water Establishment: 118	0.32
Beirut and Mount Lebanon Water Establishment: 157	0.43

n o -Reve ue Wa er

Non-revenue Water (NRW) is estimated in Lebanon at 48%, and is distributed as follows:

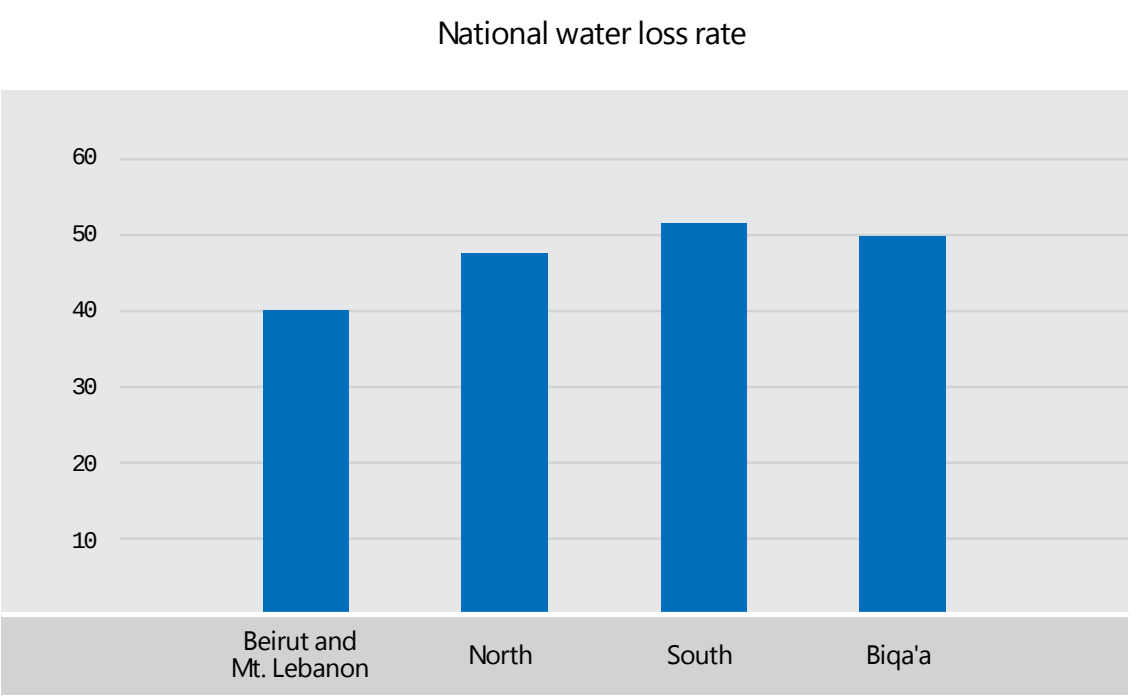

Figure 3: percentage of water losses/ Non-Revenue Water
Source: Ministry of Energy and Water, 2011

The di culty in determining the exact loss is basically attributed to not using water meters to measure the used quantities of water. This high level of NRW generally re ects the weak operational and administrative e ciency in water institutions, and insu cient maintenance operations. It is worth mentioning that the NLWE managed through the involvement of the private sector via operational contracts, to reduce NRW by raising operational and administrative e ciency in the establishment. In southern Lebanon the SLWE has resorted to using water meters in the city of Sidon, where they are planned to be used by 75% of the population connected to the water system by the year 2013.

Co Recovery

Financial performance varies between the four water establishments; the BMLWE is the only one that covers the cost of operation and maintenance from its annual revenues. As for the two establishments NLWE and SLWE, they only cover the costs of operation and maintenance, but not the cost of energy which amounts to between 43% to 50% of the total cost of operation and maintenance. As for the BWE, it is unable to cover the cost of operation and maintenance, even without counting the cost of energy. At this point it should be mentioned that the cost of energy is observed as being high in relation to the total cost of operation

and maintenance. However no speci□c plans have been developed to deal with this cost and reduce it; For example through the application of administrative and operational improvements in operational and maintenance processes, as well as applying best practices in the management and maintenance of assets, or through capital projects that deal with replacing or renewing □xed or current assets, which are considered to be the largest consumers of energy such as pumps and motors, or □nally those projects that resort to the use of alternative (renewable and clean) energy sources. The □gure below shows the operational costs as well as the revenues for the four Establishments.

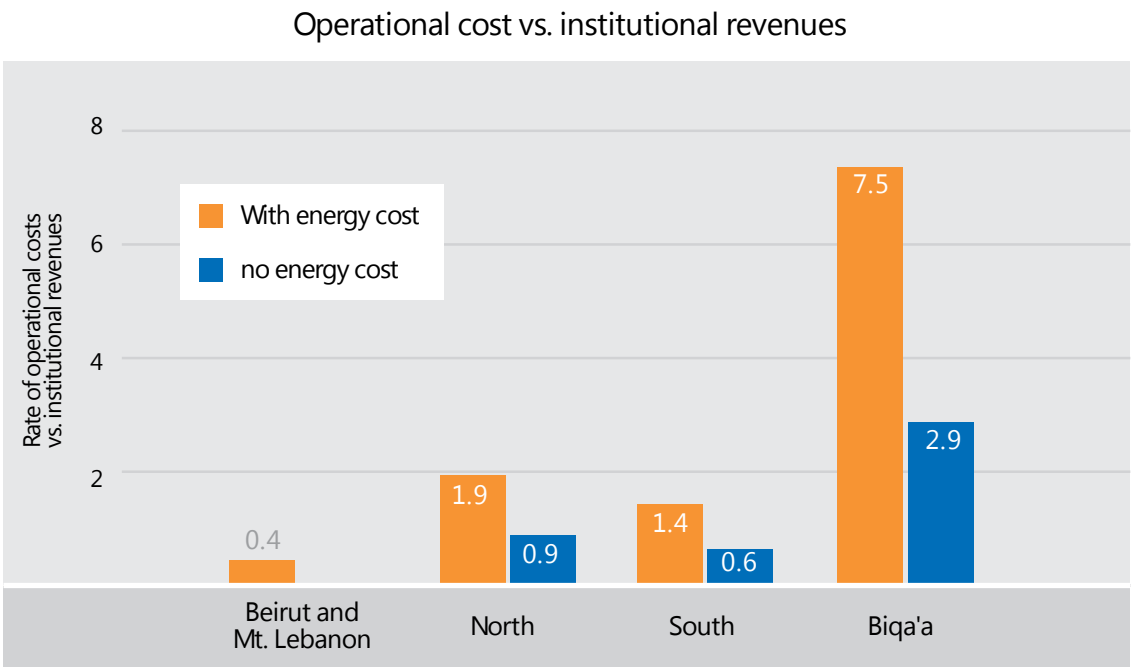

Figure 4: The Operational Costs and Revenues for the Water Establishments in Lebanon
Source: Ministry of Energy and Water, 2011

As for the issue of collection, which directly a□ects the cost coverage, the average collection rate for the four establishments amount to approximately 70% (11% in the Beka'a '52% in North Lebanon, 61% in South Lebanon and 80% in Beirut and Mount Lebanon).

st UDY REs ULt s

In general, the four establishments can work to improve their performance through the introduction of administrative and operational improvements. There is also an apparent variation in performance, where it can be said that the best performing establishment is BMLWE, and the least performing is BWE. As for the role of the establishments in the sector and their orientation to work as independent institutions, one can conclude that these institutions are still not able to reach □nancial sustainability and the aforementioned independency. Although the current tari□ used enables organizations to cover the cost of operation and maintenance, which means that the failure of institutions in the billing and collection processes has a large impact on the □nancial sustainability. It can also be concluded that the tari□ in its current form, which is not linked to actual consumption, in addition to not using water meters in measuring the amount of consumed water, does not motivate consumers to reduce consumption and does not take into consideration the poor fraction of the population. As for the private sector involvement in the provision of services to the consumers, it can be asserted that it has performed the necessary task at a high level. This involvement is highly encouraged in order to take advantage of the improvements that it brings along to the work of the sector.

REFERENCES

1. The International World Bank for Construction and Development 2010, Republic of Lebanon Water Sector: Public Expenditure Review, Lebanon.
2. Comair, F., 2006, Water Sector in Lebanon: Operational Framework for Undertaking Legislative and Institutional Reforms, United Nations Economic and Social Commission for Western Asia.

السـادة / الجمعية العربية لمرافق المياه (أكوا)

تحية طيبة وبعد،

أرجو إعلامكم بأن المصنف بعنوان " Management Of Water Utilities Case Studies From The Arab Region"، اعداد: Arab Countries Water Utilities Association (ACWUA)

قد تم منحه رقم إيداع في مركز الإيداع في دائرة المكتبة الوطنية تحت رقم الإيداع المبين أدناه.

يرجى العمل على تثبيت هذا الرقم كما هو مدون أدناه، في أي مكان ظاهر من المصنف، وتسليم مركز الإيداع ثلاث نسخ على سبيل الإيداع وبحيث تكون النسخ المودعة مطابقة للمصنف من جميع الوجوه ومن أجود النسخ المنتجة، وذلك استنادا لأحكام المواد (38، 39، 40، 41) من قانون حماية حق المؤلف رقم (22) لسنة 1992 وتعديلاته، وأحكام نظام إيداع المصنفات رقم (4) لسنة 1994 م.

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