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JAPAN INTERNATIONAL CORPORATION
AGENCY (JICA)

WATER SUPPLY IN SAUDI ARABIA
A SECTOR PROFILE

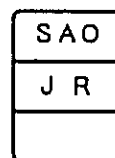
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PREPARED BY:

THE ECONOMIC BUREAU
RIYADH, SAUDI ARABIA



April 1999



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Section 1

GENERAL DESCRIPTION

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GENERAL DESCRIPTION

INTRODUCTION

In the environmental and climatic conditions of the Kingdom, water is the most important of all natural resources and the scarcity of potable water is one of the main constraints on socio-economic development. Under these conditions, the development of water resources is determined by a complex pattern of demand and supply relationships. On one hand, population growth, rising living standards and economic development in general determine the volume of water demand; on the other hand, the availability, quality and cost of water influence both the potential for growth and the nature and scope of long-term economic development.

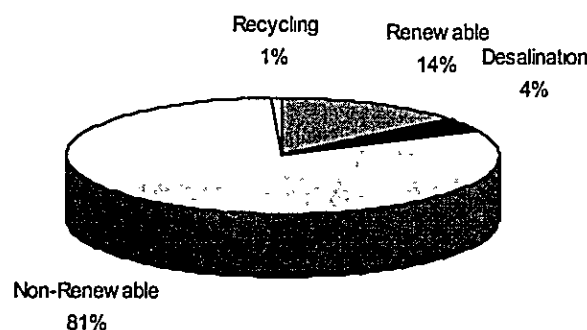
Saudi Arabia faces a chronic water supply shortage. The management of water is of principal concern as it is regarded by the Saudi government as a strategic resource. The World Bank estimates that by the year 2000, Saudi Arabia water demand will be almost five times the Kingdom's annual supply from renewable resources, posing significant problems for economic sustainability. As such, water is the single most pressing environmental issue in the Kingdom, and is considered as important as regional security and manpower development in terms of government priority. Over-exploitation, secure supply and pollution are the dominant concerns.

More than half of Saudi Arabia is covered by desert and country has one of the most adverse climatic conditions in the world. With dwindling fresh water resources and rising water demand, the Saudi government has been forced into finding new methods for both increasing the available supply and rationalizing existing usage. The Kingdom can only meet a balance between its large problems of supply and demand if conservation of surface and ground water reserves increases.

WATER SUPPLY

Water resources in the Kingdom can be divided into four categories: surface water, ground water, desalinated sea water, and reclaimed waste water. Surface water occur mainly in the west and south-west of the Kingdom where periodic rainfall is sufficient to produce run-off. There are two types of ground water aquifer in the Kingdom: renewable aquifers, where ground water is stored in the sediments of valleys and the cracked rocks below them, and non-renewable aquifers where ground water is stored in the sedimentary rock areas in 16 principal and secondary aquifers which receive only limited re-charge. According to 1993/ 94 estimates ¹, surface and shallow ground water supply only 13.8 percent of the Kingdom's total needs, while non-renewable ground water supplies around 81.5 percent of the Kingdom's total water needs. Desalinated sea water has reached an advanced stage of development in the Kingdom, which now has the largest desalination plants in the world. This source however supplies only 3.9 percent of current water needs. Finally, reclaimed wastewater is still in its early stages of development and supplies only 0.8 percent of current needs.

Water Supply Sources (1993/94 estimates)



By the year 2000, non-renewable ground water sources are projected to produce 13,040 million cubic meters, renewable sources (such as surface water and shallow aquifers) 3,000 million cubic meters ², desalination plants 1,150 million

¹ Saline Water Conversion Corporation (SWCC)'s Report of 1995-96

² Saline Water Conversion Corporation (SWCC)'s Report of 1995-96

cubic meters, and treated wastewater effluent 310 million cubic meters. for a total of 17,500 million cubic meters thus matching projected demand.

However, a national water conservation must be seriously implemented if the country has to judiciously use and harness its water resources. Also, the various options to use water, including recycling, must be pursued.

NON-RENEWABLE RESOURCES

Two main geological systems dominate the Kingdom; these are:

- a) The Arabian Shield which is basically composed of Precambrian, igneous and metamorphic rocks, and some extensive lava flows of a more recent age.
- b) The Arabian Shelf which covers about sixty-seven percent of the Kingdom's surface and is mainly composed of sedimentary formations.

The Arabian Shelf contains most of the available fossil water. The non-renewable groundwater aquifers exist in the sedimentary limestone and sandstone layers of the Shelf.

There are seven principal aquifers which contain most of the known groundwater resources in the Kingdom ³. These aquifers are: as-Saq, al-Wajid, Tabuk, al-Manjur/ Dhurmah, al-Wasia/ al-Bayadh, Um Errudhuma, and ad-Dammam. The top of the groundwater, in these aquifers, is found approximately 0 to 300 m below the surface. The depths of existing wells range from 150 to 1,800 m.

According to the Sixth Development Plan, the supply from non-renewable sources is expected to decline from 14,836 million cubic meters in 1995 to 13,040 million cubic meters in 2000, representing an annual compound decline of 2.5 percent and resulting largely from a 2.2 percent decrease in agricultural usage.

³The Ministry of Agriculture and Water (MOAW) Report of 1997.

RENEWABLE RESOURCES (SURFACE & SHALLOW GROUNDWATER)

The potential of surface water supply is negligible due to the low precipitation rate in most of the Kingdom and the absence of perennial streams, with an exception in the southwestern region (Asir highlands). Annual surface water supply potential in the southwestern region is estimated at about one billion cubic meters. The highest mean annual runoff was recorded in Bishah, Asir region.

Renewable shallow groundwater is found in isolated aquifers that are located in the alluvium layers of Wadi (valley) courses. These aquifers are recharged through runoff and occasional floods. The depth of water in these aquifers varies from 20 to 100 m. They were the main sources of water in the past.

Three major storage dams have been constructed in the southwest to collect rain runoff; these dams are:

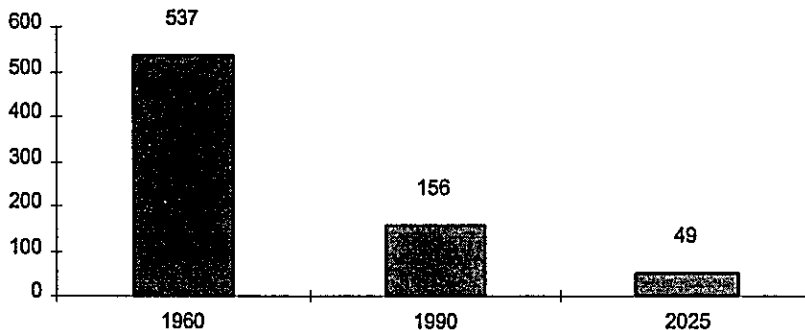
- Abha Dam (potable water supply)
- Wadi Jizan Dam (irrigation)
- Wadi Najran Dam (irrigation)

Smaller dams, numbering 181, have been constructed throughout the Kingdom for the purpose of recharging the shallow aquifers and providing limited downstream protection of agriculture. Total storage capacity in 1996 was 775 million cubic meters.

The Kingdom has gone some way to address the chronic overuse of its limited renewable water resources by agriculture.

Renewable Resources Per Capita - Estimates

in cubic meters per year

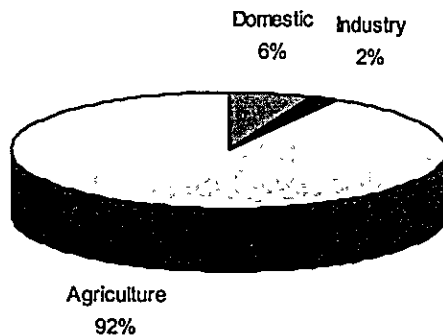


Source: World Resources Institute. World Bank Estimates.

Spurred by the aim of food self-sufficiency, Saudi Arabia began deploying a range of subsidies in the 1970s to stimulate production of wheat and barley. The results were stunning, as were the mounting costs as harvests grew. In 1992, the wheat crop hit a record 4.1 million tonnes - up from just 417,000 tonnes a decade earlier - at a cost to the Saudi exchequer of over USD 2,000 million in subsidized inputs and guaranteed purchase prices. Saudi Arabia achieved the biggest increase in agricultural output in the world in the 1980s but paid a price in water as the sector grew to account for more than 90 per cent of water withdrawals.

Share of Withdrawals from Renewable Resources

Source: World Resources Institute. World Bank Estimates. 1997.



There has since been a dramatic change of heart. However attractive the goal of self-sufficiency, the financial and environmental price was not worth paying. Agricultural policy went into reverse, with immediate results. By steadily reducing subsidies, the wheat crop had fallen to 1.2 million tons in 1996. Even more significantly, the consumption of ground water for irrigation was down to 1,850 million cubic meters (mcm) from 6,990 mcm just four years earlier. Instead of squandering water to grow wheat at several times the cost of imported grain, Saudi Arabia is both saving money and conserving its renewable water resources.

The biggest future sources of water for the Kingdom, however, will be desalination plants and reclaimed wastewater, which are both costly.

DESALINATION

Although the first step toward seawater desalination in the Kingdom occurred in 1928 with the issuance of royal instructions to establish two condensers for distillation of sea water to supply Jeddah City with drinking water, the birth of the Kingdom's massive seawater desalination industry came about in the 1960s with the construction of plants in Al-Wajh and Duba on the Red Sea coast, giving daily output of desalted water totaling 60,000 gallons per plant.

Since then, the water sector has been receiving considerable attention by the Saudi government, as more desalination plants have been put on stream under the responsibility of the **Saline Water Conversion Corporation (SWCC)**, which was created in 1974 from a department in the Ministry of Agriculture and Water into a specialized quasi-autonomous government body. Since its creation, SWCC has posted remarkable achievements in the development of the Kingdom's seawater desalination industry.

Today, the Kingdom is the largest producer of desalinated water in the world with 25 desalination plants on its eastern and western coasts⁴. The industry has a

⁴ SWCC & MOAW Annual Report of 1996-1997.

capacity of about 520 million gallons a day, representing 30% of the world's desalted water production and meeting 70% of the Kingdom's need for drinking water. This expansion of water desalination capacity was undertaken by the Government to meet the Kingdom's growing water needs. As a result, the rated capacity of desalination plants in the Kingdom has grown from 5.1 million gallons per day (mgd) in 1969 to 512.2 mgd in 1997, representing an average annual growth rate of 21.8 percent. Output of desalinated seawater is expected to rise to 1,150 million cubic meters per annum by the year 2000.

There are currently four desalination processes used by SWCC in Saudi Arabia, namely: Multi-Stage Flash evaporation compression (MSF), Reverse Osmosis (RO), Electrodialysis (ED), and Vapor Compression (VC). The MSF process is the dominant desalination system in Saudi Arabia, accounting for more than 90 percent of the country's desalinated water capacity.

The largest single desalination plant, with capacity of 240 mgd, is located at Jubail. The plants at Jeddah, Al-Khobar and Makkah/ Taif have rated capacities of 105.7 mgd, 57.5 mgd and 48 mgd respectively.

The plants supplying Madinah and Yanbu have a total capacity of 25 mgd. Smaller plants e.g. Al-Wajh, Duba, Al-Khafji, Amlaj, Farsan, Haql, Rabigh, Al-Bark, and Assir have a combined capacity of about 36 mgd.

Sea water intakes on the Gulf and the Red Sea contain some of the greatest concentrations of salt in the world, straining existing operating desalination plants. Desalinated water is piped inland over hundreds of kilometers of difficult terrain; most of the domestic water consumed in Riyadh is piped from desalination plants in the Gulf and desalinated water is pumped over the Red Sea hills into Makkah and Madinah from units on the coast south of Jeddah.

New desalination projects are directed toward reducing the cost of desalinated water through the optimization of chemical consumption, the improvement of

process construction, and the study of design features and methods of desalination. Government planning also aims to extend the life expectancy of desalination equipment through failure analysis, remedial measures, monitoring corrosion and evaluation of materials under the marine environment.

The **SWCC** conducts research and development on the operation and maintenance of desalination plants. Its research goals are to identify problem areas and suggest solutions. The **SWCC's** research facilities researches corrosion, surface scaling, and develops and evaluates new technologies, processes, chemicals, materials, instrumentation and sources of energy that relate to the desalination process.

The **SWCC** also engages in joint research with other countries, including Japan; **Japan's International Cooperation Agency (JICA)** has a technical cooperation agreement with **SWCC** that dates back to 1982 that has led to joint research studies on MSF and Reverse Osmosis (RO) systems.

Since most desalination plants have been built by Japanese and European firms, much of the equipment and materials have been sourced from either Japan or Europe. South Korea's entry into the market was only possible through low bids on projects. However, all equipment installed by Korean firms was Japanese. In total, there are more than 30 companies active in Saudi Arabia's desalination market. Many are consultants prequalified with **SWCC**.

Saudi Arabia's Desalination Industry (1994) ⁵	
Country	Market Share
Japan	38%
The United States	14%
Germany	14%
South Korea	12%
Italy	11%
Others	11%
Source: Ministry of Planning; SWCC	

⁵ United States Department of Commerce, ISS, US National Trade Data Bank.

WASTEWATER TREATMENT

The total volume of wastewater generated in Saudi Arabia is 4 million metric tons per day. Of this, only 30% (1.2 million metric tons) is treated. **The Ministry of Agriculture and Water** has constructed recycling plants in Riyadh and Jeddah and others are under construction. It is estimated that 40% of urban wastewater used in domestic processes could be recycled through treatment facilities.

The increase in water consumption has led to the design of advanced wastewater treatment plants. Industry and households are projected to produce some 310 million cubic meters of recycled wastewater by the turn of the century.

Recycled water is particularly suitable for applications in the agriculture sector. A number of pilot plants set up by Saudi-Japanese teams have already started working to recycle wastewater for agriculture and irrigation.

In 1994, there were about twenty major wastewater treatment plants generating 3.5 Mm³/day of recycled water in various cities across the Kingdom ⁶: Three large plants in the Eastern region, nine in the Western region and two in each of the Central and Western regions.

Studies have been carried out on the cost-effectiveness of recycling wastewater. It is in fact cheaper to recycle wastewater than to use complex desalination technology. Today's cost of desalinated water is approximately SR 4 per cubic meter, whereas in the secondary treatment of wastewater, a conservative estimate places the price at between SR 0.33 and SR 1 per cubic meter. Wastewater treated at the tertiary stage costs a bit more - between SR 1.5 and SR 2.5 per cubic meter - depending on the technology employed.

With the added costs of pumping stations and pipelines required in desalination technology, the total cost for desalinated water in Riyadh is around SR 5 per cubic meter, which is twice the price of tertiary treated wastewater.

⁶ MOAW's Report of 1996-1997

Good examples of advanced wastewater treatment plants in the Kingdom are the ARAMCO Wastewater Treatment Plant in Dhahran and the one at Jubail Industrial City. Saudi ARAMCO has established itself as a leader in the Eastern region in the field of exploring and developing the use of treated wastewater. It uses its secondary treated water only for landscape irrigation and sand stabilization or control. ARAMCO has already built a number of treatment plants e.g. Tanajib plant and Dhahran tertiary treatment plant.

WATER DEMAND

One of the most important policy issues facing the Kingdom is the change in the national water balance as a result of the remarkable increase in the demand for water over the past twenty years. In recent years, agriculture has been the largest consumer of water. At the same time, the growth in demand for water for domestic, recreational and industrial uses has been accelerating as a result of population growth, urban expansion, rising living standards and changes in individual consumption patterns. This growth in the demand for water had brought the overall rate of water consumption to a critical level, leading to the partial depletion of water resources, particularly in the case of non-renewable fossil water which is the main source of fresh water supply. Thus, effective water conservation measures are now needed, including possible changes in water tariffs, increasing the use of reclaimed wastewater, and the implementation of optimal cropping patterns.

Total water consumption in Saudi Arabia in 1995 was estimated at 18,200 million cubic meters, of which 1,800 million cubic meters were utilized by the domestic and industrial sectors, while agriculture consumed 16,400 million cubic meters. The current Sixth Five-Year Development Plan of the Kingdom has projected that overall water requirements will decrease to 17,500 million cubic meters by the year 2000 (2,800 million cubic meters for domestic and industrial and 14,700 for agriculture), a reduction in consumption by 700 million cubic meters. This

decrease is expected to result from the government's 1996 decision to stop grain exports and hence reduce cultivated surfaces, as well as from national conservation measures.

**TARGETED NATIONAL WATER BALANCE IN
THE SIXTH DEVELOPMENT PLAN**
(million cubic meters per year)

	1995	2000	Average Annual Rate of Growth
Water Demand			
Municipal and Industrial	1,800	2,800	9.2%
Agriculture	16,400	14,700	-2.2%
Total	18,200	17,500	-0.8%
Available Water Resources			
Renewable Water (Surface & Shallow Ground Water)	2,500	3,000	3.7%
Non-Renewable Ground Water	14,836	13,040	-2.5%
Desalinated Sea Water	714	1,150	10.0%
Reclaimed Waste Water	150	310	15.6%
Total	18,200	17,500	-0.8%

GOVERNMENT POLICIES & ACTIVITIES

Water and other utilities are heavily subsidized in Saudi Arabia, contributing to widespread waste and financial losses by public power and water companies.

In 1996, the government decided to stop grain exports to drastically reduce water use. The following year, the government launched a six-month national campaign to curb the use of water and has urged citizens to stop wasting this precious resource. Frequent advertisements on state-run television also call on the public to rein in the use of water. A second national awareness campaign is underway in 1999. Indications are that these public awareness programs have not produced the sought results. Measures to protect and conserve environmental resources are thus driven primarily by government authorities and industry.

The **Ministry of Agriculture and Water** has recently stopped issuing licenses to projects that consume large water quantities. In addition, the ministry is urging owners of various projects to switch to modern irrigation systems to reduce water consumption.

Targeted water policies include:

- Land distribution primarily in areas with large quantities of renewable water resources (not many such areas still available).
- Areas with critical ground water depletion rates identified, and regulations introduced for appropriate water pumping rates
- Adoption of appropriate advanced water use technologies.
- Continued development of infrastructure needed for collection, treatment and re-use of sewage water in all regions of the Kingdom for agricultural and industrial purposes. Priority to be given to densely populated areas so as to limit the problem of rising ground water levels in cities, and the severe health, economic and environmental consequences.

The Saudi government is moving toward the use of price mechanism as a measure to control water consumption. It plans to raise the price of desalinated water in an effort to reduce water demand.

ISSUES OF THE DAY

1) A recent study by the Center for Environment and Water, King Fahad University of Petroleum and Minerals (KFUPM) Research Institute, reveals that the drastic withdrawal of water from aquifers, which have been the basic source of water in the Kingdom for hundreds -if not thousands- of years, will have long-term negative impact on the Kingdom's ground water level, as well as the quality of this vital resource. The Center confirms that some aquifers in some parts of the Kingdom are being depleted.

2) Irrigation water constitutes about 90 percent of the Kingdom's total water consumption. The use of irrigation water though is expected to rise as the agricultural sector increases its production to meet food demand of the Kingdom's ever expanding population. The KFUPM Research Institute recommends:

- The creation of a national irrigation water management authority to implement and supervise the system.
- The implementation of a computerized national irrigation water management and information system. The system was developed by a team of KFUPM scientists and agricultural experts, and is expected to save up to 35 percent of irrigation water consumption and ground water pumping. Such a system has been locally implemented in the Eastern Province.

3) In the summer of 1998, Jeddah faced water shortages resulting from:

- Rapid population growth.
- Vast developments in construction and industrial sectors.
- Inability of desalination plants in the Red Sea to produce enough water because of the condition of the sea water. In the summer, the water at the intake point of the desalination plants becomes murky, putting pressure on the capacity and capability of the plants to purify water.
- The ground water sources in the region are also unable to produce enough because the water level has declined, putting pressure on the reverse osmosis plants to operate.
- The water conservation program is not working, not only in Jeddah but Kingdom wide.
- A shortage of capital for new investment and cash to maintain existing plants.
- Increase in water demand during the summer time.

As early as April 1999, water shortage symptoms appeared in Jeddah. A study by the Jeddah's projects department reveals that the city's daily water demand is about 900,000 cubic meters, double the volume of water pumped from the desalination stations. In a bid to alleviate the shortage, the department called on contractors to transfer drinking water to residents by tanks. Some 86 contractors operating 650 water tanks are presently retained. In addition, the Ministry of Agriculture and Water has recently contracted to major companies to expand Jeddah's water network by 60 million gallons of drinking water per day, at a cost of SR 96 million.

Section 2

RESPONSIBLE AGENCIES

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RESPONSIBLE AGENCIES

The dominant drivers of environmental policy in Saudi Arabia are generally governmental, and include:

- Nationally mandated government authorities;
- Regional and local authorities, such as municipal governments; and
- Large industries interested in site clean-up, remediation and pollution prevention, such as ARAMCO, the world's largest oil company, and SABIC, a petrochemical conglomerate.

The general populace plays an insignificant role in setting the environmental agenda or determining/ influencing policy.

The main programs for the water sector are implemented by three executive agencies during the Sixth Development Plan:

- The Ministry of Agriculture and Water
- The Saline Water Conversion Corporation
- Al Hasa Irrigation and Drainage Authority

THE MINISTRY OF AGRICULTURE AND WATER

The **Ministry of Agriculture and Water (MOAW) - Water Affairs Department** has three major programs:

- *Water Resources Development*: includes the hydrological and hydrogeological studies, the re-use of wastewater, digging wells, constructing dams, and preparing the National Water Plan.

- *Potable Water Supply:* aims at establishing potable water networks and projects to meet the basic water needs of the population in areas that have no water departments and that still suffer from a shortage of water supplies.
- *Operation and Maintenance:* of potable water networks and projects and facilities, and supply of potable water by tanker to rural and remote areas.

THE SALINE WATER CONVERSION CORPORATION

The **Saline Water Conversion Corporation (SWCC)** is the only government organization responsible for the design, construction, operation and maintenance of desalination plants in Saudi Arabia. SWCC has two main programs: the establishment of new desalination plants and the operation and maintenance of existing plants.

The SWCC is acquiring the know-how and technological expertise to produce water at low cost. It should be noted that government prices do not reflect actual cost because of the large number of subsidies involved. Artificially low water prices have encouraged inefficient and overuse of water resources.

AL HASA IRRIGATION AND DRAINAGE AUTHORITY

The **Al Hasa Irrigation and Drainage Authority** programs include:

- *Water Resource Development, Research and Studies:* aimed at providing accurate data and information about water; conducting hydrological studies to define the optimal use of water resources; rationalizing the use of irrigation water; identifying the water requirements of crops; and digging wells to meet additional water needs.
- *Operation and Maintenance* of existing water facilities.

MINISTRY OF MUNICIPAL AND RURAL AFFAIRS

In addition to the above three executive agencies, the **Ministry of Municipal and Rural Affairs (MOMRA)** requires residential compounds, commercial complexes, hotels, resorts, restaurants, schools, hospitals and light industry of the private sector to install Fresh-Water Producing Equipment as public protection and disease prevention measures in all projects. On the public sector side, the same holds true for schools, hospitals, Mosques, bases and public buildings where large numbers of government employees and/ or citizens congregate. The Ministry's main programs include the further expansion, operation and maintenance of the water network, completing the installation of house connections and the wastewater treatment system.

THE METEOROLOGY & ENVIRONMENTAL PROTECTION ADMINISTRATION

The dominant ministry involved with Saudi Arabia's environmental policies and protection is the Ministry of Defence and Aviation, under which the **Meteorology and Environmental Protection Agency (MEPA)** resides.

MEPA is responsible for supervising environmental concerns and ensuring that both new and existing industrial facilities comply with environmental regulations. It has been given greater leeway to enforce standards and, as a result, has become a more significant authority.

MEPA administers the Environmental Protection Standards (General Standards – Document No. 1409-01/ 1989), Saudi Arabia's principal code dealing with the protection of environmental resources. The code commits the government to construct and/ or modify water treatment facilities. **MEPA** is currently reviewing and updating its water protection standards to boost its effectiveness in rationalizing the country's water supply.

The secondary treatment standards for reused water must meet the stringent **MEPA** performance standards for direct discharge. These standards include the acceptable minimum and maximum levels of trace metals, biodegradable organic matter, viruses, parasites and other contaminants which may be present in treated wastewater. **MEPA** maintains that the development of strict permit systems, the full enforcement of current regulations, and continuous monitoring of wastewater quality are basic steps to minimize the potential environment and public health risks. These risks need to be sufficiently reduced before projects using treated wastewater extensively can be fully implemented.

SAUDI ARABIAN STANDARDS ORGANIZATION (SASO)

Saudi Arabian Standards Organization (SASO) was established pursuant to the Royal Decree No. M/10 Dated 1392H, as a body of judicial personality and of an independent budget. It is the only Saudi organization responsible for all the activities related to standardization in the Kingdom including:

1. Formulation and adoption of national standards for all commodities and products as well as meteorology, symbols, and methods of sampling and testing.
2. Publication of standards, spreading consciousness, and coordination of activities related to standardization in the Kingdom.
3. Setting the rules for granting certification of conformity and quality marks as well as regulating their issuance and rules.
- 4 Participating in the regional and international standards organizations and representing the Kingdom in conferences and meetings of standards organizations.

THE ROYAL COMMISSION OF JUBAIL & YANBU (RC)

The Royal Commission of Jubail & Yanbu (RC) establishes and implements the water quality regulations and standards applicable to the industrial cities of Jubail and Yanbu. The **RC** is also responsible for meeting the utility needs of the two industrial cities.

Section 3

PRIVATE COMPANIES INVOLVED

Section 3

PRIVATE COMPANIES INVOLVED

There are no private companies involved in the supply of water in Saudi Arabia, except for the bottling of drinking water and trucking of water to areas not served by the existing infrastructure network. The extent of the private sector's involvement is limited to the following areas:

- a) Design, manufacturing and commissioning of Reverse Osmosis (RO) plants: e.g., two Saudi companies, Al-Kawther Industries Ltd. and Metito, are paramount in the design, manufacturing, and commissioning of RO plants in the Kingdom.
- b) Construction and sub-contracting activities. Many local firms, joint-ventures or otherwise, import equipment and then construct, sub-contract or fabricate installation support systems, including O&M activities.
- c) Manufacturing of supplies and parts: Five domestic firms produce filters, treatment chemicals, sterilization units, and membranes mainly used in RO systems.
- d) Water treatment: e.g., Jeddah-based Tanqia Water Treatment Company is engaged in the collection (through a fleet of trucks) of wastewater, cleaning of septic tanks and collected wastewater, and production of treated water to qualities suitable for irrigation.

International firms (usually joint-ventures with Saudi companies) dominate Saudi Arabia's water and desalination market with Japanese, German, and American firms capturing the bulk of the market.

Section 4

LISTING OF COMPANIES BY NATIONALITY

Section 4

LISTING OF COMPANIES BY NATIONALITY

There are more than 30 foreign companies active in the Kingdom's desalination industry, some of them are consultants which are prequalified with SWCC. A partial list of these companies is included hereunder:

<u>Company</u>	<u>Process</u>	<u>Country</u>
Fichtner	MSF	Germany
Kloeckner Humboldt Deutz	MSF	Germany
Krupp	MSF	Germany
Preussag	MSF	Germany
Weir Westgarth	MSF	Germany
Stork Werkspoor	MSF	Holland
AnsaldoGIE	MSF	Italy
Italmimpianti	MSF	Italy
Sidem	MSF	Italy
Snamprogetti	MSF	Italy
Hitashi Engineering	MSF	Japan
Kawasaki Heavy Ind.	MSF	Japan
Mitsubishi	MSF	Japan
Mitsui	NSF	Japan
Sasakura	MSF	Japan
Tori	RO	Japan
Hyundai	MSF	S. Korea
Korea Heavy Ind. & Con. Co.	MSF	S. Korea
Electrowatt	MSF	Switzerland
Degremont	RO	France
Afax International	RO	USA
Hydronautics Water Systems	RO	USA
Mantra/ Osminics	RO	USA

Envirogenes Systems Co.	RO	USA
Mechanical Equipment Co., Inc.	RO	USA
Polymetrics, Inc.	RO	USA
Water Services of America, Inc.	RO	USA
Basic Tech.	RO	USA
Permutit Sybron	RO	USA
El Paso Environmental Systems	RO	USA
Riley-Beaird	MSF	USA
IHI	MSF	USA
Ionics, Inc.	Electrodialysis	USA
Kier Saudi Arabia Ltd.		UK-KSA

Section 5

PRIORITY OF GOVERNMENT FOR PRIVATIZATION

Section 5

PRIORITY OF GOVERNMENT FOR PRIVATIZATION

The government agencies responsible for managing and planning water affairs adopted a policy of giving the private sector opportunities to participate in the development process through:

- undertaking many of the economic activities directly financed by the government, such as water supplies and services projects and the construction of desalination plants;
- operating and maintaining the existing water facilities currently operated by the government;
- providing support and technical advisory services that enable the private sector to operate more effectively and flexibly. During the 1990-1994 period, the private sector implemented many projects financed by the state budget, such as water services and supplies projects; e.g.
 - drilling of 245 wells for drinking water and the construction of three reservoir dams;
 - implementing water supply projects in large and medium-sized cities and towns, as well as in 107 villages and hamlets in five regions of the Kingdom;
 - supplying and installing pumping units in wells;
 - providing water by tankers an average of 430,000 times per year, as well as the leasing of 50 indigenous projects;
 - operation and maintenance of 183 dams with a total holding capacity of 450 million cubic meters of water;
 - operation and maintenance of 1,010 drinking water projects in villages and hamlets;

- operation of the program to re-use reclaimed waste water for agricultural purposes in Riyadh area, with a capacity of 300,000 cubic meters per day;
- operation and maintenance of 9 purification plants.

The total cost of these projects amounted to SR 3,800 million.

According to the Sixth Development Plan (1995 -2000), the private sector has the opportunity to implement the water projects approved within the Water Development, Services and Supplies program, and is expected to play an important role in the construction of desalination plants.

Almost all desalination plants were built on a turnkey basis. Because of the government's dwindling financial resources, we believe that the Saudi private sector will gradually take over the construction, operation, and maintenance of such projects on Build-Operate-Transfer (BOT) or similar basis.

More recently, in late March 1999, the director general of the **Ministry of Agriculture and Water** has called on the private sector to invest further in sewage recycling plants, stating that these plants can feed farms and industries which consume about 70 to 80 percent of water.

The World Bank has also been assisting the Kingdom in identifying suitable options for increased private sector participation in the water and desalination plants sector.

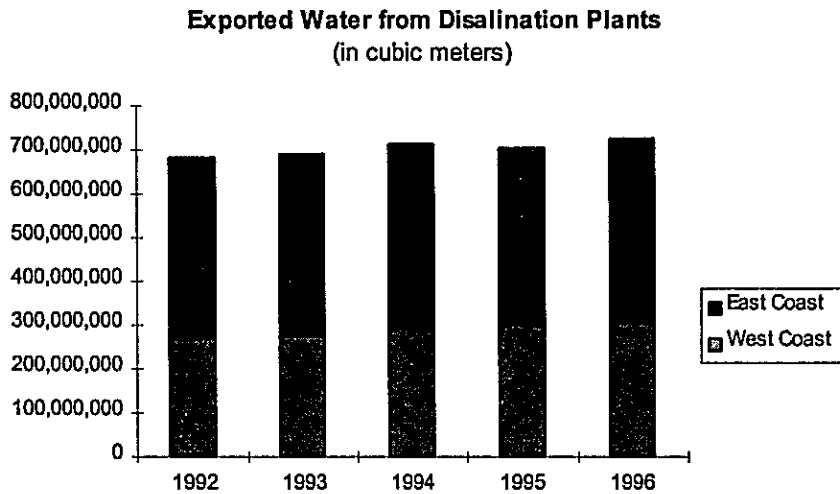
Section 6

**DEGREE OF CURRENT ACTIVITY
AND RELATIVE GROWTH**

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DEGREE OF CURRENT ACTIVITY AND RELATIVE GROWTH

The production of desalinated water over the 1992-1996 period increased by an average 1.6% compound annual rate.



Source: 1996 Annual Report. Saline Water Conversion Corporation.

According to Minister of Agriculture and Water, Dr. Abdullah Bin Abdul Aziz Al Muammar, four new water desalination projects are to be established in the Kingdom, adding to the existing 25 plants and boosting capacity from the current 520 million gallons to about 800 million gallons daily, representing an increase of more than fifty percent. According to the same source, new water-related projects to be implemented in the Kingdom are estimated to cost SR 16 billion. The four desalination plants under implementation are:

DESALINATION PLANTS UNDER CONSTRUCTION			
Export Capacity			
	of Daily Water		of Electricity
Project	Gallon	Cubic Meter	Megawatt
Madinah/ Yanbu, Ph. II	60,000,000	227,272	35
Jubail R.O.	24,015,000	90,909	--
Al-Khobar, Ph. III	60,000,000	227,272	370
Shoibah, Ph. II	100,000,000	378,787	340
TOTAL	244,015,000	924,240	745

In addition to the above, there are 16 projects for the construction of desalination plants under study, eleven of which are to be located on the Red Sea and five on the Gulf. The total production capacity of the contemplated plants is estimated at over 2,000,000 cubic meters/ annum (equivalent to 600 mgd).

This said, the **Saline Water Conversion Company**, is facing a 16 percent reduction in its 1999 budget and has been delaying payments to contractors for years. This has slowed progress on the 100 mgd desalination plant being built by South Korea's Hanjung at Shoibah and the pipeline that will eventually relieve the shortages in Jeddah.

Section 7

REGULATIONS AND ADMINISTRATIVE SYSTEM

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The imposition of fines by the **SWCC** is the most recent and important change in water regulations. Some regional government authorities, such as **The Western Region Water Administration**, already impose fines on water violators ranging from SR 200 to SR 2,000. The introduction of fines for desalinated water users is an effort to reduce water consumption. In Riyadh, for instance, the **SWCC** believes that conservation measures could reduce water consumption by as much as 40 percent.

Applications for construction licenses to establish new plant facilities or to modify existing ones must be accompanied by a certificate showing that **MEPA** has reviewed construction plans and that they meet environmental standards. **MEPA** has the ability to enforce compliance by informing the relevant licensing authority that a particular plant has not complied with regulations.

There are no restrictions on the import of desalination equipment into Saudi Arabia. Such imports are subject to a 12% custom duty in general and 20% on items manufactured locally. Desalination equipment and parts imported by **SWCC** are however exempt from import duty.

There are no Saudi standards pertaining to desalination equipment and the Saudi government will therefore accept any internationally-recognized standards.

Regulations require foreign companies that obtain contracts with the Saudi government to appoint Saudi Service Agents.

