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Sustainable Development of Agriculture and Water Resources in the Kingdom of Saudi Arabia

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Abstract: This research paper presents valuable information and figures in relation to the Agricultural development plans in Saudi Arabia despite the harsh and unsuitable climate and other conditions for a normal agricultural production.

The experience of Saudi Arabia in increasing and improving the production of many agricultural products worth to be presented in many world wide conferences and scientific meetings.

Since the year 1970 when the first five year's development plan started until the year 1999, the Kingdom of Saudi Arabia has achieved many important goals and objectives in the area of food production. The Kingdom of Saudi Arabia is now self sufficient in many agricultural products such as wheat, broilers, eggs, milk products, vegetables and fruits [3].

This paper presents a summary of achievements for each plan highlighting the positive role of the private sector in developing agricultural sector in Saudi Arabia using the most advanced technology to cope with the difficulties facing agricultural production in a country like Saudi Arabia.

1. Introduction

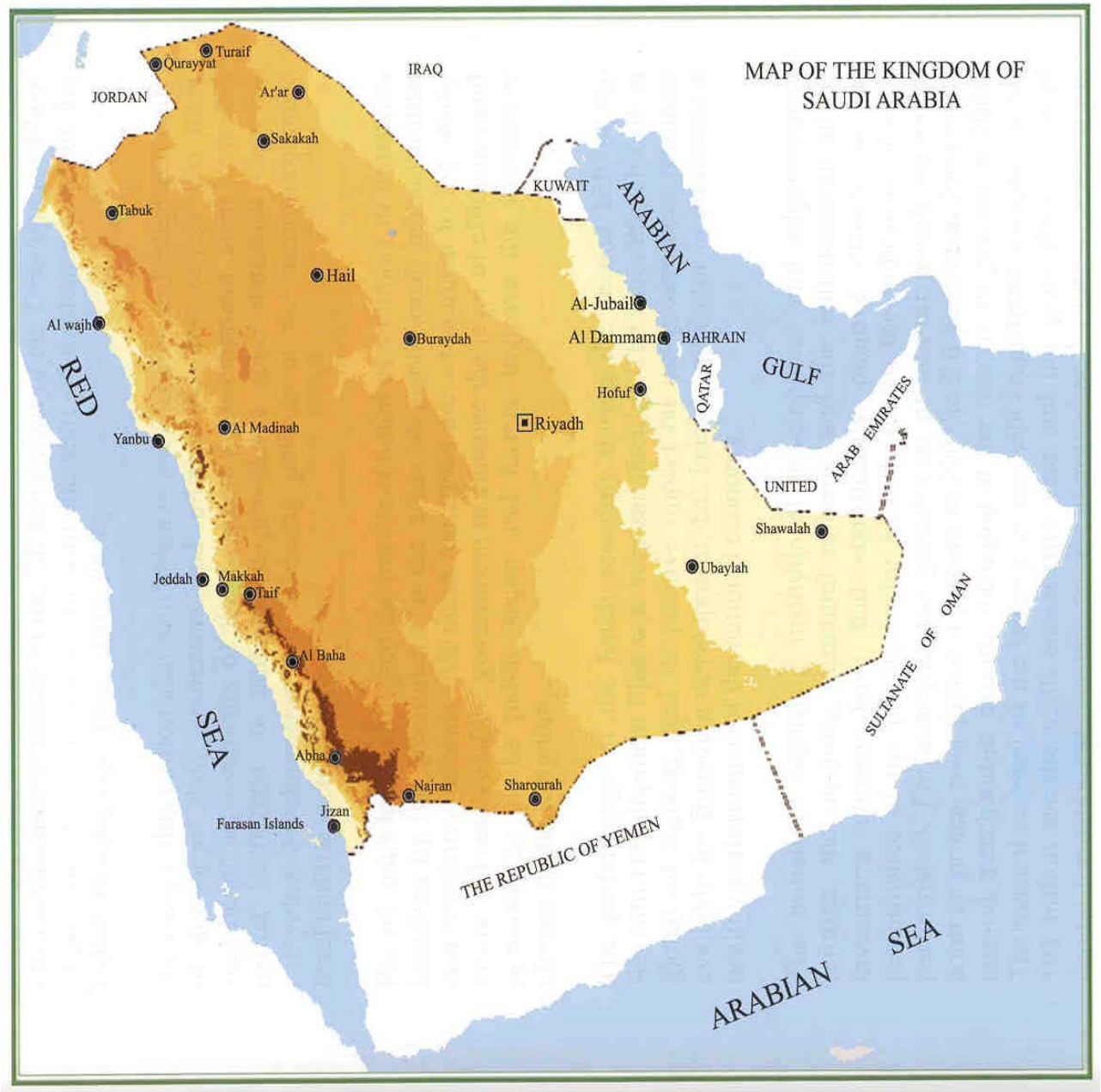
The modern sustainable development debate begun in 1960's, through the ideological conflicts between those who advocated unrestrained economic growth, an essential engine of development and environmentalists and conservationists who stressed a wider range of social, political, physical and biological goals.

The meaning of sustainability is dependent on whether it is based upon social, economic or ecological sustainability. Different societies have different conceptualization of sustainability as well as different requirements for it based on varying cultural expectations or environmental constraints.

Sustainability has become a complex term that can be applied to almost every facet of life on Earth, particularly the many different levels of biological organization, such as; wetlands, prairies and forests and is expressed in human organization concepts, such as; eco-municipalities, sustainable cities, and human activities and disciplines, such as; sustainable agriculture, sustainable architecture and renewable energy [9]. Sustainability, in a broad sense, is the ability to maintain a certain process or state. It is now most frequently used in connection with biological and human systems.

For humans to live sustainably, the Earth's resources must be used at a rate at which they can be replenished. However, there is now clear scientific evidence that humanity is living

Figure (1): Map of Saudi Arabia



unsustainably, and that an unprecedented collective effort is needed to return human use of natural resources to within sustainable limits [9].

Since the 1980s, the idea of human sustainability has become increasingly associated with the integration of economic, social and environmental spheres. Thus, all human activities have an influence on sustainability.

There are over 100 definitions of sustainability and sustainable development, but the best known is that of World Commission on Environment and Development's. This suggests that development is sustainable where it "meets the needs of the present without compromising the ability of future generations to meet their own needs" [8].

The term refers to achieving economic and social development in ways that do not exhaust a country's natural resources. In the Commission's words: "... sustainable development is ... a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with the future as well as present needs" [8].

Sustainable development should integrate all the environmental, economic and social dimensions of sustainability.

Water is one of our most precious and valuable resources. Without a gallon a day, you will perish. Plants and animals need a reliable supply of water, and it is critical to growing crops and etching chips.

In the decade 1951-60 human water withdrawals were four times greater than the previous decade. This rapid increase resulted from scientific and technological developments impacting through the economy - especially the increase in irrigated land, growth in industrial and power sectors, and intensive dam construction on all continents. This altered the water cycle of rivers and lakes, affected their water quality and therefore potential as a human resource and, most significantly, altered the global water cycle. Currently about 35% of human water use is unsustainable, drawing from diminishing aquifers and reducing flows of major rivers.

Over the period 1961 to 2001 there was a doubling of water demand and over the same period agricultural use increased by 75%, industrial use by more than 200%, and domestic use more than 400%. Humans currently use 40-50% of the globally available freshwater in the approximate proportion of 70% for agriculture, 22% for industry, and 8% for domestic purposes and the total amount is progressively increasing being about five times that at the beginning of the 20th century [9].

The path forward appears to lie in improving water use efficiency through: demand management; maximising water resource productivity of agriculture; minimising the water intensity (embodied water) of goods and services; addressing shortages in the non-industrialised world; moving production from areas of low productivity to those with high productivity; and planning for climate change.

Despite its importance, over 1 billion people around the globe still lack access to clean water and thousands perish daily for lack of it. Many of the most important aquifers are being over-pumped and half of the world's wetlands have been lost to development. There is a political dimension to water as well; almost every major river system on the planet is shared by two or more nations, making water a source of international conflict and a matter of national security.

Saudi Arabia is a desert country with no permanent rivers or lakes and very little rainfall. Water is scarce and extremely valuable, and with the country’s rapid growth, the demand for water is increasing.

The Kingdom, therefore, has turned to innovative ways to provide enough water to support its development. All water matters are handled by the Ministry of Water and Electricity.

Scarcity of fresh water resources represents one of the major challenges facing the world generally and the Kingdom of Saudi Arabia (KSA), specifically. KSA, which suffers from absolute water scarcity, is witnessing ever-decreasing water per capita in addition to continuously increasing water consumption due to population growth, house consumption patterns and the ever-increasing consumption of production sectors. This, in turn, has led to growing increases in fresh water demands for different purposes. The world is currently shifting its interest from just emphasis on water provision, or supply, to a more balance between supply and demand through considering the management of water demand. Water demand management is a managerial approach, which aims to meet the demand for water through the application of necessary and efficient measures and incentives to achieve fair and effective utilization of water. This approach also involves the application of some procedures of water preservation, which aim to stimulate and increase consumers' interest and knowledge concerning the scarcity and limited nature of water resources.

Despite the harsh climate and the shortage of water, Saudi Arabia had witness sound development in agriculture and water sector during the last four decades.

2. Water Resources And Agricultural Demand

Starting with the Kingdom's recent modernization drive, development efforts made special emphasis on provision of water resources coupled with due attention to development of water resources and rationalization of water use in agriculture, industry and other increasing urban needs. Indeed, water is a crucial element for life and is a prerequisite for socio-economic development. Therefore, water has always been a scarce national resource in the Kingdom with its characteristically arid climate. Water consumption rates increased considerably as a result of population increase; the higher living standards which changed domestic consumption patterns and helped improving health care condition; spatial growth of cities, governorates and centers, and increased production and water related needs in various sectors of the economy during the last two decades, the Kingdom's water consumption increased by five-folds. The agricultural sector’s increased share in water consumption quite conscious. Against this baclcground, development endeavors sought to develop and conserve water resource, including both renewable and non- renewable resources. Efforts were also pursued to implement large scale sea water desalination projects. In this respect, the Kigdom hold the world's top position in terms of the volume of production of desalinated water and the technology used in this regard [4].

Agriculture claims an overwhelming share of water consumption, with some 86.5 percent of total water consumed [1]. Rationalization of water use in the agricultural sector has received adequate attention in development plans, policies and measures. The first four development plans sought a target of adding new water resources, and towards that end, embarked on an increased drive to set up desalination projects. With the initiation of the Fifth Plan, a comprehensive review was conducted of water consumption rates of the agricultural sector. This helped in restructuring of crop pattern, resulting in reduced areas of high water consuming crops, such as wheat and barley.

In favor of less water consuming crops, such as vegetables and fruits. Increased expansion was also pursued in the use of modern irrigation technology, with an aim to rationalize water consumption in this sector where water losses amount to relatively high rate of 30 percent [6].

Aquifers are a major source of water in Saudi Arabia. They are vast underground reservoirs of water. In the 1970s, the government undertook a major effort to locate and map such aquifers and estimate their capacity. As a result, it was able to drill tens of thousands of deep tube wells in the most promising areas for both urban and agricultural use [7].

Another major source of water is the sea. This is done through desalination, a process that produces potable water from brackish seawater. Saudi Arabia is the world's largest producer of desalinated water [2].

The Saline Water Conversion Corporation (SWCC) operates 27 desalination stations that produce more than three million cubic meters a day of potable water. These plants provide more than 70 percent of the water used in cities, as well as a sizeable portion of the needs of industry. They are also a major source of electric power generation [7].

Dams are used to capture surface water after frequent flash floods. More than 200 dams collect an estimated 16 billion cubic feet of runoff annually in their reservoirs. Some of the largest of these dams are located in the Wadi Jizan, Wadi Fatima, Wadi Bisha and Najran. This water is used primarily for agriculture and is distributed through thousands of miles of irrigation canals and ditches to vast tracts of fertile land that were previously fallow [7].

An expanding source of water is the use of recycled water. The Kingdom aims to recycle as much as 40 percent of the water used for domestic purposes in urban areas. To this end, recycling plants have been built in Riyadh, Jeddah and other major urban industrial centers. Recycled water is used for irrigation of farm fields and urban parks [3].

Table (1): Projections of Water Demand 1420/21 – 1429/30 (2000 – 2009)

	Billion Cubic Meters			**Average Annual Growth Rate**	
				Seventh Plan	**Long-term Perspective**
	1420/21 (2000)	**1424/25 (2004)**	**1429/30 (2009)**	**1420/21 – 1424/25 (2000 – 2004)**	**1420/21 – 1429/30 (2000 – 2009)**
Domestic Sector	1.8	2.10	2.40	3.1	2.7
Industrial Sector	0.47	0.64	0.77	6.4	3.8
Agricultural Sector	18.8	17.53	15.09	-1.4	-3.0
Total Demand	**21.07***	**20.27**	**18.26***	**-0.77**	**-2.1**

* MOEP estimates

3. Saudi Agricultural Achievements

3.1 Production Of Wheat

Total wheat Production rose from 26 thousand tons in 1970 to about 4.1 million tons in 1992. In 1999 total wheat production amounted to more than 1.8 million tons having increased by 100 thousand tons as compared to 1998 [7 ; 5].

It is worth mentioning that the Kingdom has achieved self-suffIciency in wheat production.

Figure-2

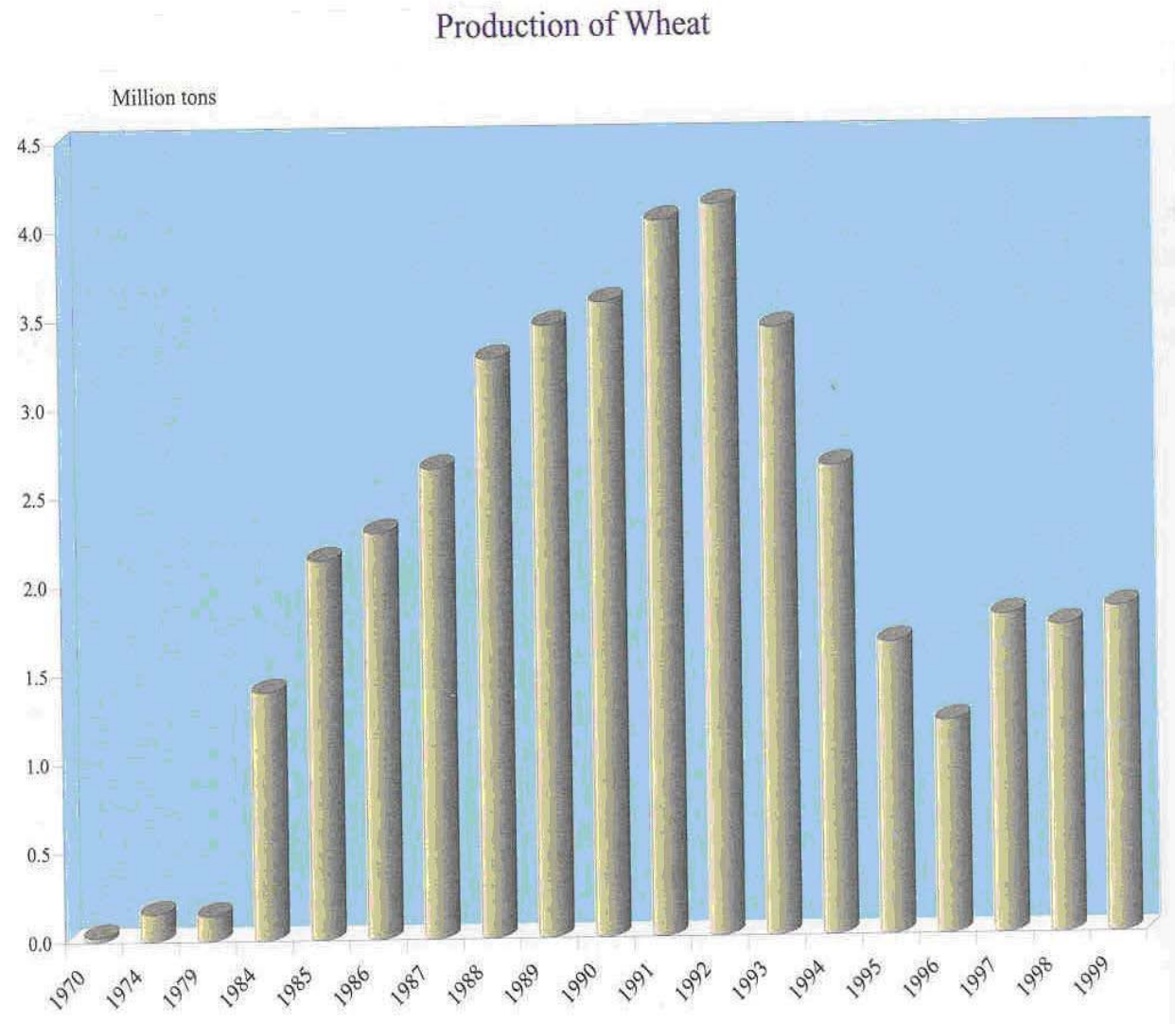


Figure-3a: Wheat Field

Figure-3b: Wheat Field

3.2. Production of Fruits and Vegetables

The Production of fruits and vegetables has increased significantly since 1970. Production of dates has grown from 240 thousand tons in 1970 to 650 thousand tons in 1999, representing an average annual growth rate of 3.7 percent [2].

Production of grapes has increased from 24 thousand tons to 142 thousand tons over the same period, representing an average annual growth rate of 6.2 percent.

Production of tomatoes grew at an average annual rate of 5.5 percent, increasing from 100 thousand tons in 1970 to 610 thousand tons in 1999.

Figure-4

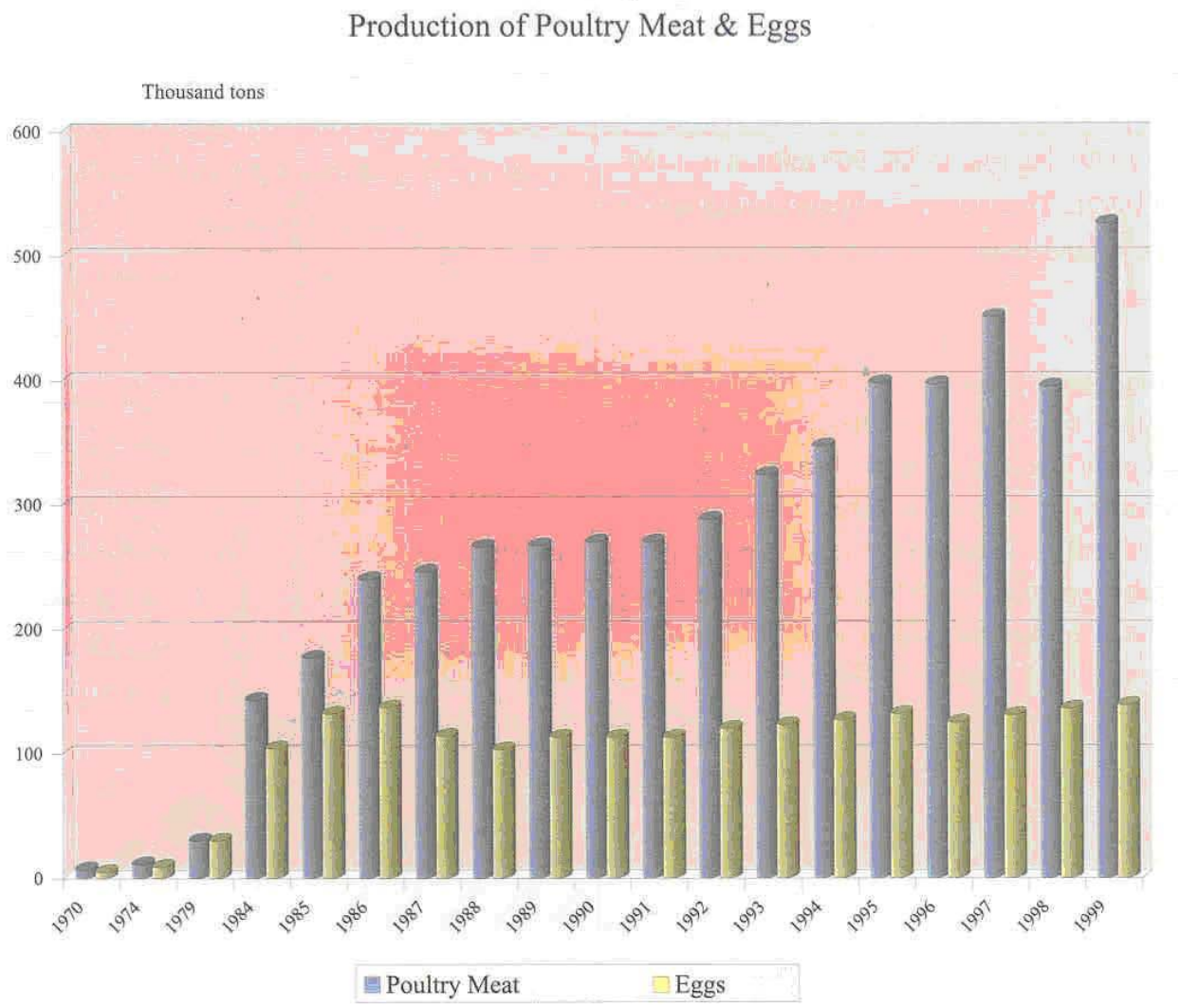
Figure-5: Date Palm Field

3.3 Production of Poultry Meat and Eggs

In 1999, 526 thousand tons of broilers were produced in the Kingdom compared to 1970 when total production was only 7 thousand tons. The production of broilers has increased at an average annual growth rate of 17.6 percent over the 1970-99 period [3].

The production of eggs in 1999 was 139 thousand tons, compared to 1970, when the total production of eggs in the Kingdom was only 5 thousand tons. The production of eggs has increased at an average annual growth rate of 12.8 percent during that period.

Figure-6

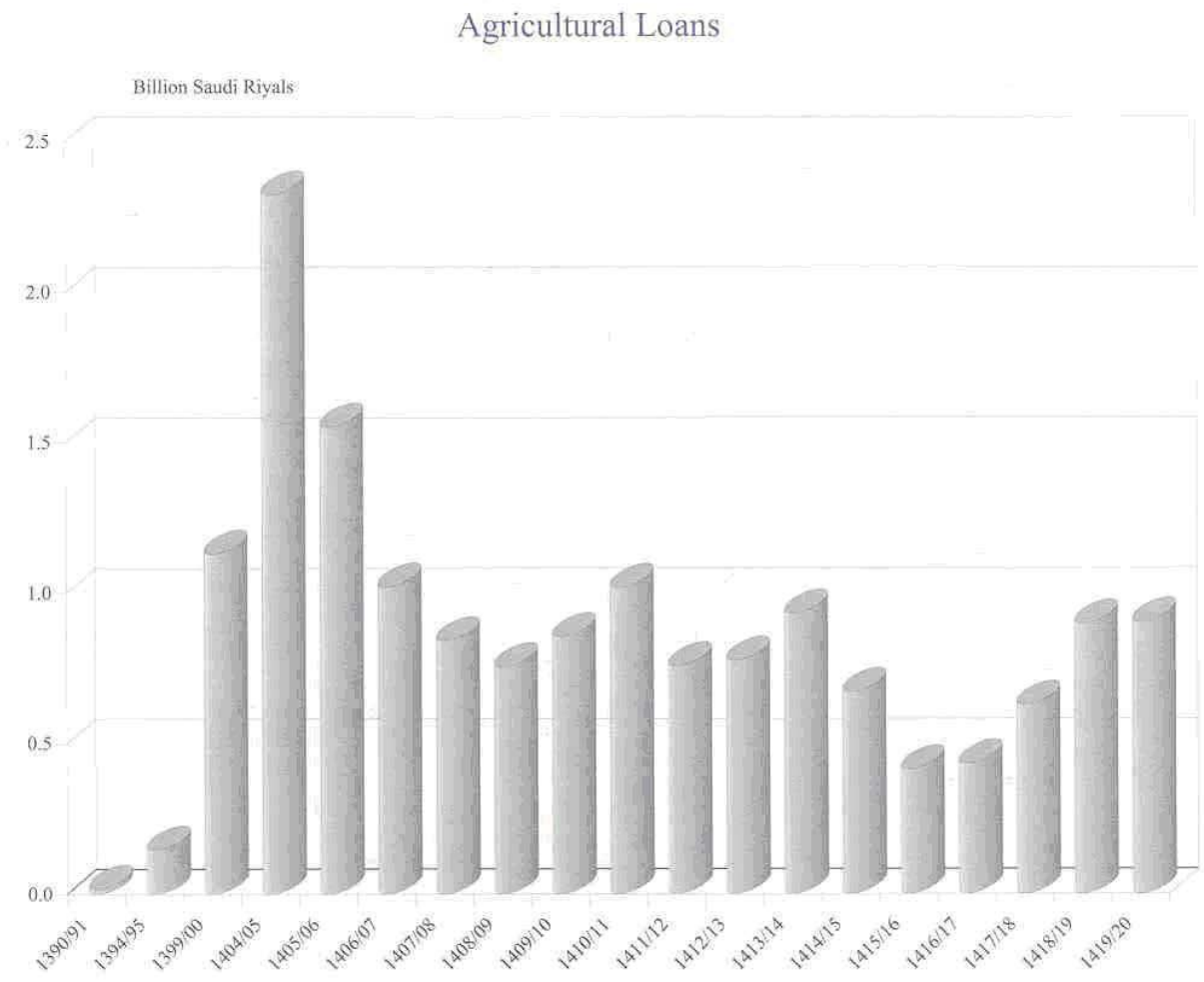


4. Agricultural Credit

Credits extended by the Saudi Arabian Agricultural Bank (SAAB) contributed to the agricultural development. Total (short-term and medium-term) loans rose substantially, especially during the first three plan periods, rising from SR 16.6 million in 1390-91 (1970) to SR. 2.3 billion in 1404-05 (1984). The loans then declined gradually during the fourth plan period to reach SR. 854.3 million in 1409- 10 (1989), but rose to SR. 903 million in 1419-20 (1999). The average annual growth rate of loans extended during that period reached 9.1 percent [7].

Medium-term loans (10 years) has dominated this type of credit since the beginning of the third plan. These loans were channelled towards financing investment in fixed assets such as agricultural machinery and equipment, irrigation pumps, etc. Short-term loans granted to finance seasonal inputs amounted to 26.1 percent of total loans in 1419-20.

Figure-7



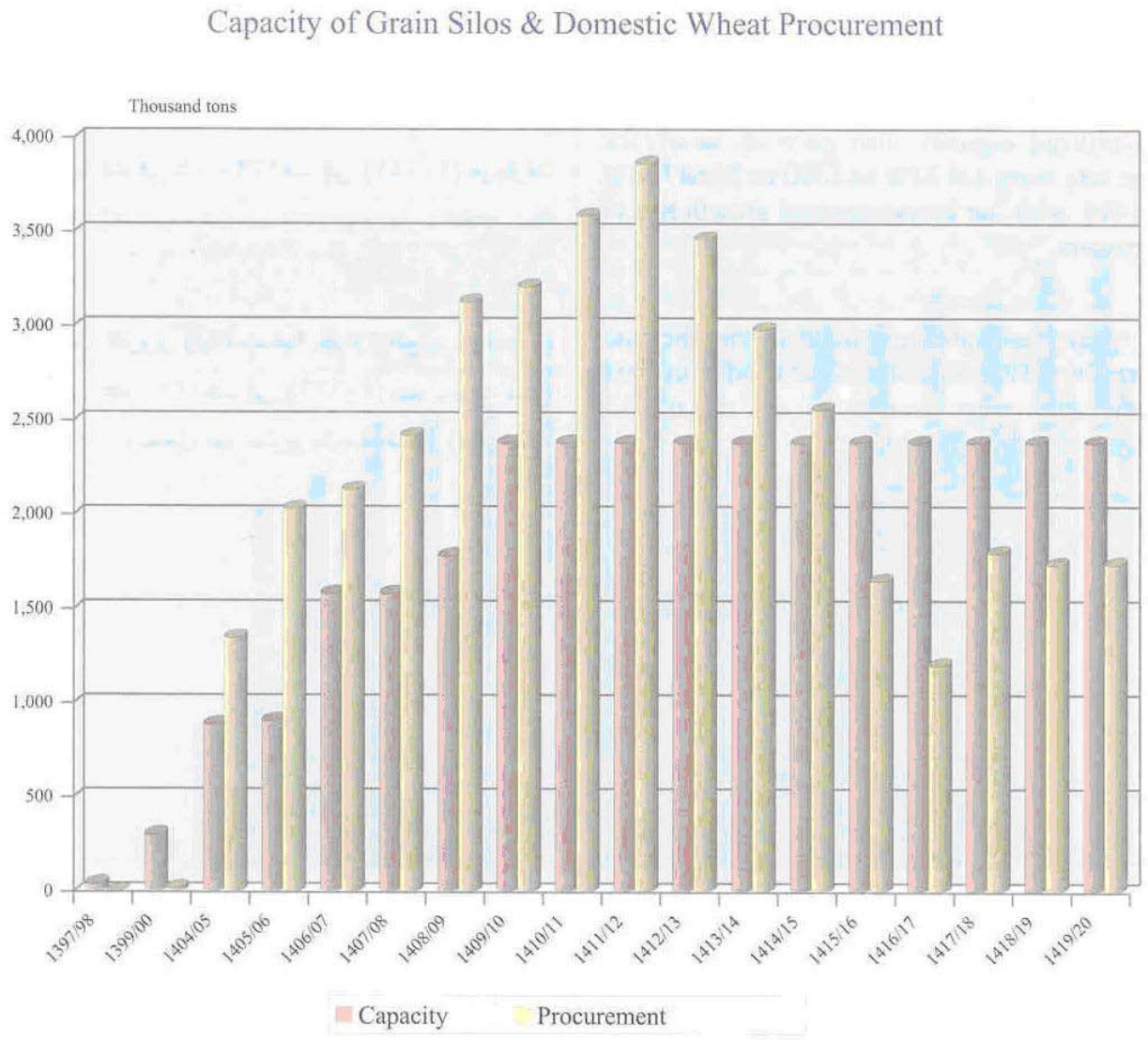
5. Capacity of Grain Silos and Procurement of Domestic Wheat

The storage capacity of grain silos which was only 40 thousand tons in 1397/98 rose gradually to almost 2.4 million tons in 1409/10 and maintained the same level in 1419/20. This reflects the successful implementation of the development policies pursued in the agriculture sector [2].

The quantity of wheat procured from domestic sources in 1419/20 was 1.6 thousand metric tons more than the quantity in 1418/19. In 1419/20, around 1.74 million metric tons of domestic wheat valued at around SR. 2.6 billion were procured, whereas in 1399/1400, 17.5 thousand metric tons costing approximately SR. 61 million were procured.

Flour milling capacity rose from 270 tons per day in 1397/98 to 7020 tons per day in 1419/20.

Figure-8



6. Saudi Water Resources

6.1- Renewable Water Resources

Directly fed by rain, the renewable water resource comprises surface water that collects in wadis and behind dams, and shallow ground water that collects in wadi sediments or cracks and fissures below ground surface. Average annual rainfall varies between 60 and 200 mm/year, with the exception of the Empty Quarter, which is very dry. Compared to other regions of the country, rainfall in the South-Westem region is relatively high, exceeding 600 mm/year in some of the mountainous areas [7].

The volume of renewable surface water is not negligible. An extensive network of dams has, therefore, been built to collect it and utilize it optimally, and these also provide protection against floods, help recharge ground water wells and directly provide drinking and irrigation water.

Currently, there are 223 dams serving various purposes and having various sizes, with a total storage capacity of 835.6 million cubic meters (Table-2). Seventeen dams are under. construction, with a total storage capacity of 979.5 million cubic meters, in addition to fifteen others planned for implementation.

6.2- Non-renewable Ground Water Resources

Ground water which has been stored in sedimentary aquifers for thousands of years has been the main source of water supply for decades. Non-renewable water is a strategic stock that is depletable if not handled with great care and used optimally. The aquifers are still the most important water resource for meeting the water needs for agricultural and municipal purposes. The volume of water utilized from them in 2004 was estimated to be 12,400 million cubic meters.

Table (2): Distribution of Dams by Purpose and Storage Capacity, 2004

Region	Distribution by Purpose					Storage Capacity (million m^3)
	Total	Drinking	Control	Recharge	Irrigation	
Riyadh	60	-	18	42	-	80.4
Makkah	25	2	3	20	-	108.0
Al-Madinah	16	-	6	10	-	80.7
Qassim	3	-	1	2	-	3.1
Assir	64	14	16	34	-	378.1
Hail	17	-	3	14	-	9.3
Jizan	3	1	1	-	1	51.4
Najran	6	-	3	3	-	88.2
Al-Baha	26	1	3	21	1	31.2
Jouf	3	-	3	-	-	5.2
Total	**223**	**18**	**57**	**146**	**2**	**835.6**

6.3- Desalinated Water

The Kingdom ranks first in the world in utilization of sea water desalination technology. It has the largest water desalination capacity, with the volume of produced desalinated water reaching 2.9 million cubic meters per day in 2004. Desalination plants also provide a net contribution of 3,426 MW (megawatts) of electrical power to the national electricity grid.

During the period of the Seventh Development Plan, three additional desalination plants were commissioned in Khobar, Shuaiba and Jubail, with a total capacity of 710,000 cubic meters of water per day and 651 MW of electricity. With these three plants, the number of desalination plants operated by the Saline Water Conversion Corporation (SWCC) reached 30 plants, distributed along the coasts. New plants currently under construction will, by the end of the Eighth Development Plan, add 580 million cubic meters/day to the existing total capacity. In addition, a program for rehabilitation and renovation of existing desalination plants and facilities will be implemented (Figure - 9).

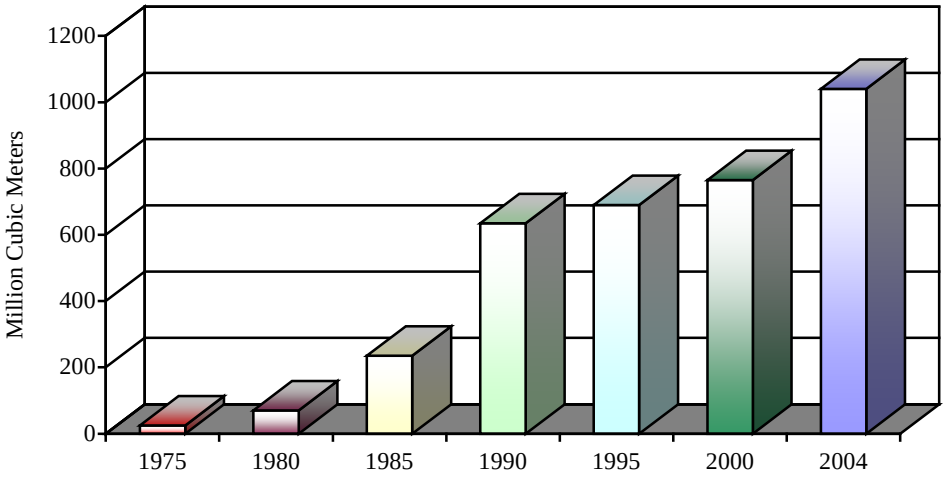
Table (3): Production Capacity of Desalination Plants By end of the Seventh Development Plan (2003)

	Net Water Production Capacity (000 cu m/d)	**Net Power Production Capacity (MW)**
Existing Plants	2,167	2,775
New Plants	710	651
Total	**2,877**	**3,426**

Source: Saline Water Conversion Corporation.

Expansion of production capacity was accompanied by a parallel development of the network of transmission lines and storage facilities. In 2004, the lengths of pipelines reached 4,170 kilometers, and the number of pumping stations reached 30, in addition to 165 water reservoirs, with a total capacity of 9.4 million cubic meters. By the end of the Seventh Development Plan, this expansion enabled desalinated water to cover 51% of the overall water demand for municipal purposes [7 ; 3].

Figure (9): Production of Desalinated Water



6.4- Reclaimed Wastewater

In 2004, the average rate of collection and treatment of wastewater reached 33.5%, rising from 32% in 2000. This rate varies substantially among cities, approaching full coverage in Jubail and Dammam, but ranging between 30% and 40% in Riyadh, Jeddah and Al Madinah. About two thirds of municipal water is not collected and treated, but leaks into the ground, causing a rise in surface water levels in some areas and causing environmental pressures and health hazards. In addition, high leakage prevents making use of the substantial potential in wastewater [7].

Rapid expansion of cities and urban centers had led to past efforts being concentrated on getting rid of wastewater, rather than treating and re-using it in an effective way for appropriate purposes.

In view of the importance of reclaimed wastewater, as an alternative to fresh water for agricultural, industrial and recreational purposes, projects aimed at utilizing reclaimed wastewater for irrigation purposes were launched during the Seventh Development Plan; one of which, covering the area extending from South of Riyadh to Al-Muzahymiah in Riyadh Region, is expected to be operational in 2006 [4].

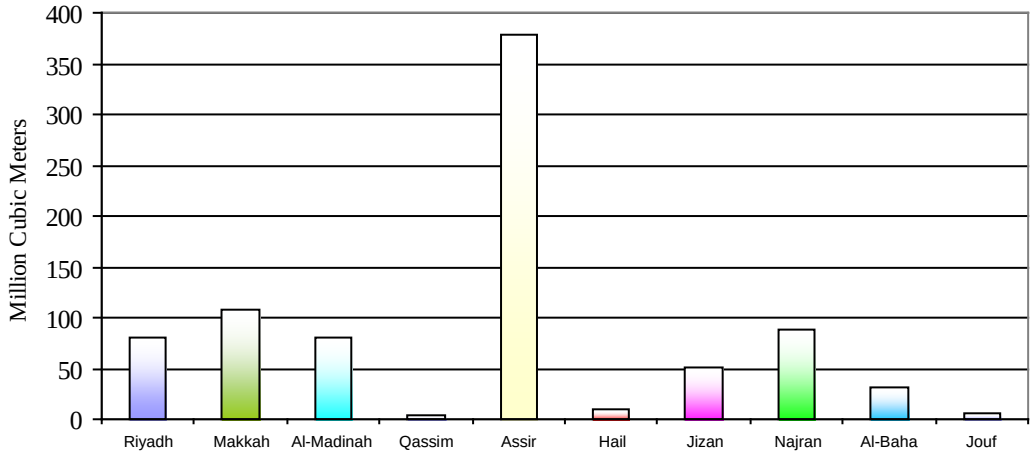
The Al-Hasa Irrigation and Drainage Authority (HIDA) is also expected to utilize fully the treatment plants in Hofuf, Mubaraz and Thoqba; thereby

6.5- Water Dams

6.5.1 The Basic Objectives for Dams Construction

There is no doubt, that while thinking of constructing a dam on a certain valley for serving a city or a region, the purpose for which the dam is built, is considered the important effect of building such dam; yet it never means that the benefit and the revenue of building the dam are restricted to such purposes but there are other purposes integrated with the basic purpose with different impact degrees (Figure-10).

Figure (10): Storage Capacity of Dams, 2004



The basic objectives of building dams can be briefed as follows:

1. To recharge under ground water in the dam area, and provide the wells with water in the agricultural regions, behind the dam.
2. Secure potable water for some regions through the treatment plants built on the dams.
3. Secure irrigation water for farming purposes, through direct irrigation for farmlands behind the dams through irrigation projects organizing the same.
4. Protecting cities and villages from the risks of torrents, dangers of floods and preserving the lives and properties of citizens.

6.6 Types Of Dams In The Kingdom

In view of the differences of the Kingdom terrestrial situation and valley's volume, types of constructed dams shall not be of one definite type, therefore, several types of dams with respect of constructing method to suit the nature of the valley on which the dam is constructed. The constructed dams in the Kingdom are restricted to the under mentioned types:

1. Concrete dams.
2. Earthfill dams.
3. Rockfill dams.
4. Under ground dams.

6.7 Number of Dams in the Kingdom of Saudi Arabia

Due to the vast area of the Kingdom of Saudi Arabia which include several regions where several large and small valleys exist, it is deemed essential to expand in constructing dams and increase their number to match that enormous and large flux of flood water passing through those valleys, to benefit from them and avoid their risks, since the majority of the Kingdom area is overwhelmed by desert lands or high mountains, and residential communities are commonly existing on the banks of the valleys or near them, because they are the place where waters are collected.

The number of executed dams in the Kingdom up to the present amounts to 230 dams, 60 dams in the Riyadh region; 27 dams in Makkah Al Mukarramah Region, 16 dams in Al Madinah Al Munawarrah Region, 65 dams in Aseer Region, 17 dams in Hail region, and 26 dams in Al Baha Region, 6 dams in Najran Region, 4 dams in Qassim Region, 3 dams in Jazan Region, 3 dams in Al-Jouff Region, 2 dams in Tabouk Region, and one dam in Northern Region [7].

It is deemed impossible to say which dam is the most important one, because every dam constitutes greatest importance to the region where it is built. However, it is possible to consider high storage capacity dams as important, such as King Fahad Bin Abdul Aziz Al Saud dam, built on Bisha valley whose capacity exceeds 325 million cubic meters, and Najran Dam which stores more than 86 million cubic meters; and it plays an important role in protecting Najran city from torrents risks which used to overrun it continuously, besides to enhance the underground water storage of the region, in addition to Jazan Dam which stores more than fifty million cubic meters and keeps away the flood that used to overrun the region, for draining them for the irrigation of an integrated agricultural region, whose area exceeds 6000 hectare, through an integrated irrigation project attached to the dam. Good examples of the same are those dams used for securing potable water such as Abha Dam, Al Aqiq Dam, and Truba and ordah Dams (which were constructed underground), and they were built in 1404 H. They are considered two of the first dams to be built in this way, at international level. They have played a great role in securing potable water for Al Taif City.

7. Environmental Effect

7.1- The Effect on Human life

Dams have played a great and basic role in the settlement of the inhabitants in their environment, because they - after the will of Allah Al Mighty - have made water available, which is basic element of life, consequently, they have led to the living stability and the development of life in the regions where dams are built, in addition to the expansion of the residential and farming areas and developing them. For example, Al Aqiq Dam has played a great role in securing potable water for whole region of Al Baha; and therefore the development and progress in the region witness great increase day after day. Al Aqiq Dam in Al Baha region is still the source of potable water in the region. The same role had been played by Truba Dam in securing water to Al Taif region, and Abha Dam and Atoud Dam in Aseer region before connecting desalinated water to them. Also Wadi Fatima Dam played the same role for Jeddah city before providing it with the desalinated water, and Wadi Fatima is still contributing in securing water to Jeddah city.

7.2 - Effect on wild life:

It has been noticed that dams have positive impact on the neighboring region, and also on the back regions through flourishing the vegetation life i.e. all trees and herbs which grow in the dam region, other than farms, and to the development and progress of animal life which reproduce and multiply nearby the dam's lakes. The same applies to various types of birds. The construction of dams has led to the establishment and expansion of the agricultural area by the local inhabitants, besides their great role in enhancing progress and controlling desertification in those regions.

8. Dams And Provision Of Drinking Water

In the light of the huge water amounts stored in dams basins, and the associated development and extension process witnessed by most of the Kingdom's cities and villages, the Ministry of Water & Electricity has adopted the idea of securing drinking water through direct methods from surface or underground dams, where water is continuously available, by constructing purifying plants on the dams or excavating wells behind surface dams, or ahead of underground ones, and consequently conveying water to treatment plants, then to the drinking water network or transmission units by movable water trucks. Hereunder, is a list of those projects:

1. Water treatment plant at Abha Dam.
2. Water treatment plant at Atoud Dam, Khamis Musheit.
3. Water supply project from Al Aqiq Dam to Al Baha.
4. Water project supply from Truba dams to Al Taif City.
5. Water project supply from Aradh dams to Al Baha.
6. Al Kashasha feeding project from Wadi Fatima Dam, for providing Jeddah city with water.
7. Water Treatment Plant at King Fahad Dam in Bisha.

The Ministry of Water & Electricity shall go ahead in building water treatment plants on the appropriate dams, to provide the citizens living in the neighboring areas to these dams which suffer from shortage of potable water resources, with water.

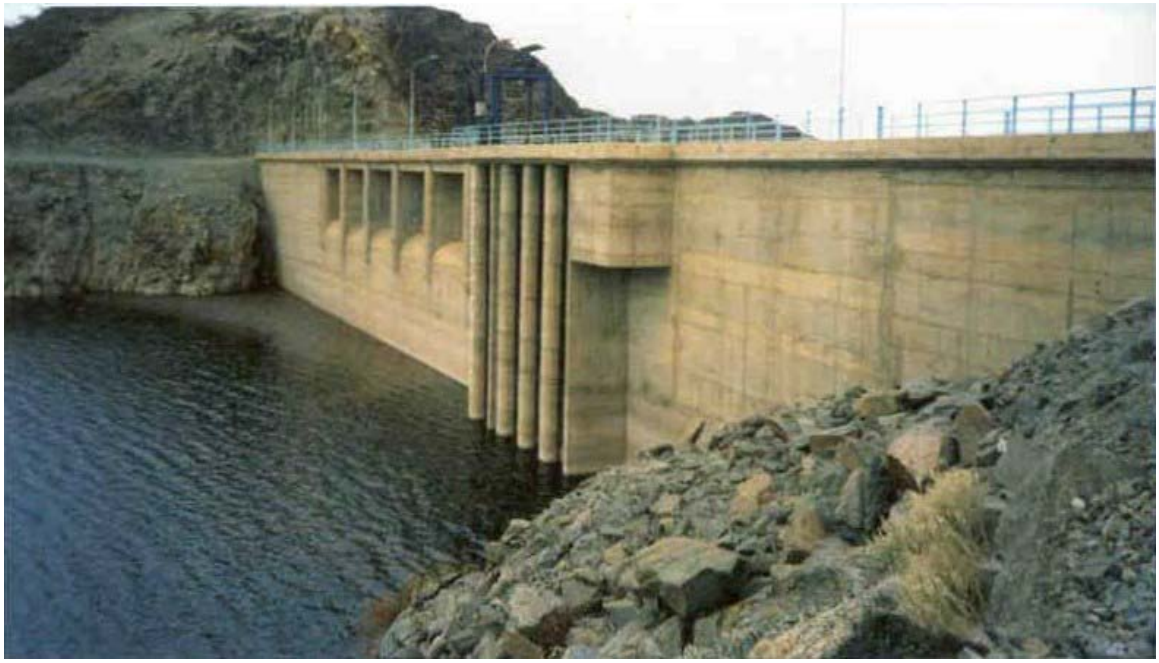
9. Dams Under Construction

230 Dams had been already executed. Now, 25 Dams in the various regions of the Kingdom are currently under construction with total capacity of 1,112,014,230 cubic meters, and 142 dams under-tender.

Figure 11a: Selected Pictures of Some Saudi Water Dams

Dam Area	Aseer
Type of Dam	Concrete
Length	507 M
Height	103 M
Storage Cap.	325,000,000 C.M.
Purpose of the Dam	Recharge
Execution Date	1417 H
Cost	246,000,000 SR

Figure 11b: Selected Pictures of Some Saudi Water Dams



Dam Area	Al-Baha
Type of Dam	Concrete
Length	175 M
Height	30 M
Storage Cap.	22,500,000 C.M.
Purpose of the Dam	Potable
Execution Date	1408 H
Cost	

Figure 11c: Selected Pictures of Some Saudi Water Dams

Dam Area	Riyadh
Type of Dam	Earthen
Length	554 M
Height	14 M
Storage Cap.	3,000,000 C.M.
Purpose of the Dam	Recharge
Execution Date	1397 H
Cost	24,000,000 SR

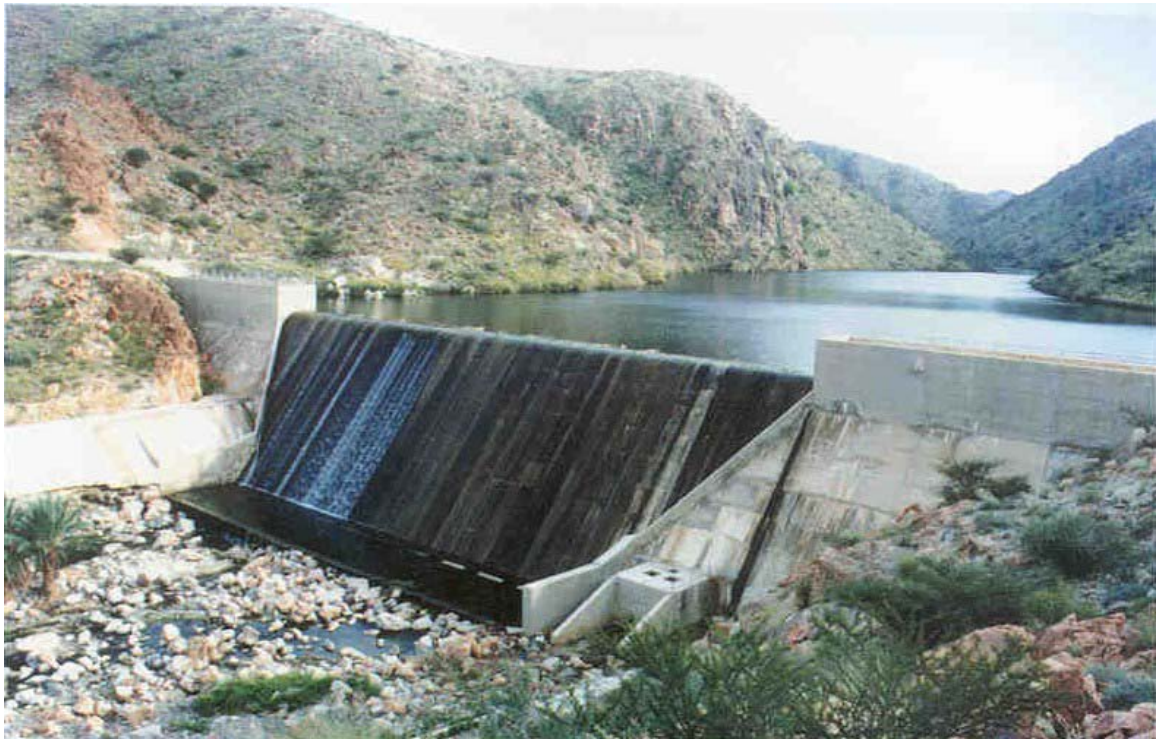
Figure 11d: Selected Pictures of Some Saudi Water Dams

Dam Area	Riyadh
Type of Dam	Earthen
Length	500 M
Height	12 M
Storage Cap.	1,000,000 C.M.
Purpose of the Dam	Recharge
Execution Date	1402 H
Cost	19,400,000 SR

Figure 11e: Selected Pictures of Some Saudi Water Dams

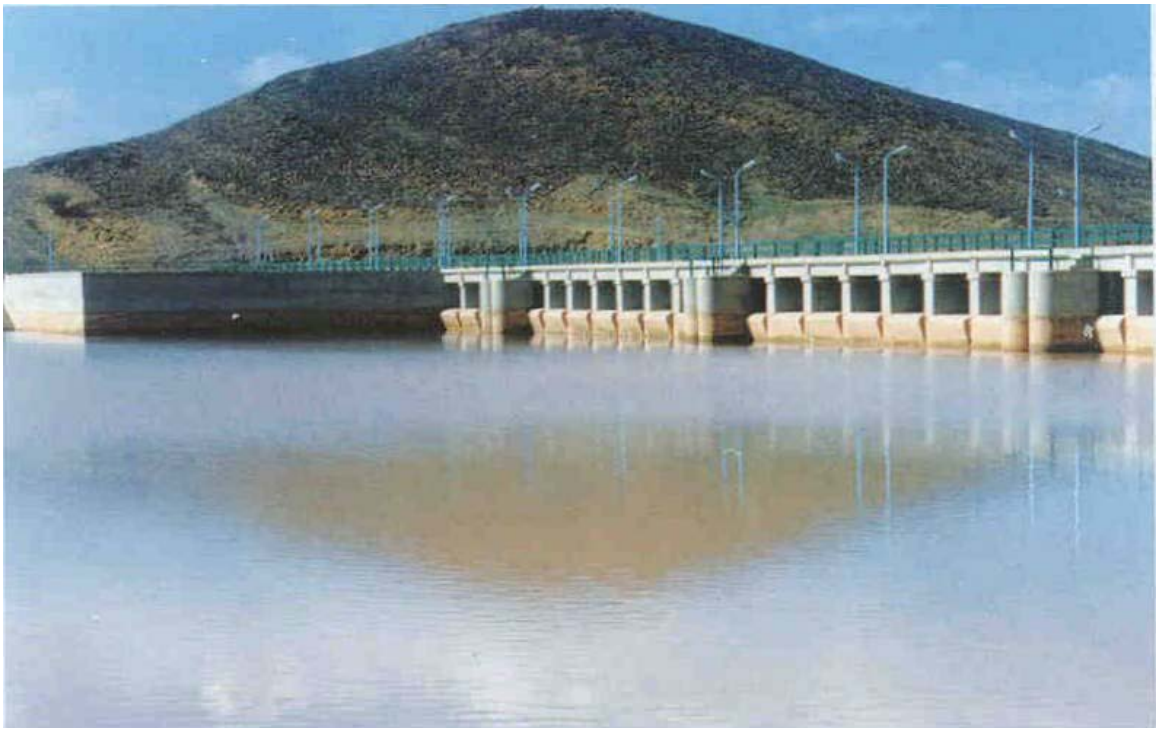
Dam Area	Makkah
Type of Dam	Concrete
Length	380 M
Height	21 M
Storage Cap.	20,000,000 C.M.
Purpose of the Dam	Recharge
Execution Date	1401 H
Cost	121,000,000 SR

Figure 11f: Selected Pictures of Some Saudi Water Dams



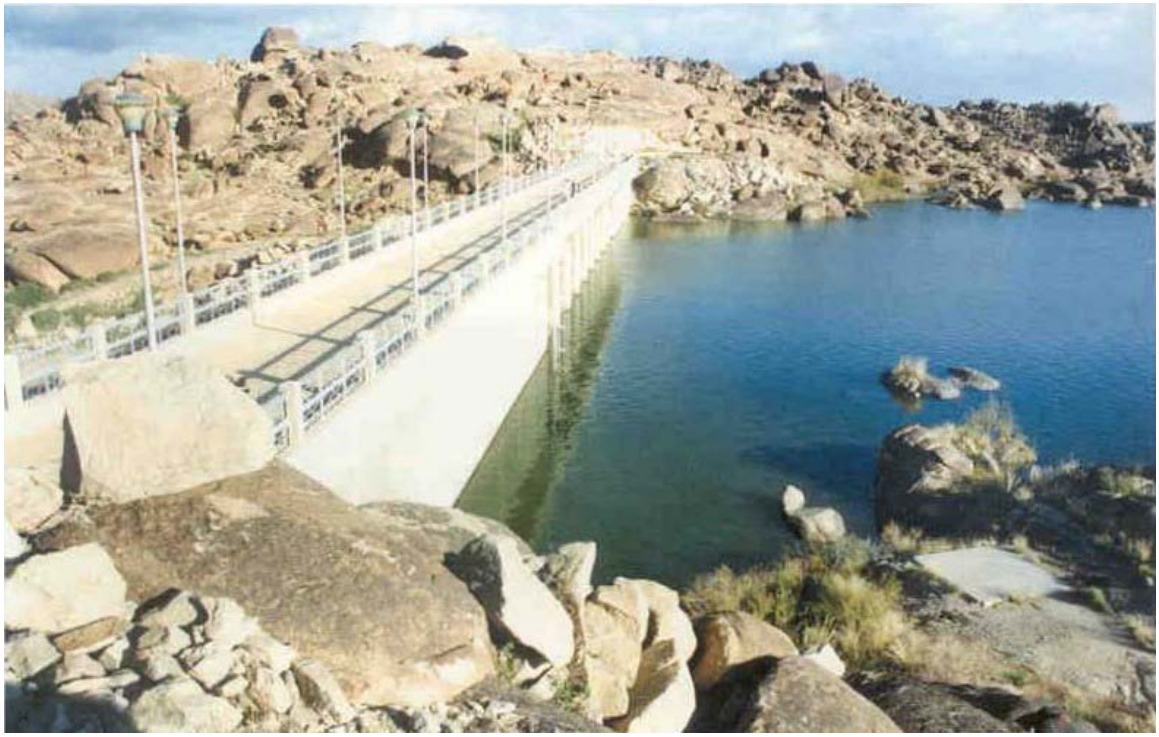
Dam Area	Makkah
Type of Dam	Concrete
Length	150 M
Height	27 M
Storage Cap.	1,500,000 C.M.
Purpose of the Dam	Recharge
Execution Date	1408 H
Cost	4,000,000 SR

Figure 11g: Selected Pictures of Some Saudi Water Dams



Dam Area	Al-Madinah
Type of Dam	Concrete
Length	450 M
Height	11 M
Storage Cap.	7,000,000 C.M.
Purpose of the Dam	Recharge
Execution Date	1399 H
Cost	17,000,000 SR

Figure 11h: Selected Pictures of Some Saudi Water Dams



Dam Area	Aseer
Type of Dam	Concrete
Length	120 M
Height	24.5 M
Storage Cap.	4,200,000 C.M.
Purpose of the Dam	Potable
Execution Date	1404 H
Cost	22,000,000 SR

Figure 11i: Selected Pictures of Some Saudi Water Dams

Dam Area	Aseer
Type of Dam	Concrete
Length	75 M
Height	13 M
Storage Cap.	150,000 C.M.
Purpose of the Dam	Recharge
Execution Date	1407 H
Cost	6,000,000 SR

Figure 11j: Selected Pictures of Some Saudi Water Dams

Dam Area	Tabouk
Type of Dam	Earthen
Length	401 M
Height	12 M
Storage Cap.	1,552,800 C.M.
Purpose of the Dam	Recharge
Execution Date	1427 H
Cost	7,229,840 SR

10. Saudi National Water Campaign

The Ministry of Water and Electricity started huge water campaign during the year 2005 and the years after. The main objecctive of the national campaign is to spread awareness among water consumers to save and use water wisely. The main consumer attraction and effective display symbol of the campaign is "**Decision is yours**".

The national campaign had four stages:

1. Distributing water saving devices to house hold sector.
2. Distributing water saving devices to Government building sector.
3. Distributing water saving devices to the private sector.
4. Distributing shower devices to all water consumers.

Some valuable results of the campaign:

1. Reducing the household consumption of water by 30%
2. Reducing the water consumption in government building sector by 25 – 50%
3. Distrubuting more than 3 million water saving device bags to house hold consumers.
4. Distrubuting more than 1.6 million water saving device bags to government building sector
5. Distrubuting more than 1.5 million water saving device bags to the private sector buildings.
6. Sold more than 309 thousand shower saving devices.

Due to the efforts that had been made by the Ministry of Water and Electricity in raising the awarness of water consumers to use water in rational manner, some valueable achievements were made. The ministry had received many national and international rewards and letter of thanks and acknowledgements for conservation and saving the water resources in the Kingdom.

Now the symbol "**Decision is yours**" is well known in the Kingdom of Saudi Arabia.

Figure 12a: National Water Saving Campaign

Figure 12b: National Water Saving Campaign

Figure 12c: National Water Saving Campaign

Figure 12d: National Water Saving Campaign

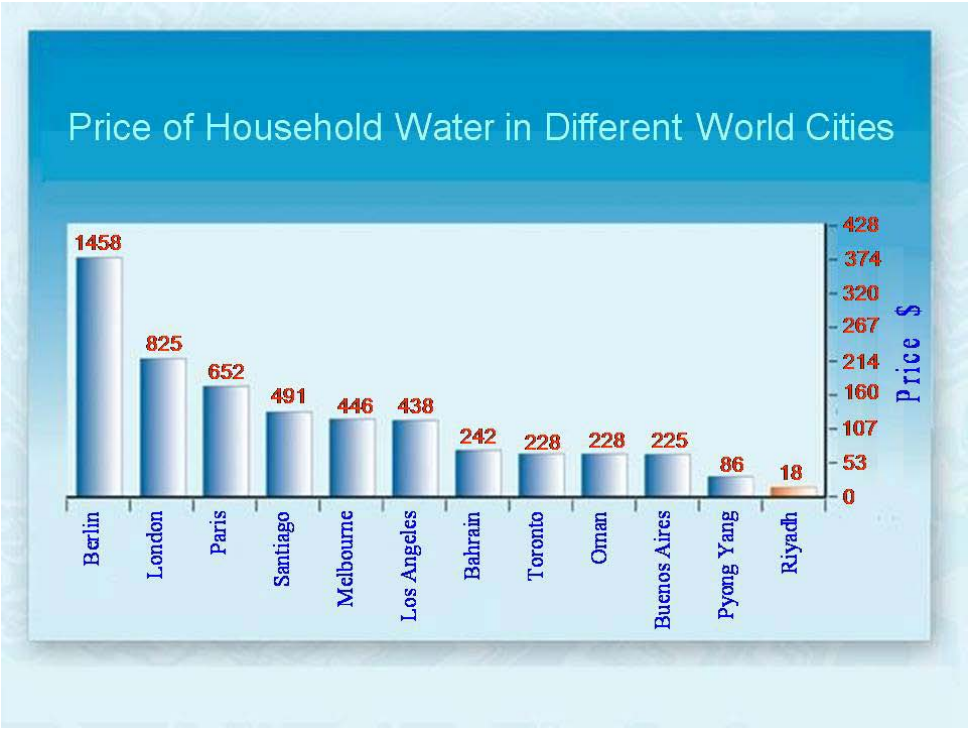


Figure 12e: National Water Saving Campaign

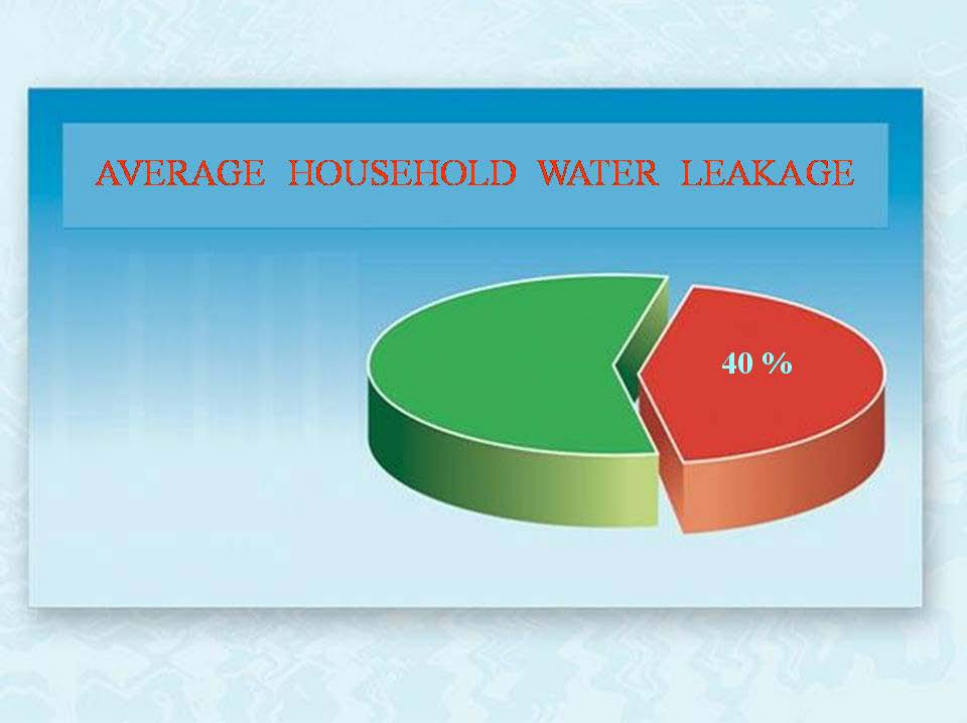


Figure 12f: National Water Saving Campaign

Figure 12g: National Water Saving Campaign

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