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INTRODUCTION:

At first glance the results seem impressive. In less than ten years Saudi Arabia has turned itself into the breadbasket of the Arabian peninsula. Between 1970 and 1985, wheat production grew to over 2 million ton per year. During that period, the increase in Saudi wheat production accounted for 80 percent of the rise in wheat production for the entire Middle East and North Africa (Middle East Report, 1987:7). Wheat production is now exceeding domestic consumption by 65 percent. To achieve this, the Saudi government initiated a series of high subsidies directed toward increasing wheat and other food production to stabilize the basic food prices.

Wheat has the lion's share of those subsidies. Wheat farmers subsidies include free land, grants, a 45% subsidy on farm implements, interest free loans, and 50% subsidy on fertilizer, engines and pumps. As a result, the Kingdom accomplished the goal of self-sufficiency in wheat production in 1984 plus and exportable surplus.

The Arab Oil embargo of 1973 and the capability shown by the Arab Oil exporting countries to use supply embargo as a political weapon during and after the 1973 Arab-Israeli war, has made the Saudis aware of the use of similar sanctions on food exports (such as wheat) by the food exporting countries (Al-Abrahem, 1987:1). Consequently, agriculture has a new status as the consciousness of a "food security" danger becomes the justification of these generous subsidies. Since the Mid 1970s, the government has constantly stressed attainment of greater food security. The third five year plan called for a prudent level of self-sufficiency in food production. The apparent success in reaching more self-sufficiency in certain food items has been achieved at tremendous cost. These costs can be classified into direct costs and indirect costs.(Gardner, 1985: 35-41)

The direct costs have been high in several dimenstions. First: costs of imported inputs: the rapid expansion in wheat production was accompanied by growth in the reliance on imported agricultural inputs. Second: producer's subsidies: inflated wheat procurement prices represent a financial burden on the government budget. Third and most important of all, is environmental costs: the center pivot irrigation system, which is used in wheat irrigation, relies exclusively on deep wells. Water in deep Saudi Aquifers will not be replaced by nature in the future, and there is a high possibility of salination of these aquifers under the current high extraction rate.

Indirect costs include the significant declines in sorghum, barely, and millet production resulting from the artificially high wheat procurement price as acreage was shifted from these crops to wheat. This had led to an increase in the quantity of other imported grains.

In the light of these problems, the government lowered the wheat procurement price from SR 3.5 to SR 2.00 per Kg. with guarantees to maintain this until 1989.* As mentioned before, food security was the major factor behind the agricultural expansion in Saudi Arabia. In this paper we are intending to examine whether or not the achievement of the current food security goal is by itself endangering future food security. In other words, would current food security policy lead to future food insecurity as water resources become insufficient in the future?

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* one US$ equals 3.78 Saudi Riyals in July 1989.

II- OBJECTIVE OF THE STUDY:

This research is dealing with the economic and environmental viewpoint, therefore, it is concerned with the possible ecological effects of current agricultural practices. However, there can be no doubt that the Saudi government authority have excellent strategic and social reasons for their policy toward wheat and other agricultural production in the Kingdom.

The objective of this research is to look at the water resources and the wheat industry in Saudi Arabia; and show how food and water security goals are in conflict with each other; and finally, a conclusion and recommendations on how to preserve future water and maintain food security for generations to come will be drawn.

III- METHODOLOGY:

A VISICALC program on an Apple II computer will be used to estimate the remaining reserve of non-renewable water resources and the cumulative payments to wheat producers and the cumulative water use by wheat and other agricultural crop.

The VISICALC program will be run using four scenarios. In the first scenario we assume wheat production is frozen at the 1986 level of 2.048 million tons a year. In the second scenario we assume the reduction of wheat production to the self-sufficiency rate of .7 million tons a year, in the third scenario we assume wheat production to grow at 1 percent annually. And finally in scenario four we deal with the growth in self-sufficiency rate of 1 percent annually. In all four scenarios, the effect on the stock of water resources and the economic costs will be shown in tables 9-12.* figure 5-8.

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* The worksheet for tables 9-12 are provided in the Appendix.

IV- WATER RESOURCES IN SAUDI ARABIA:

Water shortages in the Arabian peninsula in general are not new. Saudi Arabia in particular, which covers more than four fifths of the Arabian peninsula, has always desperately needed more water. Containing to rivers whatsoever, the country is one of the largest and most arid in the Middle East. The water resources of Saudi Arabia, like those of every other part of the globe, are dependent upon climate, topography, and geographical formation. Because its land area is desert, it is not surprising that Saudi Arabia has a "water problem". Thus, ground water is the main source of irrigation, as well as the most limiting factor in agriculture.

In addition to Saudi Arabia's scarce water resources base, continued rapid agricultural development and use of its non-renewable ground water supplies portend the possibility of exhaustion of that resource at some time in the future due to scarcity of rainfall and excessive irrigation development, the annual withdrawals of ground-water exceed natural recharge in most areas in Saudi Arabia. This process could render the supply of ground water to economic and/or physical exhaustion (Battal, 1986:2)

Over the country as a whole rainfall averages about 75mm annually. Rainfall in the northern, eastern and south-eastern part of the country is very limited. The higher rainfall is in parts of the highland areas of the southwest which may receive about 800mm annually (Table 1).

The fact that there is a limited water supply has led to huge expenditures on irrigation projects and construction of desalination plants. Desalination is by far the most highly developed technology of fresh water production. The current 25 desalination plants are playing a major role in Saudi Arabia's water supply for the urban

TABLE 1

Rainfall According to Meterological Stations 1979-85
(Millimeters)

Station	1979	1980	1981	1982	1983	1984	1985
Riyadh	22.8	63.8	21.8	129.3	64.1	83.7	71.8
Jeddah	107.4	34.4	14.5	0.4	5.7	6.9	71.4
Mekkah	-	-	-	-	-	38.3	123.5
Taif	146.1	80.3	221.0	220.0	142.6	87.5	285.0
Dhahran	56.5	65.9	44.0	329.8	93.9	60.2	67.9
Tabouk	60.0	25.0	2.2	65.5	5.3	27.1	76.8
Qassem	115.7	106.6	170.7	460.3	200.6	85.5	140.5
K.Mushait	192.9	191.4	204.3	160.3	231.1	76.0	198.8
Abha	-	-	-	-	-	121.0	274.4
Al-Baha	-	-	-	-	-	45.8	217.6
Bisha	108.9	28.8	46.0	144.5	38.8	46.4	189.4
Sharurah	-	-	-	-	-	-	7.3
Najran	53.9	17.6	65.2	129.7	132.9	57.4	75.6
Medina	62.1	6.8	53.4	151.0	25.3	74.1	120.2

Source: Kingdom of Saudi Arabia, Ministry of Finance and National Economy, Central Department of Statistics, Statistical Yearbook, 1985-1986,p.4.

centers, providing 1,829,293 cubic meter per day in 1986 (SAMA, 1986: 113). Consequently, expansion in the construction of desalination plant is expected to play further major role in Saudi Arabia's future water supply.

Surface and Ground Water:

Water resources in the Kingdom can be divided into four categories: (Fourth Development Plan, 1985-90: 133).

1. Surface Water:

Surface water occurs mainly in the west and south-west of the country where rainfall is sufficient to produce runoff. It is estimated that a potential surface water supply of upto 900 million cubic meters can be utilized annually through the efficient use of dams.

2. Ground Water:

There are two types of aquifer in the Kingdom: Renewable and Non-renewable. Most renewable ground water is already in use by traditional agriculture and household use.

The non-renewable ground water is stored in principal and secondary aquifers, both of which receive no recharge. These aquifers supply more than 70 percent of the Kingdom's water needs (Ibid: 133). While renewable ground water supplied are estimated to continue at levels of around 950 million cubic meters per year, the intensive development of non-renewable ground water during the Third Plan has resulted in a rapidly rising rate of depletion of this valuable resources. Proven reserves from the seven principal aquifers amount to 337,500 million cubic meters, as shown in Table 2.

TABLE 2

Non-Renewable Water Resources
(Million cubic meters)

Principal Aquifer	Proven Reserve
Wasia/Riyadh	89,000
Wajid	69,000
Um Er Radhuma	65,000
Minjur/Dhurma	53,400
Saq	49,000
Tabuk	5,600
Dammam	5,000
Total	337,500

Source: Kingdom of Saudi Arabia, Ministry of Planning, Fourth Development Plan, 1985-1990: p. 135.

Together with secondary aquifers, total proven non-renewable groundwater reserve amount to approximately 500,000 million cubic meters.

3- Desalination Seawater:

Desalinated seawater is an important resource for drinking water in Saudi Arabia. The Kingdom now has the largest desalination plants in the world. In 1985 saline water conversion corporation's (SWCC), operated 20 water desalination plants on the west coast and 5 on the east coast. Total water capacity increased almost tenfold during the Third Development Plan, to reach a level of 400 million cubic meters per year by 1985. Desalination water is mixed with brackish groundwater to produce drinking water for domestic consumption. However, because of the high costs associated with current desalination production, desalinated seawater cannot presently be regarded as a viable long-term substitute for groundwater in meeting domestic consumption needs.

4. Reclaimed Waste Water:

The reclamation of waste water is in its early stages of development in the Kingdom, requiring extensive treatment and control in accordance with strict water quality standards. An improvement of sewage networks and advanced technological treatment have resulted in the ability to utilize this resource for irrigated landscaping and for industrial use only. It is estimated that around 100 million cubic meters per year of reclaimed waste water had been made available for use by the end of 1985, and it is expected to double during the 1986-1990 period. Figure 1 shows the distribution water resources in the Kingdom in the four major categories.

The Distribution of Water Resources (supply) in the Kingdom

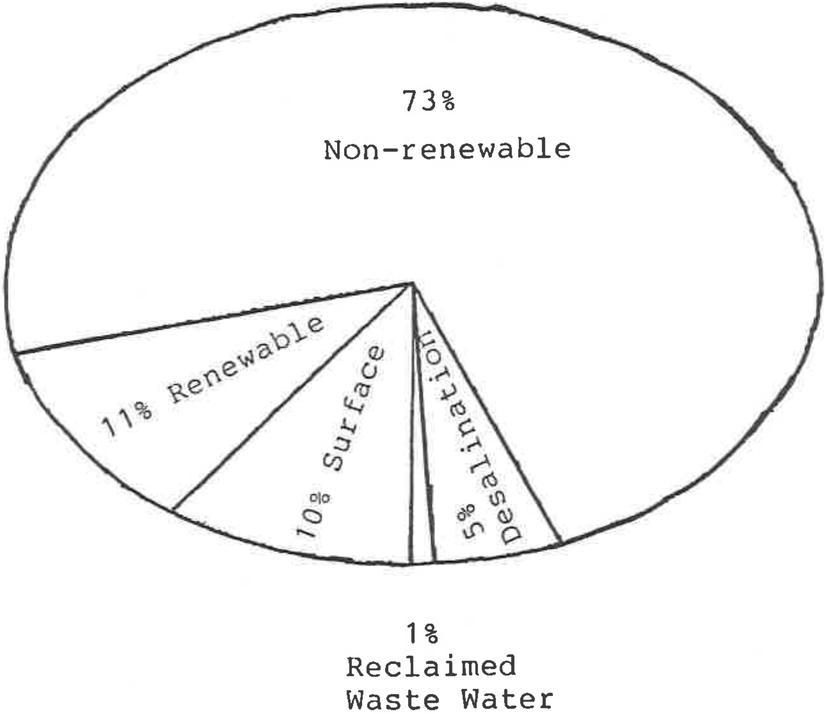


Figure 1.

Water Demand:

Of the three enduser categories - domestic, agricultural and industrial - agricultural demand for water increased sharply during the third plan: From less than 2,000 million cubic meters per year in 1980 to 7,430 cubic meter per year in 1985, or 84 percent of total consumption. Over 70 percent of this water comes from the Kingdom's non-renewable groundwater reserves Table 3, figure 2.

Because of climatic conditions and the chemical composition of both soil and water in Saudi Arabia, there is a constant danger of increasing soil salinity, which may lead to a situation in which cultivation is no longer possible. The degree of soil salinity and its increase depends on the quality of irrigation water, intensity of cultivation, soil characteristics, and irrigation practices. To a certain degree crops are tolerant to salt. Salt also can be removed by applying an amount of water higher than actual crop requirements. The surplus percolates through the soil along with the salt. This procedure, known as "leaching", may be accomplished by using water applications in excess of normal irrigation requirements. This leaching procedure explains why Saudi agriculture needs more water than normal for irrigation.

During the first four years of the third plan, 435,000 hectares of cultivable land were distributed to the private sector by the Ministry of Agriculture and Water. Over 90 percent of all land relies mainly on non-renewable groundwater for its water needs. The spectacular growth in agricultural production had led to extensive depletion of non-renewable water resources in some areas. As the aquifer depletion rates in several areas are approaching critical levels, immediate measures are required for individual locations, such as controlling and rationalizing water consumption.

TABLE 3

National Water Resources-Demand Balance

	Million cubic Meters per year		Percentage Share
	1980	1985	1985
Demand:			
Agriculture	1,860	7,430	84
Domestic, Industrial ,other	502	1,400	16
Total	2,362	8,830	100
Resources:			
Surface water	485	900	10
Ground water:			
Renewable	660	950	11
Non-renewable	1,154	6,480	73
Desalination seawater	63	400	5
Reclaimed wastewater	-	100	1
Total	2,362	8,830	100

Source: Kingdom of Saudi Arabia, Ministry of Planning, Fourth Development Plan, 1985-1990, p. 139

NATIONAL WATER RESOURCES: THE DEMAND FOR WATER IN DIFFERENT SECTORS IN THE KINGDOM

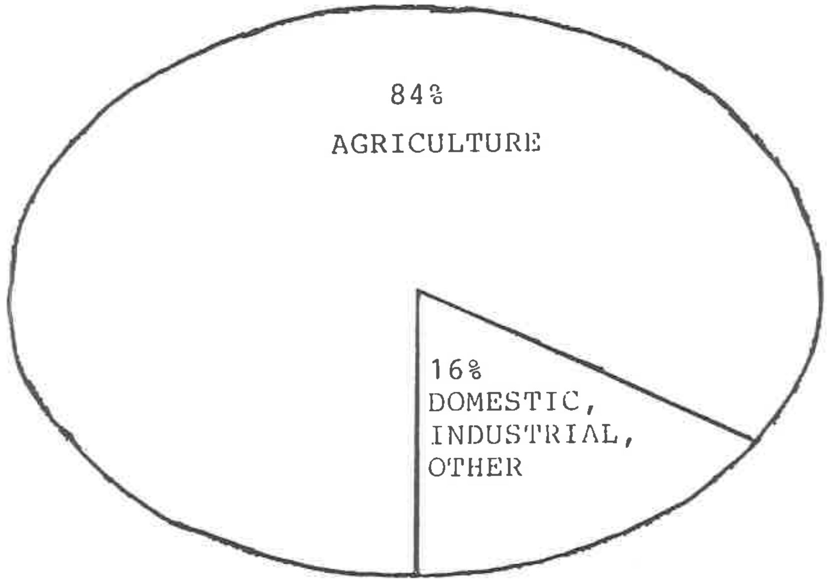


Figure 2

V- THE WHEAT INDUSTRY IN SAUDI ARABIA:

There are two types of wheat production practiced in Saudi Arabia, and they differ according to type of irrigation. Wheat produced on land with controlled irrigation, where water is supplied from deep wells is located mainly in Qassim, Hail, Riyadh, and the inner South. Wheat produced on land under rainfed conditions is located in the mountain region of the inner South.

The irrigated wheat area increased more than eight times between 1971 and 1983, and accounts for 97 percent of the total wheat area in 1983, as compared with 78 percent in 1971.

On the other hand, rainfed wheat area, as a percentage of the total wheat area, has decreased to 3 percent in 1983, compared with 30 percent in 1975 (Bulletin of Agricultural Statistics, 1970-83). The decrease in the relative importance of the rainfed wheat area is attributed to inadequate rain in the south and heavy government investment in irrigation development (Table 4). Average wheat yield grew at a striking rate during 1971-85, while the country experienced a significant decline in other main grain crops such as barley, sorghum, and millet production resulting from the artificially high wheat procurement price as acreage shifted from these crops to wheat (Table 5), because high price support, adoption of high-yielding wheat varieties, extensive use of fertilizer, and irrigation development, all boosted wheat yield. Total wheat production has increased from 41,908 metric tons in 1971 to 2,047,653 metric tons in 1985.

Wheat Utilization:

Saudi wheat passes through a number of outlets. While 95 percent of the available wheat supply was channeled to food consumption and stockpiling, only 5 percent was used as seeds or wasted. The

TABLE 4

Wheat Areas and Production in Saudi Arabia

Year	Area (donems)			Domestic Production (metric tons)		
	Irrigated	Non-Irrigated	Total	Traditional Farm	Specialized Farm	Total
1970			366,000			
1971	234,782	66,221	301,003	41,908	-	41,908
1972	286,535	100,674	387,210	38,954	-	38,954
1973	239,967	71,678	311,646	63,719	-	63,719
1974	657,730	174,839	832,570	153,385	-	153,385
1975	434,707	186,303	621,011	132,038	-	132,038
1976	573,089	154,368	737,457	92,540	-	92,540
1977	555,937	160,054	715,991	124,610	-	124,610
1978	479,591	119,532	599,123	119,928	-	119,928
1979	502,738	167,253	669,991	140,767	-	140,767
1980	558,747	113,513	672,260	141,732	-	141,732
1981	705,845	29,171	735,016	187,222	12,208	199,430
1982	1, 330,270	16,326	1,346,596	358,121	58,614	416,735
1983	1, 967,462	59,059	2,026,521	630,000	187,478	817,478
1984	N.A.	N.A.	4,041,000	835,040	566,960	1,402,000

Source: Saudi Arabia Ministry of Agriculture and Water, Dept. of Economic Studies and Statistics. Bulletin of Agricultural Statistics-Current Sample Survey. Riyadh, Saudi Arabia, various issues, 1970-83.

TABLE 5

Area Planted in Donems and Production in Metric Tons of the Main Grain Crops in Saudi Arabia for Selected Years During the 1972-85 Period

Crop	1972	1975	1980	1983	1984	1985
Wheat						
Area	387,210	621,011	672,260	2,026,521	4,040,792	5,754,775
Production	38,954	132,038	141,732	630,019	1,401,644	2,047,653
Barley						
Area	152,843	70,580	44,027	9,325	10,350	12,682
Production	9,318	16,710	5,461	1,851	2,157	2,149
Sorghum						
Area	813,016	2,369,656	3,497,004	592,389	213,987	110,457
Production	52,360	127,866	109,341	47,088	18,875	7,616
Millet						
Area	150,329	363,428	297,657	103,546	16,490	24,404
Production	7,770	10,598	8,625	7,478	2,012	2,271

Source:
1. Statistical Yearbook 21 & 22 Issue, Ministry of Finance and National Eoonomy, Central Department of Statistics 1985-86.
2. Bulletin of Agricultural Statistics - Current sample survey, Ministry of Agriculture and Water, Riyadh, various issues 1970-83.

use of wheat as feed, or for industrial purposes, is negligible. Very small volumes are consumed in the form of spaghetti, noodles, and macaroni. Most of the wheat is used in making regular Western bread and Arab pita bread, as well as different types of bakery products. (Al-Abrahem: 9)

Who Buys the Saudi Wheat Crop:

Until the late 1970's wheat production was largely for the subsistence of farm families, or for sale in local markets. Generally, farmers sold their marketable wheat surplus immediately after harvest since they needed immediate cash and lacked adequate storage facilities and road networks linking the wheat production areas with the urban centers. In view of this problem, local market were the sole outlets for wheat farmers. In addition, the Saudi farmers generally obtained low price for their product due to a combination of factors such as lack of price information on other markets, as well as their poor bargaining power, lack of recognized standard and grades of wheat, which often resulted in low prices paid for a good quality product. Added to this was conclusion of wholesalers to purchase the farmers' products at a low price. All this resulted in a very low price to Saudi farmers, while the wholesalers reaped high profits (Tamimi, 1978).

The Saudi government established the Grain Silos and Flour Mills Organization (GSFMO) in 1972, with the main aim of attaining a strategic balanced stockpile of cereals in accordance with the Kingdom's needs. It was not until 1977 that the GSFMO went into operation.

In the late 1973, the Saudi government introduced a wheat subsidy program of 0.25 SR on every Kg. of wheat produced. This subsidy was paid to farmers in addition to the prevailing market price they received for their product. The government only provided the subsidy and did not buy wheat from the farmers.

In 1978 the government intervened in the markets more directly. The Grain Silos and Flour Mills Organization purchased wheat directly from farmers at SR2.5 per Kg. In 1979 the wheat price was raised to SR3.5 per Kg. The price support provided remarkable incentives which raise the wheat production from 141,732 metric tons in 1980 to 1,401,644 million tons in 1984. The government initially did not purchase all the wheat produced because of limited storage facilities. For instance, only 3% of total wheat production was bought by the government in 1978. However, by 1984 the quantity bought had increased to 96% of total production (Table 6). The amounts that were not purchased by the government were sold by farmers in the open markets.

In 1984, the Kingdom announced the achievement of self-sufficiency in wheat production. In 1986 Saudi Arabia exported more than 1.2 million tons of wheat from a total production of about 2.3 million tons. In addition to export, Saudi Arabia makes gifts of wheat to Arab countries. It approved on September 21, 1987 a gift of 100,000 tons to Iraq while Syria received a similar amount. Egypt was given 200,000 tons in August 1986. Indonesia was the leading importer of Saudi wheat with 240,000 tons in 1986 followed by Jordan at 202,000 and South Korea at 200,000 and lately in early 1988, Saudi Arabia exported wheat to the Soviet Union (Saudi Gazette Sept. 30, 1987).

TABLE 6

Market Outlets for Domestic Wheat Production in 1970-84

Year	Amt. of Wheat Production Delivered to the GSO (Metric tons)	Amt. of Domestic Wheat sold in the Market (Metric tons)	Total Domestic Wheat Production (Metric tons)	% of Wheat Delivered to GSO	% of Wheat sold in Market
1970	-	135,000	135,000	0	100
1971	-	72,000	72,000	0	100
1972	-	39,000	39,000	0	100
1973	-	63,719	63,719	0	100
1974	-	153,385	153,385	0	100
1975	-	132,038	132,038	0	100
1976	-	92,540	92,540	0	100
1977	-	124,610	124,610	0	100
1978	3,297	116,631	119,928	3	97
1979	17,505	123,262	140,767	12	88
1980	32,882	108,850	141,732	23	77
1981	85,435	113,995	199,430	43	57
1982	239,690	177,045	375,000	64	36
1983	674,631	142,847	817,478	82	18
1984	1, 346,943	54,706	1,401,649	96	4

Source: Al-Abrahem, An Econometric Analysis of Supply and Demand of Wheat in Saudi Arabia, unpublished Ph.D. dissertation, WSU, 1987: p. 16.

VI- WATER SECURITY VS FOOD SECURITY: THE CONFLICTING GOALS:

The loss of the Saudi government's confidence in the willingness of the major food exporting countries to supply food purely as a commercial transaction motived the Saudi policy makers to introduce a series of very high subsidies to farmers in order to attain food self-sufficiency and stablize prices of the basic foodstuffs. As a result of these generous subsidies, the Kingdom claims it achieved the goal of food security in wheat production in 1984. But this claim to wheat self-sufficiency is open to question, since most of the seeds, pesticides, insecticides and farm labor equipment and spare parts are all imported. As we have seen in the introduction, the apparent success in reaching food security goal is been achieved at high costs. The most important cost, in our opinion, is the environmental one. The center pivot irrigation system, which is used in wheat irrigation, relies exclusively on deep non-renewable aquifer. Water in deep Saudi aquifers will not be replaced by nature in the future and there is a big possibility of salination of this aquifers under the current high extraction rates. The withdrawal of groundwater is so great that concerned people are worried about the future of agriculture in Saudi Arabia and the danger that depletion of groundwater may bring.

The agricultural expansion in the Kingdom requires an incredible amount of water from non-renewable resources. Wheat production has increased to remarkable level, irrigated agriculture uses more than 90 percent of the total amount of water used, about 40 percent of this water is used to grow wheat (Table 7, Figure 3). What is alarming is that about 90 percent of the water consumed comes from non-renewable aquifer. The present over-exploitation of the fossil water reserves contained in these aquifers will cause future water insecurity and, as a result, future food insecurity. Water becomes insecure because there is usually a limit beyond which withdrawing

TABLE 7

Average Water Consumption By Crop (in 1984)

Crop Category	Area (hectares)	Water Demand		
		m^3/ha/year	m^3 million per year	percent
Wheat	320,000	8,700	2,784	37.5
Coarse grains	144,600	9,000	1,301	17.5
Vegetables	74,600	15,000	1,120	15.1
Fodder	45,000	25,000	1,125	15.1
Dates & fruits	85,000	5,000	425	5.7
Other perennial crops and plants	67,500	10,000	675	9.1
Total	736,700		7,430	100.0

Source: Ministry of Planning, Fourth Development Plan 1985-1990, p. 140.

AVERAGE WATER CONSUMPTION BY CROP IN 1984

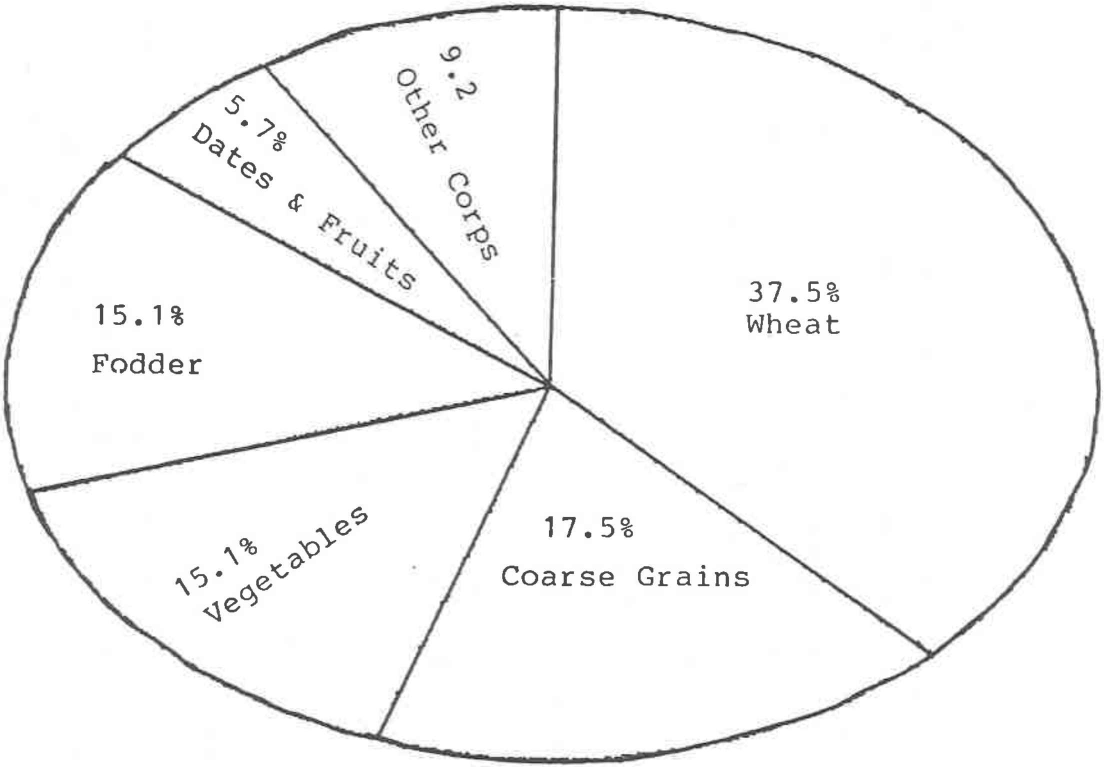


Figure 3

well water becomes uneconomical. For example, the limit of drawdown in the confine Saq aquifer is 300 meters. This depth is regarded as the economic limit for acceptable pumping, using available technology. The problem becomes even more serious if we consider that the water level is dropping by 10 meters a year in many Saudi Aquifers.

At present rate of water withdrawal, the future food and water security is fraught with predictable problems. The surface land area that can be farmed with aquifers is going to decrease dramatically when the economical limit of water withdrawal is reached. The aquifers will not be able to withdraw water economically unless advance technology makes it economical to withdraw water below the present economical level. If this does not happen, the future of both water and food security is questionable.

Leakage of Aquifers:

Over-exploitation of the aquifer in the Kingdom not only speeds up the limit beyond which withdrawing well water becomes uneconomical, but it is also feared that under such intensive over-exploitation, some limited natural leakage will occur from the higher pressure confined from one aquifer to other aquifer. The leakage will increase as the water table goes down. The water quality will be reduced as some aquifer with higher salt content (such as Tabuk aquifer) leakage to an other aquifer with good water quality (Al-Walie, 1985).

Recharge of Saudi Aquifer:

In general, the natural recharge of the aquifers are very small as rainfall is low. The over-exploitation of fossil water by the 10 meter yearly drawdown of the free water table makes this figure of natural recharge seem negligible. The recharge is very important if steps are taken to reduce the rate of water withdrawal from aquifer. As time goes on, an accumulation of recharged water will lead to a reduction of leakage of bad quality water from overlying formation, rising the water table to a more efficient and economical level, reducing the risk of water salination, and ensuring future water security for human and agricultural consumption.

Discharge of Saudi Aquifers:

A great deal of debate is going on regarding the discharge of Saudi Aquifers. Some Saudi officials claim that "our water resources in the Sedimentary Section of Saudi Arabia are naturally discharging and are susceptible to depletion towards the Gulf or from Wadi Addwasir towards the Empty Quarter. Therefore, we must benefit from them before they get discharged".

The above argument is worthy of a comment. The natural discharge of Saudi Aquifers is a complex mechanism and should not be taken as an excuse for the exploitation of groundwater at these higher rates. It is known that there are some confined aquifers whose natural discharge is nil. Those aquifers which have natural discharge have some controlling mechanism against depletion. Under natural conditions where no exploitation of water has occured, aquifers are usually in a state of equilibrium. The natural discharge is equal to the natural recharge and over a given period the water table stays in a fixed position. The Paleo-Triassic aquifer system in Saudi Arabia is a closed system. It holds infiltrating groundwater because natural discharge is virtually nil, except for some water that is leaked to other aquifers or lost through faults, but it is not considered important. The Saq, minjur, Tabuk, Wajid belongs to this group (Table 8).

The cretaceous aquifer system is confined in parts and is semi-open in parts. There is some sub-surface discharge to the overlying

TABLE 8

Groundwater Movement in the Aquifer Systems

Aquifer System and Components	Groundwater Movement		
	Recharge Area	Storage Area	Discharge Area
Eocene Aquifer System:			
Alta Member Khobar Member Umm-er-Radhumah Formation	Levels falling recharge less than discharge	Open down-dip movement	Springs and evaporation
Cretaceous Aquifer System :			
Wasia Formation Riyadh formation	slow fall in levels due to extraction	semi-closed little movement	Sub-surface transfers
Paleo-Trias Aquifer System:			
Dhurma Formation Minjur Formation Tabuk Formation Saq/Wajid Formation	Fall in levels due to extraction	closed circulation	No natural discharge

Source: Al-Welaie, 1985: 385.

aquifers through zones of tectonic disturbance. It is believed that the natural discharge is higher than natural recharge. However, the water discharged is not lost as it goes to other aquifers within the domain of Saudi Arabia.

The Eocene aquifer system is generally a confined system functioning as an open system. It has natural discharge through springs and evaporation. Another strong point is that natural processes are so low that they must be measured by thousands of years. Over-exploitation of groundwater will acclerate the rate of water depletion and create a disturbance in the natural states of an aquifer (Al-Welaie, 1985).

As for life expectancy of the aquifers, Saudi water officials say that some regions of Saudi Arabia do experience shortages of ground water, but we have regions with abundant ground water that will last for tens of years and is sufficient for our socio-economic needs. From observed signs of over-exploitation like the falling water table in some major agricultural regions such as Al-Qassim (and other areas) and the drying up of some wells, one wonders if they are going to last that long.

Saudi Arabia is an arid country with limited water resources that should be regarded as non-renewable just like oil. The time at which these aquifers will be deplated should not be the center of debate, nor should we believe that our water resources are naturally discharging and are susceptible to depletion and that therefore, we must benefit from them by expanding agricultural output. What should matter greatly is that ground water must be used wisely and economically because it is depletable, whether the depletion takes a short time or hundreds of years. Only we can extend the life expectancy of the Aquifers and insure the fulfillment of future water as well as food security goals.

Water Security and Food Security:

Water security is much more important than food security, for it is the only insurance against future food insecurity. The food security the country is enjoying now may last for some years to come, but at the expense of finite ground water. It is feared that when a real need for future food security arises the country will have neither water security nor, as a result, food security. Ground water should be utilized more efficiently and economically. There may come a time in the future when world trade is halted by war or some other unexpected events, therefore, we should have some security against such events. But the direction the country is following now will lead to the opposite.

The Threat to Water Security:

The following tables (9-12) and figures (5-8) show the future threat to food security as a result of higher environmental and economic costs due to excessive wheat production. These tables explain four Scenarios.

SCENARIO I : When wheat production is frozen at the 1986 level of 2,048 million tons a year.

SCENARIO II : When wheat production is reduced to the selfsufficiency rate of .7 million tons a year.

SCENARIO III : When wheat production grows at 1 percent annually.

SCENARIO IV : When the self-sufficiency rate grows at 1 percent annually.

In all four Scenarios other agricultural crops (cereals, vegetables, fruits and others) remained constant at the 1986 level of 4.944 million tons annually with estimated water consumption of 3797.75 million cubic meters per year (Agricultural Sector Development :

Graphical Indicator 1987 and Fourth Year Development Plan 1985-90). It is estimated that the proven reserves of non-renewable water resources is used for agricultural purposes i.e. 303,750 million M^3 (Fourth Development Plan).

The government pays price support of SR2000 per ton of wheat and this figure is assumed to be constant throughout the analysis. The government's cumulative payments to farmers increase or decrease depending on the production level of wheat. It is estimated that the government buys 85 percent of the total wheat production and the remainder is sold in the open market. The remaining reserve is obtained by subtracting cumulative water use in agriculture from the stock of non-renewable resources. The cumulative use is the total water consumption by wheat and other agricultural crops accumulated annually.

Scenario I:

Table 9 shows the real threat to future food security when wheat production was maintained at the 1986 level. Non-renewable water resources will be exhausted by the year 2020 as shown in figure 5. By that time the country will have neither water nor, as a result, food security. Cumulative payments to wheat producers will reach over SR120 billions as shown in figure 6. Any increase of wheat production above this level, or any increase of other agricultural crops, means water will be exhausted sooner and economic costs in terms of payments to farmers will be higher.

Scenario II:

In this case we assumed the country maintains its self-sufficiency rate that existed in 1986 throughout. Economic and environmental costs will be lowered. Any lower production rate means

TABLE 9

Economic and Environmental Costs of Wheat Production 1986-2024

Year	Freeze Production of Wheat at 1986 Level of 2.048 Million Tons, and Other Agricultural Crops at 4.944 Million Tons		
	Cumulative payments to wheat producers Million SR	Cumulative Water Use by wheat and other Agricultural Crop Million M^3	Remaining Reserve Million cubic Meters
1986	3481.6	8805.5	292944.5
1990	17408	44027.6	259722.4
1994	31334.2	79249.7	224500.3
1998	45260.8	114471.7	189278.3
2002	59187.2	149693.8	154056.2
2006	73113.6	184915.9	118834.1
2010	87040	220137.9	83612.1
2014	100966.4	255360	48390
2018	114892.8	290582.1	13167.9
2022	128819.2	325804.1	- 22054.1
2024	135782.4	343415.2	- 39665.2

Sources: Author's estimation.

higher life-span for the non-renewable aquifers and lower economic costs. Higher production levels above self-sufficiency will, of course, lead to the opposite. This can be shown in Table 10, figure 5,6.

Scenario III:

In this case we assume an increase of wheat production by a 1 percent annually. The result shown in Table 11, figure 7 indicates that water will be exhausted by the year 2016 which again shows that any higher percentage growth rate means higher depletion rates. Economic costs will be high as well as shown in figure 8. Lower growth rate will result in lower depletion rates, and lower economic cost. The life of the aquifer will be extended further.

Scenario IV:

In table 12, figure 7,8 we can see that if the production level of self-sufficiency increases by 1 percent annually to meet future consumption as the population increases, remaining reserve will be reduced and economic cost will increase as a compared with case III.

Results:

From the previous four cases we can draw some very important results:

1- Food security today could result in food insecurity tomorrow.
2- The need to achieve a production level of certain agriculture product, including wheat, that does not threaten future food security. One way to do this is to balance and rationalize water uses for agriculture as the major consumer of water.
3- Reducing wheat output will contribute to future water as well as food security by increasing the life time of the aquifers, raising the water table reducing the salination problem, maintaining an economical aquifer pressure which prevents future leakages.

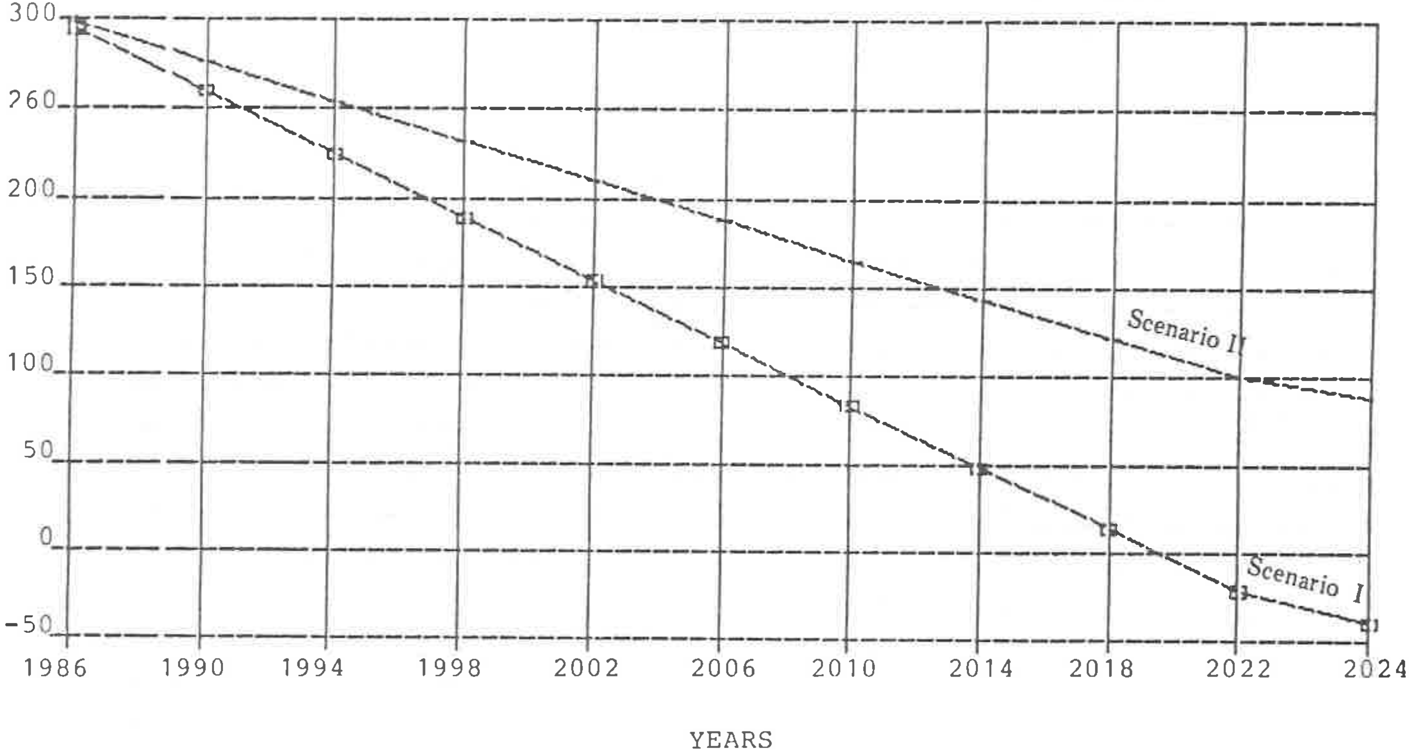
TABLE 10

Economic and Environmental Costs of Wheat and Other Agricultural Products 1986 – 2024

Year	Reduces. Wheat to Self-Sufficiency Rate of .7 Million Tons with Constant Other Agricultural Crop at 4.944 Million Tons		
	Cumulative Payments to Wheat Producers Million SR	Cumulative Water use by wheat and other agricultural crop Million M^3	Remaining Reserve Million cubic Meters
1986	1190	5509.4	298240.6
1990	5950	27546.9	276203.0
1994	10710	49584.6	254165.4
1998	15470	71622	232127.9
2002	20230	93659.7	210090.3
2006	24990	115697.3	188052.7
2010	29750	137734.9	166015.1
2014	34510	159772.5	143977.5
2018	39270	181810.1	121939.9
2022	44030	203847.6	99902.4
2024	46410	214866.4	88883.6

Sources; Author's estimates.

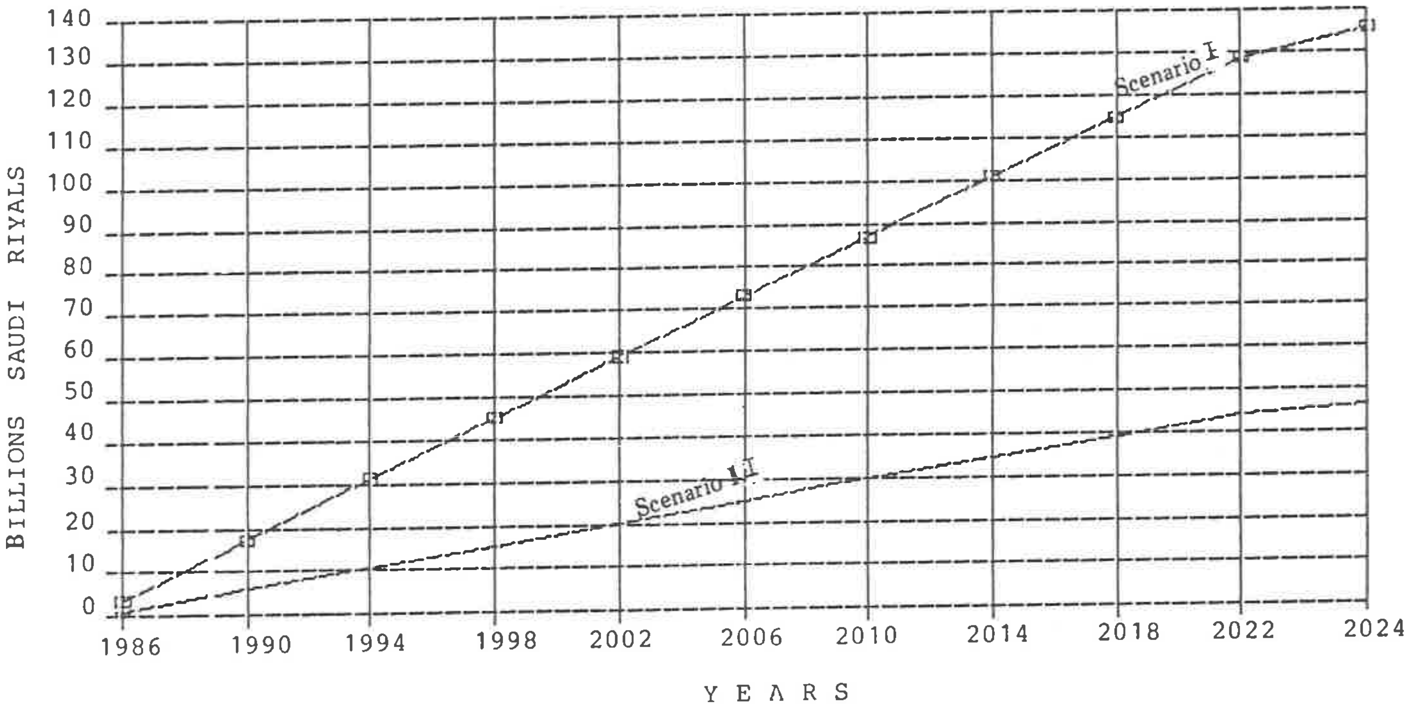
ENVIRONMENTAL COST OF WHEAT PRODUCTION 1986 - 2024



SCENARIO I SCENARIO II

(Figure 5)

ECONOMIC COST OF WHEAT PRODUCTION 1986 - 2024



SCENARIO I SCENARIO II

(Figure 6)

TABLE 11

Economic and Environmental Costs of Wheat and Other Agricultural Products 1986 – 2024

Year	When Wheat Production Grows at 1 Percent Annually Assuming Constant Level of Other Agricultural Production at 4.944 Million Tons		
	Cumulative payments to Wheat Producers Million S.R	Cumulative Water Use by Wheat and other Agricultural crop Million M^3	Remaining Reserve Million cubic Meters
1986	3481.6	8805.5	294944.5
1990	17759.7	44533.4	259216.6
1994	32617.5	81095.2	222654.9
1998	48078	118524.6	185225.4
2002	64167.4	156857.1	146892.9
2006	80909.6	196129.2	107620.8
2010	98331.5	236379.1	67370.9
2014	116460.9	277646.5	26103.6
2018	135326.3	319972.6	-16222.6
2022	154957.8	363400.6	-59650.6
2024	165070.5	385541.7	-81791.7

Source: Author's estimation.

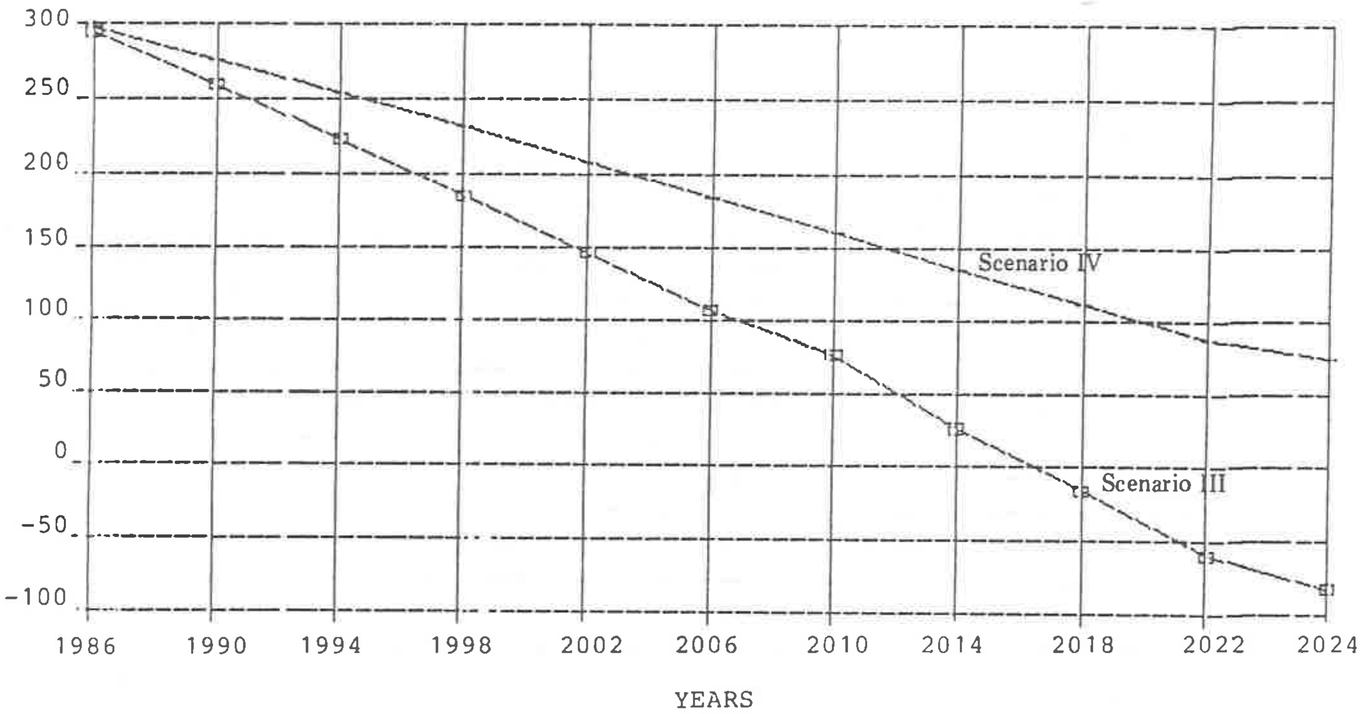
TABLE 12

Economic and Environmental Costs of Wheat and Other Agricultural Products 1986-2024

Year	When Self-sufficiency Rate Grows at 1 Percent Annually Assuming Constant Level of Other Agricultural Production at 4.944 Million tons		
	Cumulative payments to wheat producers Million SR	Cumulative Water use by wheat and other agricultural crop Million M^3	Remaining Reserve Million cubic meters
1986	1190	5509.4	298240.6
1990	6070.2	27719.9	276030.1
1994	11148.6	50215.4	253534.7
1998	16433.1	73007.4	230742.6
2002	21932.2	96108.1	207641.9
2006	27654.7	119530	184220
2010	33609.4	143286.1	160463.9
2014	39805.9	167389.9	136360.1
2018	46254.1	191855.7	111894.3
2022	52964.1	216698	87052
2024	56420.6	229265.1	74484.9

Source: Author's estimation.

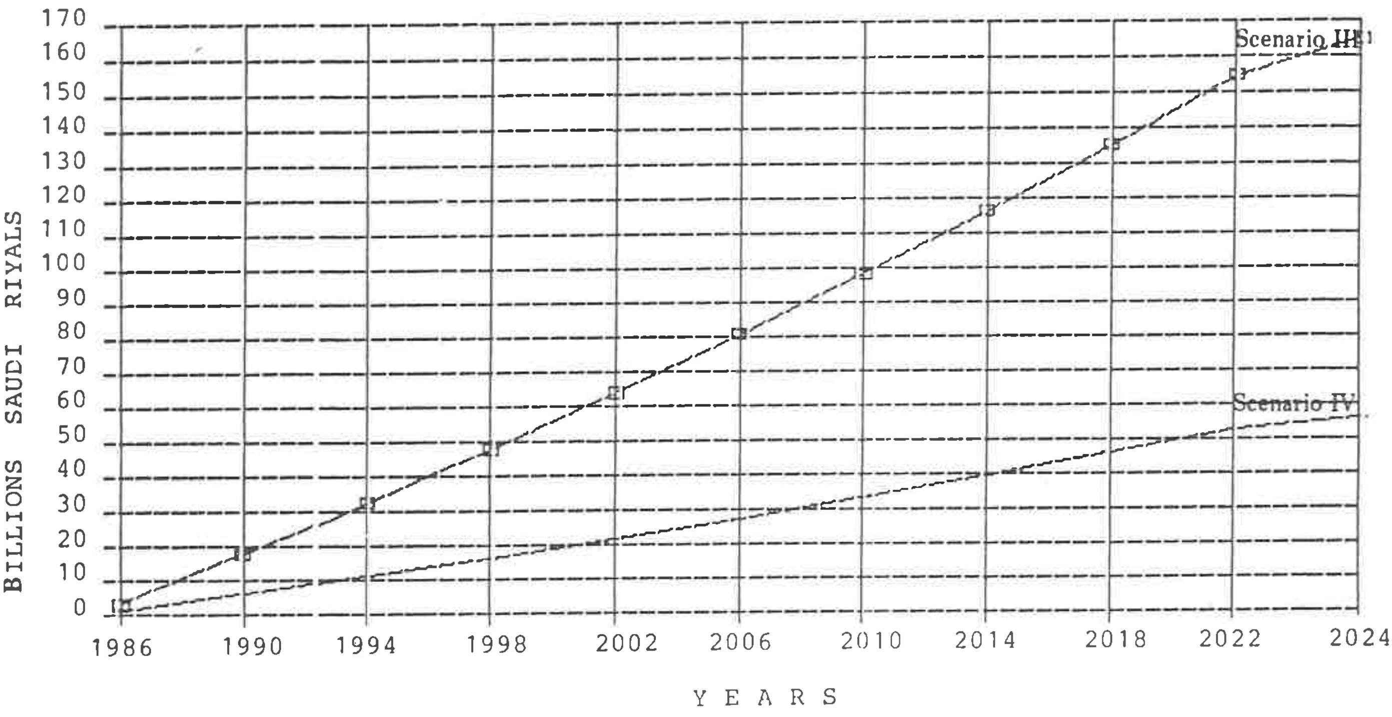
ENVIRONMENTAL COST OF WHEAT PRODUCTION 1986 - 2024



SCENARIO III SCENARIO IV

(Figure 7)

ECONOMIC COST OF WHEAT PRODUCTION 1986 - 2024



SCENARIO III SCENARIO IV

(Figure 8)

VII- CONCLUSION AND RECOMMENDATION:

Conclusion:

Saudi Arabia has been fourtunate in having large volumes of groundwater contained in 11 major aquifer. The present large agricultural expansion in wheat production and the continuation of current production rates for years to come depends heavily on irrigation coming from these deep non-renewable aquifers. Agriculture has been the largest consumer of water. Within the agricultural sector, wheat is the largest consumer of water. Although water consumption by urban centers is growing at an incredible rate, these ground water aquifers contain fossil water with little or no recharge taking place at present. The over optimism that officials frequently expose in the media should subside and calls for wisdom and conservation should be arise. People believe that incredible amount of groundwater is contained in the sedimentary section of the Kingdom. This is not true if we consider water quality and the depth of the aquifers. The available water is not as large as people believe. People would be told about the real water situation in the Kingdom and taught to conserve water especially in agriculture by seeking better managerial and technological options for its use. Many farmers in Saudi Arabia believe that they are dealing with infinite amount of groundwater that will never run dry. They do not know that they are dealing with a finite and non-renewable resource. They do not know that food security today could result in food insecurity tomorrow as future water resources become insufficient and more scarce.

Recommendation:

It is evident from the previous discussion that there is an over-exploitation of fossil water reserves contained in Saudi Aquifers.

However, expanding wheat production will increase the demand for non-renewable groundwater. To obtain a secure future water and food supplies a few recommendations are made:

1. By following the water security principle, wheat production should be reduced by cutting back gradually on price support for wheat as it is the major consumer of water. Wheat production is estimated to decrease sharply if the government support price is reduced or abolished (Al-Abrahim, 1987:150). The modeling and simulation results obtained by Al-Abrahim reveal the dilemma of the government wheat policy.
The enthusiastic response of wheat producers to government price support was the main factor for the marked increase in wheat production. It was the hope of the government to gradually reduce its price support for the wheat producers so that they will be able to sustain the existing level of self-sufficiency. However, simulations with reduction in support price or total abolition of the price support indicates otherwise. The self-sufficiency rate is projected to drop from 1.29 in 1984 to .35 in year 2000 when price support decreases to a comparable free market price of SR1.00 per Kg., and to an extreme low rate of 0.01 with the removal of government pricing intervention (Al-Abrahim, 1987, 172-3). Thus, self-sufficiency in wheat production is only sustainable with the help of a continuously high flow of government expenditure.

2. As the quest of good security based on self-sufficiency in production is only attainable at high economic and environmental costs, a different approach is needed. A possible approach is to depend on the world markets for a portion of the food supply while holding a reserve stock in case of a food embargo or shortages. Maintenance of a viable producing sector at some minimal level of output does contribute to food

security without incurring economic or environmental costs that arise with higher wheat production.

3. The government should re-consider the policy of reducing wheat by encouraging the production of barley through a price support of SR1.00 per Kg. In September 1986, the government told the five largest wheat producers to switch one-third of their cultivated land to barley. The government now subsidies wheat at SR2.00 per Kg. This means there is little incentive to change to barley and the government may be forced to increase the barley subsidy.* Al-Abrahim estimated that price support for barley is projected to cause a decline in wheat area of only 206,000 donems about 5 percent of the total crop area. This is expected as the current price support of wheat is twice the price of barley. It is unlikely that there will be a significant shift from wheat to barley (atSR1.00 per Kg.), though demand on the country's scarce water resources.

4. Conservation is not a popular concept when standards of living are high and rising and resources are plentiful, but it is acceptable when the limits on natural and financial resources become clearer. In Saudi Arabia water is a precious commodity, especially when the government incurs heavy expenditure in supplying desalinated water to citizens in addition to huge consumption by agriculture in general and wheat crops in particular. It is vital that a rational use of water is called for. Public awareness is one of the most important and effective methods of water conservation. Effective conservation techniques need the cooperation of the general public, particularly those who consume large quantities, such as farmers (DE. Jong, 1987: 8).

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* Barley imports rose from 530,000 tons in 1978 to over 6,500,000 tons in 1986. Barley imports costs an estimated $678 million in 1986 the grain's low world price has kept the bill below the 1984 peak of $1,082 million (MER 1987).

REFERENCES

1- Al-Abrahim Basem A.; "An Econometric Analysis of Supply and Demand of Wheat in Saudi Arabia", unpublished Ph.D. thesis. Washington State University, Department of Agricultural Economics, May 1987.

2- AlWelaie Abdullah N.A.; "The Role of Natural and Human Factors in the Degradation of the Environment in Central, Eastern, and Northern Saudi Arabia". Ph.D. thesis, University of California, Riverside, December 1985.

3- Battal Hamad S.; "Water Resources Allocation in Saudi Arabia: The Case of Al-Kharj district, unpublished Ph.D. thesis. University of Nebraska, Department of Agricultural Economics, November 1986.

4- Beaumont, Peter.; "Water and Development in Saudi Arabia", The Geographical Journal, Vol. 143, London: The Royal Geographical Society, March 1977.

5- Bernardo, Daniel D.; "Optimal Irrigation Management under Conditions of Limited Water Supply". Ph.D. thesis, Washington State University, December 1985.

6- De Jong R.L., "Water Conservation in Arid Regions". Ministry of Planning press, 1987.

7- Gardner R.G.; "Saudi Arabia drives for Agricultural Self-sufficiency: A Political Goal with High Economic Cost", Middle East and North Africa outlook and situation report RS-85-3, U.S. Dept. of Agriculture, 1985.

8- Lewis, Carl B.; "Allocating a Limited Supply of Water for Irrigation". Ph.D. thesis, University of Nebraska Department of Agricultural Economics, June 1969.

9- Middle East Economic Digest, MEED, "Success with Wheat sees shift in subsidy focus", June 1987: 34-36.

10- Ministry of Agricultural and Water, Agricultural Sector Development, "Graphical Indicators", Dept. of Economics and Statistics, 1987.

11- Ministry of Agriculture and Water, Annual Bulletin of Complete Enumeration of Specialized Farms Crops and Livestock, several issues, 1979-1985.

12- Ministry of Agriculture and Water Bulletin of Agricultural Statistics, Riyadh, Saudi Arabia, various issues, 1970-1983.

13- Ministry of Finance and National Economy. Central Department of Statistics, Statistical Year Book, Riyadh, Saudi Arabia, 1985, 1986.

14- Ministry of Planning, Fourth Development Plan, Riyadh, Saudi Arabia, 1985, 1990.

15- Ministry of Planning, Seminar on Development and Uses of Water Resources, Vol. 1,2,3, Riyadh, Saudi Arabia, 1982.

16- Saudi Arabian Monetary Agency (SAMA), Annual Report, Riyadh, Saudi Arabia, 1986.

17- Saudi Gazette, "Saudi Wheat Export Soar", Sept. 30, 1987.

18- Tamimi M.A., "Agricultural Marketing in the Central Region, Ministry of Agricultural and Water, Riyadh, Saudi Arabia 1978 (in Arabic).

19- Vahid Nowshirvani, "The Yellow Brick Road: Self-sufficiency or self-enrichment in Saudi Agriculture", Middle East Report (MER), March- April 1987.

A P P E N D I X

WORKSHEET FOR SCENARIOS 1-4

	1986	1996	2006	2016	2024
Stock of non-renewable water (MillionM^3)	337500				
Agricultural percentage use of total stock of water (90%)	303750				
Wheat production (Million tons)					
Growth rate in wehat production	0				
Wheat production (Million tons)	2.048	2.048	2.048	2.048	2.048
Wheat area (Million hectare)	.5756	.5756	.5756	.5756	.5756
Average water consumption per Hectare (M^3)	8700				
Total water consumption by wheat crop (Million M^3)	5007.75	5007.75	50075.75	5007.75	5007.75
Other agricultural crop (Million hectare)	.2967				
Average water consumption per hectare (Million M^3)	12800				
Total water consumption by other agricultural crop (Million M^3)	3797.76	397.76	3797.76	3797.76	3797.76
Total water consumption (wheat and other agricultural production	8805.51	8805.51	8805.51	8805.51	8805.51
Cumulative use	8805.51	96860.69	184915.9	272971.0	343415.2
Remaining Reserve of non-renewable water resources (Million M^3)	294944.5	206889.3	118834.1	30778.97	-39665.2
Government purchases of wheat (2000 SR per ton)	2000				
Government buys 85% of wheat produced by farmers	.85				
Total government purchases of wheat (Million tons)	1.7408				
Total payment by government (Million SR)	3481.6	3481.6	3481.6	3481.6	3481.6
Cumulative payments (Million SR)	3481.6	38297.6	73113.6	107929.6	135782.4

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