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THE EUPHRATES RIVER: AN ANALYSIS OF A SHARED RIVER SYSTEM IN THE MIDDLE EAST

by
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Abstract

In a world where the amount of resources is constant and unchanging but where their use and exploitation is growing because of the rapid population growth, a rise in standards of living and the development of industrialization, the resource of water has become a critical issue in the foreign relations between different states. As a result of this many research scholars claim that, today, we are facing the beginning of the "Geopolitical era of water".

The danger of conflict of water is especially severe in the Middle East which is characterized by the low level of precipitation and high temperatures. The Middle Eastern countries have been involved in a constant state of political tension and the gap between the growing number of inhabitants and the fixed supply of water and land has been a factor in contributing to this tension. These circumstances have led some researchers to predict that the next war in the region will break out because of a conflict over the allocation of water resources in the region.

The Euphrates is the third biggest river in the Middle East. It rises in East Turkey, and crosses 2,330 km of territory through Syria and Iraq until it links up with the Shatt-Al-Arab river. The amount of average annual water flow over many years is about 32 billion m^3 but the seasonal and annual variations are very great because of the regions climate.

From the nineteen-sixties onward the three riparians began to plan and carry out extensive development programmes for the Euphrates river water by constructing dams whose main purpose was to control the flow of its water, for the production of hydro-electric power and for agricultural purposes. These programmes caused tension in the foreign relations between the countries.

The study provides a review of the hydrology of the river and of the river's relevance to the economies of its three riparians. This resource profile is the basis of the analysis of the strategic role of the river in the relations between Turkey, Syria and Iraq.

This study also examines the influence of the Euphrates water allocation on the network of relations between the riparians countries. An examination of the different variables involved in this subject has been carried out with the help of three models:

1. Cognitive mapping - which allows all the states along the river basin to evaluate the interests of a particular country over three periods of time (past, present, future).

2. Quantitative indicators of vulnerability due to water shortages - which measure the level of vulnerability of states to a possible shortage of water.

3. Matrix model - which examines the possibility of military conflict between the states on the basis of five factors - also over three periods.

Analyses based on these models together with the data on the river and on the economies of the riparians show that there will not be a future shortage of Euphrates water, military conflicts between the countries along the river are unlikely to develop. It appears that social, economic and political factors are the central issues in the tense relations between the riparians and not necessarily, as many research scholars claim, issues of water allocation.

Acknowledgements

It is a pleasant duty to thank many friends colleagues and organizations who have both accompanied and assisted me in bringing this research thesis to fruition.

I would, first and foremost like to express my deep gratitude to my thesis director, Professor Tony Allan, whose advice, contribution and never-ending encouragement made it possible to transform a collection of potential ideas into a piece of significant research. The relationship which developed between us during the period we worked together was one which not only made us both colleagues and friends but one which I hope will continue for many years to come.

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Arnon Medzini.

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A. Introduction

A1. The basic importance of water

It should surprise no-one that water is the most abundant chemical substance on the earth's crust; covering more than half of the five km deep outer shell of the earth. Water and air, are vital to the existence of both man, and life itself. Water and watery solutions play an all-important role in the physical, biological and geological processes which take place on earth. The great oceans, the inland lakes, rivers and the polar icecaps together cover some three quarters of the surface of the Earth providing sustenance, transportation and protection. Population centres have evolved on the shores of water bodies, creating economic development along sea-shores and in major river valleys such as the Euphrates-Tigris, the Nile, the Mekong and the Danube *(Gustafsson, 1985,130).*

A prevailing scientific consensus agreed upon at the United Nations Water Conference in 1977 placed the world's total volume of fresh water at less than one thirtieth of all the water on the globe with the water moving in streams each year estimated at 40 to 47 trillion m3. Altogether, at any one time, about 22 per cent of the fresh water is in the soil in, ground water storage and flows, 0.35 per cent in the lakes and wetlands, 0.04 per cent in the atmosphere, less than 0.001 per cent in the streams, and about 77 per cent in snow and ice. These figures show that the great reserves of fresh water, apart from snow and ice, lie underground, while the running streams and lakes are a very small, rapidly circulating proportion of the total resource. There is, however, some doubt about how much of the ground water is within economic pumping depth: perhaps only one-third at most *(Shiklomanov, 1990, 34)*. Estimates of global water in various storages and fluxes are in general agreements, but there can be significant competition for available water by different using sectors. It is also relevant to note the very unequal per capita distribution of the available water resources in the world. Relative per capita water availability has been classified by Shiklomanov (1990) according to the following seven categories (see table A.1)

Table A.1:

Relative water availability (m^3/year per capita)

* Extremely low =	below 1,000
* Very low =	1,100 to 2,000
* Low =	2,100 to 5,000
* Medium =	5,100 to 10,000
* Above medium =	10,000 to 20,000
* High =	20,000 to 50,000
* Very high =	over 50,000

(Source: Shiklomanov, 1990, 40)

Individual users depend on the availability of a relatively small volume of one cubic metre per year as a minimum supply of potable water and an additional volume of safe water which increases with economic and social development and advancing technology. In modern societies, water is used for human consumption, the removal of wastes, general sanitation, the production of energy, agricultural production, transportation and recreation. In 1940 the world's average per capita water use, including water diverted for irrigation, was below 400 cubic metres a year; it is now at least double that and stands at 800 cubic metres a year *(Clarke, 1991, 32)* reflecting the increased use of water in all sectors and especially in agriculture. No account is taken here of the contribution of rainfall in the agricultural sector.

Table A.2:

Global water use by sector per year

Domestic	100 cubic kilometres
Industrial	200 cubic kilometres
Cooling	225 cubic kilometres
Livestock	40 cubic kilometres
Total	565 cubic kilometres

Source: Clarke, 1991, 23.

These figures, which come from a 1977 estimate, assess per capita values for domestic, industrial, cooling and livestock use at about 20,40,45, and eight m^3 per head per year in round terms - an annual total of some 120 m^3 per person *(Clarke, 1991, 23).*

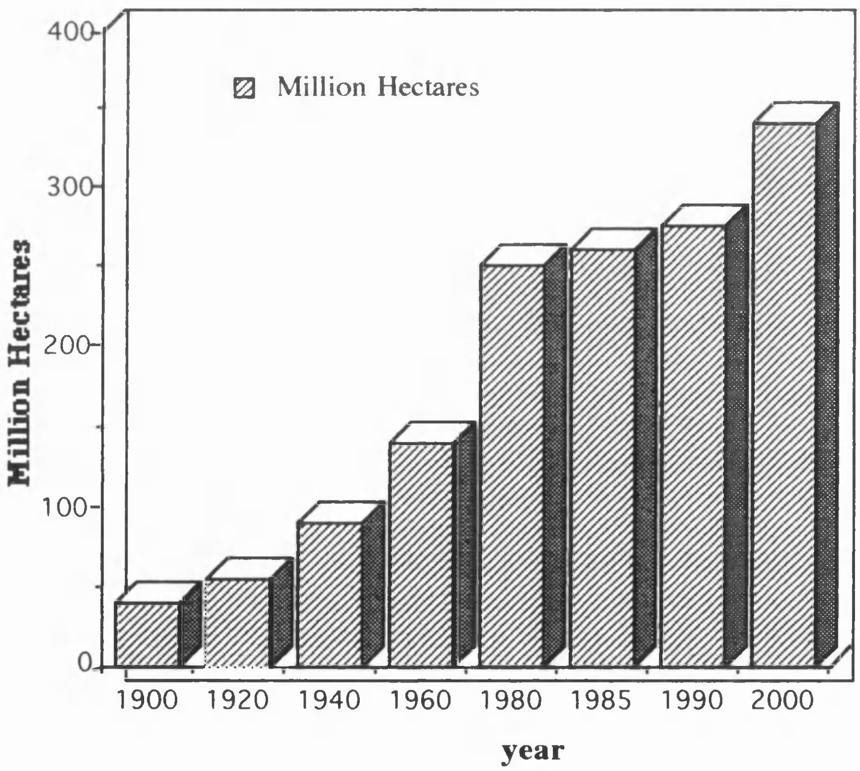
A2. Irrigation water use

Irrigation is, by far, the biggest and most rapidly expanding user of water since plants use large quantities of water during their growth. Under dry conditions, it takes about 1000 cubic metres of water to produce one tonne of plant growth. Where rainfall alone is insufficient to meet plant needs, irrigation is required and the volume of water needed rises dramatically. The amount of water used for irrigation has increased ten times this century, and elaborate plans are still being made to extend irrigation to more and more areas *(Clarke, 1991, 27).*

In 1900, some 40 million hectares were irrigated world-wide and by 1950, the total had reached 94 million hectares. Over the next four decades, the growth was explosive with irrigation increasing some three times to 272 million hectares (see figure A1).

Figure Al:

World irrigation areas: 1990 - 2000



The 178 million hectares added to the world's irrigated area from 1950 to 1990 entailed the heavy use of both river and underground water resources. Since both of these methods involved large capital commitments, irrigation was a major focus of investment for national governments as well as leading international development agencies *(Brown, 1988, 23).*

The watering of crops currently uses something like 3300 cubic kilometres of water a year - roughly six times the requirement for industrial and domestic use. Unless land is irrigated carefully, irrigation can cause a great deal of environmental damage, but, it has also brought enormous benefits when properly managed.

Irrigation has extended cultivation in areas that are too dry for rainfed farming, and irrigation also allows multiple crops to be taken in the same year, thus further increasing productivity. Finally, irrigation can provide security to a farmer who was previously dependent on unreliable seasonal rains, encouraging him to use higher-yielding varieties and more costly inputs such as fertilizers and pesticides on which he might not dare risk spending money if his water supply was unreliable.

Table A.3:

The increase of water consumption and irretrievable water losses over the world (km^3/year).

Water user / Year	1900	1940	1950	1960	1970	1982	2000
Irrigated area Million Hectares	47	75	101	142	173	218	347
Municipal water consumption	20/5	40/8	60/11	80/14	120/20	250/38	440/65
Industry	30/2	120/6	190/9	310/15	510/20	1100/45	1900/70
Agriculture	350/260	660/480	860/630	1500/1150	1900/1600	2400/1900	3400/2600
Reservoirs	0/0	1/1	4/4	20/20	70/70	170/170	240/240
Total	400/270	820/500	1100/650	1900/1200	2600/1600	3900/2200	6000/3000

Sources: Gustafsson, 1985, 130: Shiklomanov, 1990, 39.

Although irrigated land comprises only 13 per cent of the world's total arable area, irrigation accounts for the largest proportion of the total water used by man. Other non-agricultural water uses (for industry, mining and domestic purposes) are however now increasing much faster than the use for irrigation. A considerable amount of this water is non-consumptive and such water can be recycled, while irrigation continues to be a consumptive use with little recycling except in special alluvial circumstances. Irrigated agriculture will therefore continue to be the greatest water consumer in the future *(The*

Global 2000,1982,150).

As economies have developed and populations have grown, water has become a scarce resource, at least in many parts of the world, and it has been predicted that world demand for water will quickly outstrip supply. By the year 2000 population growth alone will at least double the demand for water in half the countries of the world, principally in developing economies with the greatest pressure taking place in parts of Africa, South Asia, the Middle East, and Latin America. If the growing demand for water cannot be met in these countries it will, for instance, be impossible to increase food production, causing food deficits which lead to malnutrition in several developing countries where food cannot be imported to make up the deficit. Agriculture consumes two-thirds to four-fifths of the water used in nearly every dry country. Meanwhile world food demand will increase by at least one-third by the end of the century, and will increase by a similar volume in the Middle East region and in the Euphrates countries which are the subject of this study. The capacity of the Euphrates resource will be identified and the extent to which its future regulated flows can service the national and sectoral needs will be studied. To meet such demands it will be necessary to extend the irrigated area and to increase production from existing irrigated fields*(Global 2000, 1982, 142).*

In table A.3 one can read the increase of water consumption and irretrievable water losses over the world. Table A.4 shows the estimates of world water use in 1967 and projections to 2000.

Table A.4:

Estimates of world water use in 1976 and projections for 2000

	Total use in millions of m^3		Projected growth in per cent per year	Rate fraction of total use in per cent	
	1967	2000	1967-2000	1967	2000
AGRICULTURE					
Irrigation	1.400.000	2.800.000	2.1	70	51
Livestock	58.800	102.200	1.7	3	2
Rural domestic	19.800	38.300	2.0	1	1
OTHER					
Urban domestic	73.000	278.900	4.1	4	5
Industry & mining	437.700	2.231.000	5.0	2	41
Total	1.989.300	5.450.400	3.1	100	100

Source: The Global 2000, 1982, 150.

Because of the ubiquitousness, heterogeneity, and ability of water to renew its supply, it is difficult to estimate the present or future supply while the common - property characteristics of water, the large quantities used, and the low user costs all act as obstacles to forecasting its future use. Global water consumption is expected to grow, as shown in table A.3, and this trend will probably continue into the next century with about 70 per cent of total water use and 90 per cent of irretrievable, consumptive use being due to irrigation. According to Shiklomanov, the expected increase from 1980 to 2000 will range from a minimum of 20 per cent in North America, 32 per cent in Europe, 70 per cent in Africa to a maximum of 95 per cent in South America *(Shiklomanov, 1990, 39).*

From the GNP and resource projections it has been concluded that: "increases of at least 200 to 300 per cent in world water withdrawals are expected over the period 1975-2000". The report asserts that "population growth alone will cause demands for water to at least double, relative to 1971, in nearly half the countries of the world"*(Global 2000, 1982, 149).* The Food and Agriculture Organization's 1977 estimates, note that by far the largest absolute increase in demand will be (and so far has been) for irrigation. The study stressed the problems of meeting the needs for potable water and of using irrigation water effectively without causing soil and water deterioration. As is well known, fresh water resources are not always situated clearly inside state borders. The greater the number of international boundaries that a nation has, the more complex its internal water management becomes. Approximately 148 of the 200 first order river basins in the world (whose final destination for basin water flow is an ocean, closed inland sea or lake) are shared by two countries and 52 by three to ten countries. Thus policy regarding the use and management of water resources cannot be treated exclusively as an internal affair of different states, since two or more states often participate in the formulation of policy. This international characteristic of water resource policy is, for its part, likely to intensify conflicts among nations with shared water resources, especially in times when the pressure on water resources increases *(Gustafsson, 1985, 131).* The Euphrates River traverses three countries with very different water and other resource endowments, and differing economic opportunities and policies. It will be the purpose of the thesis to establish the capacity of the Euphrates water to provide the water needs of the foreseeable political economies of the catchment.

A3. Domestic water use

In the most water scarce and extreme environmental conditions individual users in subsistence economies seem to use a minimum of about 2 litres of water daily (one cubic metre/year) to meet drinking requirements, the limit depending on the water content of the food eaten and the climate of the region. When users are supplied with accessible water which is carried from a standpipe in the neighbourhood, daily use commonly runs from 10 to 20 litres per capita. No matter how plentiful the water nearby is, or how suitable its quality for health and culinary purposes, one person's use rarely exceeds 40 litres per day where the supply has to be transported. Where water is less readily available because of either time or quality, the daily use per capita ordinarily ranges from 4 to 20 litres. For global purposes, a rough figure of about 12 litres may be taken as a conservative estimate of the daily use for those who are obliged to draw water from outside their households.

Where engineering works bring piped water into the family household, the daily use in virtually all cases exceeds 16 litres per capita, and 30 to 40 litres is the general level of use in buildings with only one tap per family group and without indoor waste disposal. In households with more than one tap and with indoor waste disposal, the use ranges from 25 to more than 600 litres daily. The mean use for modern cities is about 100 to 180 litres but this average figure varies by as much as 60 to 600 litres for consumers within the same city *(White, 1983, 481)*.

Domestic use can be estimated from data on urban and rural populations, using figures or per capita use where such data are available. Use factors for European countries range from 76 to 270 litres per day per capita, with a general average of 150 litres. The World Health Organization considers 150 litres per day to be an adequate amount for planning urban supply in developing countries *(Falkenmark, 1983, 472)*. In 1977 the global use of domestic water was estimated at 100 billion m^3/year - the equivalent of about 20 m^3 per person per year. As a result of population growth, and ambitious plans to increase the availability of safe drinking water and sanitation throughout developing countries, this is expected to rise more than nine fold by the end of the century, to 920 billion m^3/year,- more than 150 m^3 per head for the project population. Much of this increase will be for sewage disposal, which is a water-intensive process, and is really for municipal rather than strictly domestic use. The figure of 150 m^3 per head per year is equivalent to 400 litres per head per day *(Clarke, 1991, 21)*. Thus domestic water use will depend upon future lifestyles, family income, family size, water-using appliances, technology, and the future price of water for domestic purposes.

Many water problems facing those responsible for providing new domestic water supplies relate to the settlement of immigrants. In most large cities in the Third World we find peripherally located shanty towns which are considered illegal by the city authorities who do not feel obliged to provide them with water, drainage and sanitation facilities. Most of these are surrounded by squatter settlements house relatively poor families, without title to the land they occupy, and living in dwellings made of very crude materials. Their water is often contaminated and they lack sewage systems and waste-disposal services encouraging vermin infestation and disease *(Richards & Waterbury, 1990, 276; Lindh, 1990, 30)*.

Although fertility rates have fallen during the past generation the decline in the death rate has been swifter, accelerating population growth during the past ten years. The old debates over the political economics of population ("Malthus versus Marx") have remained vigorous with some of the neo-Malthusians believing that rapid population growth will negate any attempts at development. In this view, population growth is the cause of underdevelopment. The Marxists believe that maintaining poverty and underdevelopment causes rapid population growth, but they may agree that rapid population growth is undesirable since it complicates the development process and generates political problems *(Richards & Waterbury, 1990, 82)*.

A simple linear extrapolation based on population growth alone obviously ignores many other important factors that might affect a country's water situation (e.g., the level of agricultural development, degree of urbanization, etc.). Indeed, water availability itself is a relatively crude measure of an overall water situation. Nonetheless, population growth will be the single most significant cause of increased future demand, and the projections are useful as a general indication of potential problem areas.

A4. The role of water in the Middle East

Although important in many places, water interests and issues are more significant in the Middle East than in any other region of the world - and the reasons are obvious. Relatively recent colonialism and international intervention in the region have left a legacy of conflict and suspicion. Most of the Middle East is semi-arid and arid with the location of major Middle Eastern cities determined by access to water from rivers often flowing from mountains in remote parts of the region and even outside it. In addition agriculture and animal husbandry (both water dependent) have traditionally been the region's basic economic activities, and population growth has been generally high, increasing water demands. Under such conditions, water is vital, trust is low, conflict rife and harmonious management difficult, at best. Water runs both on and under the surface of politics in the Middle East, and it has often been seen as the primary strategic factor behind political and military manoeuvring in the region. As the water problem becomes more acute, it will surface as a domestic political issue and this domestic conflict will probably affect other issues, including foreign relations *(Naff & Matson, 1984,180)*.

A recent assessment of water resources in the Arab League countries by INWARD has assumed a basic demand for water of 55 m^3 per head per year for domestic water use, plus 1150 m^3 needed to provide an average daily diet of 3000 - 3500 kilo calories. The total of 1205 m^3 of water per head per year was called the lower limit of water requirements. In 1985 nine of the Arab League countries could meet this basic level of water demand but twelve could not. Overall, the average per capita supply will be well in excess of the minimum at 1750 m^3 by the year 2000 but, as a result of population growth, the estimated overall availability will fall to just under the minimum, of 1108 m^3. By the year 2025, however, supply will lag far behind demand and only 536 m^3 will be available. By then the region's deficit will amount to more than 421 billion m^3 of water a year - more than the region's total supply, and only a few countries in the region will be able to meet even the lower limits of water requirement *(Clarke, 1991, 88).*

A4.1 Domestic water use

A41.1 Urbanization

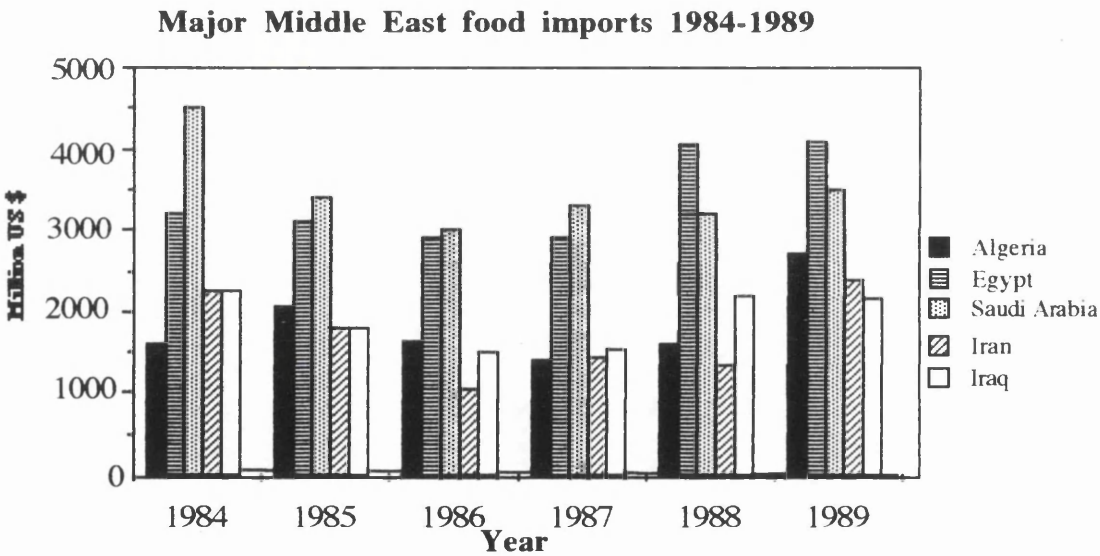
The Middle-East has long been dominated by cities which control their rural hinterlands and were the focal points of the extensive international trade system linking Europe to Asia. The most spectacular change in water use in the Middle East since the Second World War has been associated with the growth of urban centres. Urbanization has concentrated large numbers of people in relatively small areas, while the rising standards of living of urban dwellers has meant that per capita water consumption has increased rapidly. The net result has been to put severe strains on the water-resource base and especially on the water resource infrastructure in many regions, besides causing other environmental problems *(Beaumont, 1981, 63).*

The overall picture of urbanization in the region shows that it is more urbanized than China, India, Southeast Asia or sub-Saharan Africa, and less urbanized than Latin America. For the larger countries of the region (Morocco, Algeria, Egypt, Turkey, Iran), from two-fifths to over one-half the population live in cities - in many cases in one or two very large cities *(Richards & Waterbury, 1990, 263).* During this century most cities have grown rapidly through both immigration and natural increase and their morphologies have been transformed. Generally, the growth of large cities has been more rapid than that of smaller cities, but not without exception, and particularly rapid growth has been experienced by ports and capitals *(Clarke & Fisher, 1972, 31).* The diverse significance of cities for populations within the region, ranges from a low of around 20 per cent in Sudan and Yemen, to about 90 per cent in Kuwait and Israel. The higher the per capita income, the higher the percentage of the population that is urban. It is therefore plausible that increased urbanization and rising per capita incomes are both the result of the economic growth processes and industrialization. Middle East countries have some of the highest birth-rates in the world as well as disruptive rural-to-urban migration, both of which require constantly increasing domestic water provision. The natural growth of the urban population is not the same as is in rural areas since both fertility and mortality rates are lower in urban areas. Thus, since general mortality is also lower in urban areas, it is uncertain whether overall rates of natural growth are lower in the cities than in the villages*(Richards & Waterbury, 1990, 266).*

A4.1.2 Food deficit

The Middle-East has a rapidly escalating demand for food and a sluggish supply response so the region is considered to be the least food self-sufficient region in the world. Self-sufficiency in food production is not a realistic goal as, the amounts of water needed for irrigation would be many times those potentially available even assuming substantial improvements in the productivity of irrigated agriculture. For example Egypt already would need almost twice as much water for its agricultural sector than currently available to be food self sufficient.

Figure A2:

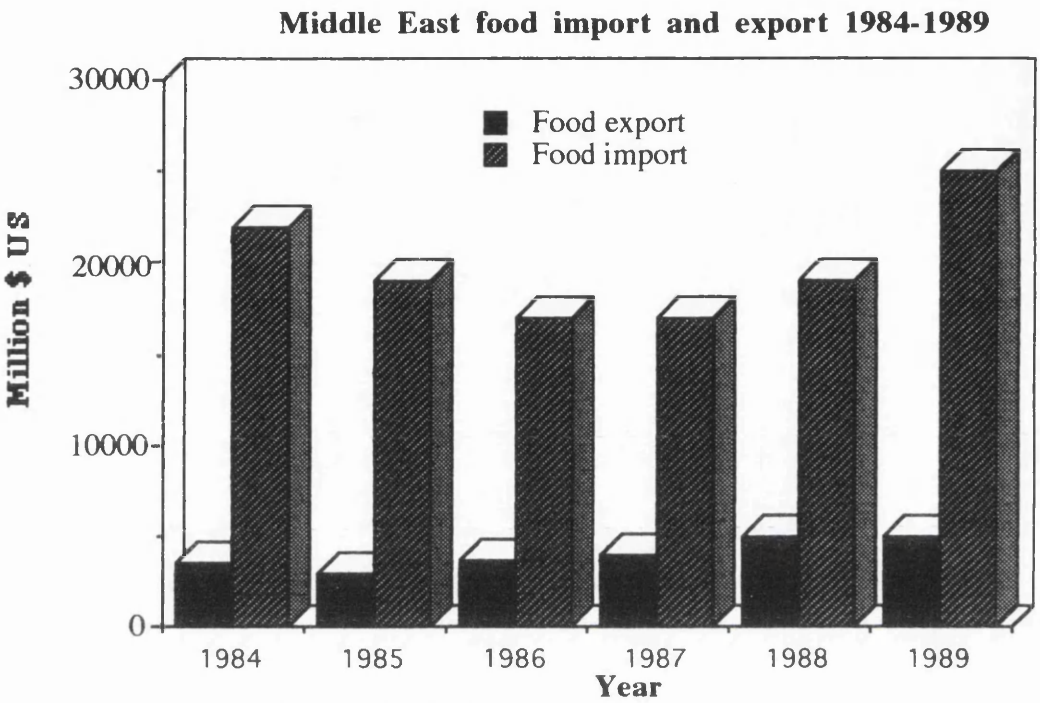


Source: Comet, January 1992, 27

Regional population growth is unlikely to fall dramatically and even the recent collapse of oil prices has not reduced income sufficiently to have affected national food demand substantially. Food consumption is highly inflexible downward: and governments are likely to cut everything else (except defence) before they reduce the nation's (urban) food supply. It is therefore reasonable to conclude that there will be little reduction in the food gap from the demand side. There are two ways to increase agricultural production: bring new land into cultivation, and raise the productivity of existing farms. Middle-East countries must increasingly rely on the second option. Output growth can only be accelerated by shifting from "extensive" to "intensive" growth. This kind of process is difficult and expensive, and requires numerous state initiatives which will transform Middle Eastern rural societies, and generally involve an increase in water use. The rate of growth of the production of various crops has also varied widely with the output of "luxury" foods like fruit, vegetables, poultry & livestock products increasing more rapidly than that of the cereals. Such trends do not reduce the food gap, but may actually increase it since, for example, increased poultry production stimulates feed imports. The most important natural constraint in the Middle East is the unfavourable rainfall. The "gamble on rain" causes many countries to look for supplementary foreign currency to buy increasing amounts of food four years out of ten *(Richards & Waterbury, 1990,143).* The devastating droughts cause social, economic and political disruption; forcing people from their homes, and causing movement to cities or to less severely affected areas ("drought refugees"). The first response to this situation was to import food. Food imports grew region wide at an annual rate of about 12 per cent between 1960 to 1980. Because of the rapid population growth rates in the region and the significant rise in the standard of living, food shortages continues to grow. In 1960, the Middle East was still a net food exporter but, in 1973, food imports amounted to $ U.S. 4 billion; by 1980, the food import bill had reached $ US 20 billion, and by 1984 $ U.S. 26 billion. *(Lawless, 1985,107; Qasem, 1990,162).* According to Comet (1992), in 1989 alone the food imports amounted to $ U.S. 26 billion (see figure A3) as opposed to the $ 23 billion in 1984. One should note that, since the various researchers do not define the Middle East region and the countries included in it, differences in the data might result.

Wheat is the most widely grown food crop in Middle East and, in 1970, but total wheat imports to Arab countries still averaged 4.9 million tons, costing $ U.S. 323 million. This amount increased to 10 million tons in 1980, and 16.7 million tons in 1983, at a cost of $ U.S. 3,237 million. The Arab countries produced 60 per cent of the wheat they consumed in 1970 and only 33 per cent in 1983. There were several main reasons for this: unstable domestic production was caused by erratic rainfall and the oil exporters commanded large supplies of foreign exchange and they could buy food freely and were not constrained by balance of payments problems until the 1980s. In addition since most of the wheat imports to the region were hardly related to the international market, increased purchases had no impact on price and, in some countries, urban-consumers preferred wheat which had to be imported.

Figure A3:



Source: Comet, January 1992, 27

In most countries of the Middle East the food deficit between domestic production and consumption has increased over the last two decades. Syria was a net exporter of basic food commodities (wheat) and feed stuff (barley) in 1960s but in the 1970s, although it still reached self-sufficiency in barley production, it was only 72 per cent self-sufficient in wheat production. In the 1980s production lost ground again, and Syria slipped to 84 per cent self-sufficiency in barley and 60 per cent in wheat. These circumstances are critical but many countries in the region find themselves in an even worse situation. If current levels of productivity continue to the year 2000, not only Syria, but most of the countries of the region, will have a deficit in wheat production of 55 per cent of domestic needs *(Perrier & Salkini, 1991, 279)*.

All Arab countries, suffer from trade deficits in food commodities, however Arab countries vary in the magnitude of their food trade deficits. To a certain extent, the level of such deficits is an indicator of the extent to which each country takes measures to correct its trade imbalance. Arab food trade deficits for the years 1980-1984 are shown in table A.5.

Table A.5:

Average annual food trade deficits (1980-1984)

Country	Value of net food imports (in millions of US dollars)
Saudi Arabia	4000-5000
Egypt, Algeria	2000-2500
Libya, Iraq	1000-1500
Kuwait, United Arab Emirates	700- 850
Lebanon, Syria, Yemen Arab Republic	400- 600
Jordan	300- 400
Morocco, PDR Yemen, Qatar	200- 300
Bahrain, Tunisia, Oman Sudan, Djibouti	50- 100

Source: Qasem, 1990,162.

For a country to import food is not necessarily problematic for the economy, but when food imports make up a large share of the total value of a country's exports of all types then they become a constraint upon the economy. The cost of food imports as a percentage of the value of all exports in the Arab world during the period 1980-1984 is shown in table A.5. Saudi Arabia, for example, imported food commodities at an average value of $ US 4.5 billion each year during 1980-1984. However, this figure represented only about 5 per cent of the total export income. On the other hand, Egypt's net imports of food averaged $ US 2.4 billion over the same period, constituting 68 per cent of all its export income *(Qasem, 1990,163)*.

Several of the states in the Middle-East have become entirely dependent upon imported food, a situation from which they would prefer to be freed by means of planned agricultural development. One result has been that food imports have increased government control over strategic urban food supplies *(Richards & Waterbury, 1990,* 144).

Expansion of food production in water-short areas and in marginal land has made rapid development of irrigation and land reclamation necessary, to the degree that water and land resources have often been exploited to their limits. Throughout most of the 1980s period Middle East governments and farmers were mainly concerned with the provision of a sufficient volume of water for agricultural needs, and only minor amounts of water were diverted for domestic purposes. Although agriculture continues to be the largest single user of water, the growth of domestic and industrial water consumption has increased sharply *(Beaumont, 1981, 67)*. From calculations of the demand for water and agricultural soil in the region it is clear that, there is a high natural growth rate in the Middle East and that some 150 million people will be added to the total population between 1980 and 2000 representing an additional regional water requirement of 150 billion m^3 per year or nearly three times the flow of Egypt's section of the Nile. As a result, the states would like to increase their cultivated areas significantly and add large amounts of water to irrigate these additional regions. Locating and developing sufficient new water for this purpose is not possible *(Beaumont, 1985b, 318).*

Table A.6:

Average cost of food imports as a share of total exports

Country	Food imports/total exports (as a percentage)
Saudi-Arabia, Kuwait, U.A.E, Qatar	4 - 5%
Libya, Oman, Morocco, Sudan	6-10%
Tunisia, Iraq, Algeria	13-15%
Syria	27%
Lebanon, PDRY (South Yemen)	41-46%
Jordan	56%
Egypt	68%
Bahrain, Yemen Arab Republic	Over 84%

Source: Qasem, 1990,163.12

A4.2 Industrialization and industrial water use

Household and even municipal water needs are only a small part of the water supply problem. Globally, industrial water usage is at least twice that of domestic use industrial uses include uses associated with the generation of thermo-electric power, the production of steel, chemical and allied products, paper and allied products, mining and petroleum refining.

We need at least three litres of water to produce a tin of vegetables, 100 litres to produce one kilogram of paper, 4,500 litres to produce one tonne of cement, 4.3 tonnes to manufacture one tonne of steel, 50 tonnes to manufacture a tonne of leather and no less than 2700 tonnes to make a tonne of worsted suiting *(Clarke, 1991, 3).*

The Middle-East countries have embarked on industralization to reduce their dependence on imports of industrial products and to gain prestige, economic strength and national and international significance. Industralization implies a higher level of labour productivity and income, and is profitable to those willing to invest in a modern economy. Most significantly returns to water are much higher in the non-agricultural sectors of industry and services. Such economic and business reasons have suited the Middle East where purchasing has risen during the last three decades *(Tuma, 1987 ,131).*

The move towards industrialization has enjoyed high priority in government planned expenditure in the Middle East. Such governments may be directly involved in industrialization either as a natural result of the "relative backwardness" and underdeveloped structure of the economy and policy in the region, or because they have socialist ideologies where central planning and ownership of the means of production predominate. Alternatively they may be traditional and state capitalist economies, where the state owns or controls most of the natural resources and carries responsibility for large sectors of the economy *(Tuma, 1987, 138).*

Regardless of the ideology or economic and political systems, all the countries in the region have economic plans that specify the expected level of expenditure in each of the main sectors of the economy and reflect the emphasis on industry and manufacturing. According to the national plans of six out of twelve Arab countries in the late 1960s and early 1970s, on which data were available, more than 50 per cent of the total government investment expenditure was devoted to industry and manufacturing. The other six countries devoted from 21 per cent to 49 per cent of their investment budget to industry and manufacturing. This trend continues and is generally expressed as a joint venture between the public and private sectors, with the public sector controlling a majority of the shares.

There are many ways of evaluating industrial development: by examining the rates of industrial growth, changes in the relative contribution of industry to the GDP, or by the per cent of the labor force employed *(Tuma, 1987, 131).* For example, half of the Middle East countries reported a larger percentage of the GDP originating in industry and manufacturing in 1980 than was reported by the industrialized countries for the same year.

While the share of the GDP of industrial and manufacturing products increased between the years 1960s and 1981, the average annual rates of growth varied widely. Another way of looking at the pattern of industrialization is to observe the consumption of energy per-capita, on the assumption that industrialized societies use more power, machinery and equipment than less industrialized ones. In fact, energy consumption has increased in all countries of the region, very dramatically in some cases, and especially in the oil-rich countries.

Another criterion of industrialization is the percentage of the economically active labour force which is engaged in industry and manufacturing. For example Israel, Tunisia and Egypt, employed more than 30 per cent of their labour force in industry and manufacturing in 1980 *(Tuma, 1987, 134).* All the countries of the region (except Jordan) have experienced increases in the percentage of the labor force engaged in industry and manufacturing. In Jordan the shift in emphasis has been towards the service sector reflecting its particular circumstances and international relations.

Energy is considered to be a crucial factor for rapid development and the welfare of society and, as the pace of economic growth increases, energy derives critical importance through the development of energy-intensive industries. The bulk of water used by industry is for the production of electricity. This use is generally not a problem because there is little consumptive loss and there is usually only the disposal of hot water to worry about. Vast quantities of water are used by power stations as cooling water, and although this water is not "used", - being returned directly to the river from which it is taken, unaltered except for a temperature increase of a degree or two - it must still be subtracted from available run-off. A power station must have a reliable supply of cooling water (a condition that is increasingly hard to meet in some areas), and this means that the water power station use cannot be diverted upstream for other purposes, making cooling water a drain on water resources. Taken together, these two uses - industrial use and cooling - amount to more than four times domestic water use and they must be supplied from reliable sources of run-off water *(Clarke, 1991, 22)*. In other industries water is used as a coolant, a lubricant, and a component. Three industries - chemicals, primary metals and paper - account for 70 per cent of industrial water use. When the petroleum, coal and food industries are added to the three largest users, the water use of these industrial groups amounts to more than 85 per cent of the total industrial water use *(Speidel, 1988, 914)*.

When industry develops the amount of water required increases and, in regions with a water surplus, some branches of industries have developed technologies with relatively high water demands. At present, water saving technology is being developed in many places in order to make industrial development less dependent on large amounts of good quality water.

A5: Research topic: water in the region - supply and demand

One of the most important characteristics of the Middle East is, undoubtedly, the small amount of precipitation, and the most limiting characteristic in the agriculture of the region is the lack of water. Throughout most of the region rainfall is seasonal, mostly in the winter although in southern Arabia and the Sudan there is summer monsoon rainfall. Only in northern Turkey and northern Iran (in the Black Sea-Caspian Sea region) is there year-round precipitation. The heaviest precipitation, some 1,500 mm annually, falls along the Black Sea and Mediterranean coasts of Turkey while in most of the upland areas of the region, the average annual precipitation is around 400 mm. In the Arabian peninsula, southern Iran, Iraq and Egypt, the annual precipitation is less than 100 mm. In most cases, the rain falling in the mountainous areas is not utilised for agriculture in the areas in which it falls due to the steep topography and low temperatures which cause the precipitation of snow in these areas; thus the water flows in rivers over hundreds of kilometres towards the arid regions of the Middle East *(Beaumont, 1985a, 16)*. Because of the political subdivision of the region, the Middle East is characterized by a large number of rivers shared by more than one state. According to Kolars (1990), over fifty per cent of all the population in the Middle East and North Africa (excluding the Maghreb), either depend upon water from rivers which cross an international boundary before reaching them, or upon desalinized water and water drawn from deep wells. More startling, two-thirds of all Arabic speaking people in the same region depend upon river water which flows to them from non-Arabic speaking countries, while another 24 per cent live in areas with no perennial surface streams whatsoever *(Kolars, 1990, 57).*

Agriculture, the largest user of water, is the most important economic activity in the region. On an average, some 30 per cent of employed people in the region make their living directly from agriculture, and there is an additional population which is dependent upon agricultural production as a source of raw material for their industrial production. This is still the case, even though the contribution of agriculture to the Gross National Product in all the states of the Middle East has been in constant decline, as has the proportion of the total population employed in agriculture *(World Bank, 1992).* Most of the states in the region base their agriculture on ground water or water from rivers, the sources of which are outside the state or even outside the region *(Allan, 1985, 52).*

According to Miladi (Regional coordinator of the UN in the Middle East), the total area of fertile land in the Arab Countries is only six per cent, and sixty per cent of that area depends on rain, while the other forty percent is mostly forest or grazing land. Only relatively small areas are such as the valley of the Nile in Egypt and the Sudan, and the Tigris and Euphrates region of Syria and Iraq are irrigated *(Underwood, 1981, 53).*

In the past 40 years an agricultural revolution has taken place in the Middle East originating in the transition from a traditionally agricultural society to one based on modern agriculture using water on ever-increasing areas. Additional substantial changes in water usage in the region have stemmed from the rapid population growth, in particular since the Second World War. In 1950, there were some 130 million inhabitants in the region extending from Iran, in the east, to Morocco in the west, and from Turkey, in the north, to Sudan, in the south. In 1985, the same region had 264 million, people and the projected population for the year 2000 is 420 million *(Beaumont, 1985b, 315).* A strong process of urbanization, a rise in the standard of living, industrialization, and the desire of the states to reach self-sufficiency in the area of food production have created a demand for large quantities of water *(Beaumont, 1985a, 20, Allan, 1981, 24,).*

Today the supply of water is seen, by most of the governments of the region and most of those shaping water policy, not only as a prerequisite for organized development, but also as a basis for spontaneous development *(Beaumont, 1981, 62).* On the other hand, the shortage of water in the region has been exacerbated by the development of modern irrigation systems which can only be operated with the aid of considerable energy, a feature which reduces the quantity of water in the rivers and leads to an increase in the subsidies to in the agricultural sector and especially in the provision of water. The energy subsidies to the agricultural sector are especially high due to the enormous costs of transferring the irrigation water to the most fertile soils which are not necessarily found in the areas closest to the sources of water. The model for the development of new irrigated agricultural areas is based on the transfer of irrigation water to previously uncultivated areas or on the improvement of agriculture in areas which once used dry-farming methods. The transfer of river water for irrigation has been made possible through advanced technology introduced over the past 40 years, especially water pumps operated by electricity or diesel engines which have replaced the traditional methods based on manpower or animal power *(Beaumont, 1981, 59).*

The development projects of the past 40 years have had a considerable influence on the river and ground water regimes and on the quality of the irrigation water. In several instances, the development projects have caused a diminution in the amounts of water reaching states further downstream because of water utilization for irrigation purposes and the considerable evaporation which occurs in the reservoirs behind the dams, especially in dams built for the sole purpose of creating electricity *(Adams, 1985, 72).*

Further damage is caused by a rise in water salinity as a result of the increased evaporation and the return of polluted water to the rivers, preventing downstream states from cultivating salt-sensitive crops. The implementation of development plans is in turn greatly influenced by the damage caused to the irrigation systems by inadequate drainage and the increased salinity of agricultural soils *(Naff & Matson, 1984,160).*

The high natural growth rates in the region (between Iran and Morocco and between Turkey and Sudan), some 150 million people will be added to the population between 1980 and 2000. As a result the states must significantly increase cultivated areas and increase the amount of water to irrigate these additional regions. There is no doubt that adding water for this purpose to the amounts of water currently in use, is not possible *(Beaumont, 1985b, 318).* According to Fahmi (1988), the water resources of the Middle East (for purposes of agriculture, industrial and human use), are estimated at about 163 billion m^3/yr., of which 140 m^3 meters are surface water and 23 billion m^3 are ground water. In addition, 9.7 billion m^3 are derived from unconventional sources such as the processing of drainage water and the desalination of sea water, leading to total annual utilized water resources for all purposes of 173 billion m^3· These volumes represent only 50 per cent of the 305 billion m^3/yr. required by Arab states to achieve self-sufficiency *(Fahmi, 1988, 8).* Because of the rapid natural growth rates in the region and the significant rise in the standard of living, the food shortage, has continued to grow since the growth rate in the agriculture sector during the last decade has remained at a low level of only two per cent. Demand for food products, on the other hand, has increased at the very rapid pace of five per cent per annum causing the Middle East to now be one of the world's largest food deficit areas. *(Fahmi, 1988, 8).* In 1960 the Middle-East was still a net food exporter, but by 1973, food imports amounted to $ U.S. 4 billion and by 1980, the food import bill had reached $ U.S. 20 billion *(Lawless, 1985, 107)*. In 1989 the Middle East import of foodstuffs, mostly cereals, amounted to $ U.S. 22.3 billion *(Comet, January 1992, 25)*. According to Miladi, the food imports in the Arab World as a whole, increased during the eighties by 700 per cent, and the annual food imports reached 35 per cent of the world total *(Underwood, 1981,* 53). In this way several of the states in the Middle East have became entirely dependent upon imported food, a situation from which they would prefer to be freed with the aid of development plans *(Lawless, 1985, 102)*.

The development projects of the various states have created an increasing shortage of water which will become much more acute in the future, as additional development projects are put into operation. All the states in the Middle East are increasing their use of water; thus the possibility of disputes arising over shared water resources has been sharpened. This process is occurring over a wide geographic area, from the viewpoints of physical, ethnic, cultural, religious, and political structure. This makes solving the problems difficult since the finding of solutions to water problems is unique in the range of factors which impinge on the societies, economies and political institutions of the countries which share surface and ground water resources..

As the use of water is essential to the development of agriculture, the production of energy, industrialization, health, and raising the standard of living, it should be seen from political, economic, legal, social, and ecological perspectives. Thus, any examination or analysis of the topic will be both complex and complicated.

A6: Competing demands

In the opinion of several researchers, the future of the Middle East depends more on water sources than oil resources *(MEI, June, 1990; Perera 1981, 47; Caelleigh 1983, 22; Nasrallah, 1990, 16)*. Nesser Wahabi, the Minister of Social Affairs & Labour of Oman, puts a common argument and even if it is based more on emotion than on sound economic evidence it is nevertheless a pervasive and for many a persuasive one: "Obviously agriculture cannot compete at the moment with the lure of the capital area where people can get a guaranteed wage for an eight hour working day and, as a result, agriculture is suffering. But it is clearly something that has to be sorted out because agriculture, together with fisheries, is in the long term more important to this country than oil and minerals". *(MEED, 1977,14)*

As long as there is joint use of river water systems in the Middle East it is natural for the developing system of relations in the region to be expressed in terms of cooperation or conflict between the states involved. An example of this can be seen in the struggles directed against development works concerned with water resources in the region. Only a small number of agreements to divide the waters of a joint river system among several states have been signed or otherwise settled and those that exist have proved to be difficult to implement.

For example Syria and Jordan signed an agreement to divide the water of the Yarmuk River in 1987, but about 30 million m^3 of the Yarmuk water reaches lake Kinneret in Israel annually. It can be assumed that Israel will probably not permit any change in the quantity of water reaching Kinneret, and that Syria will probably not in the event be prepared to give up water to Jordan.

The Orontes River rises in Lebanon and flows through Syria to the sea in the Hatay region of Turkey. Syria and Lebanon reached an agreement over the use of water from this river in 1972, but there is no similar agreement between Syria and Turkey. The Syrians claim that the Hatay region is an integral part of their state which was illegally transferred by the French Mandate to Turkey in 1938. The Syrians' demand for a water division of the Euphrates is countered by the Turks demands for an agreement to divide the water of the Orontes which is used almost entirely by the Syrians. However, such an agreement would bring about de facto Syrian recognition of the area as belonging to Turkey, something that the Syrians are not prepared to acknowledge *(Naff & Matson 1984).*

Israel and Jordan, both of which currently over utilize their water potential *(Frey & Naff 1985)* are examples of states whose future development of agriculture will be retarded. In this respect, Cooley (1983), Naff (1991, 17) and Stork (1983) have presented the external relations strategy of Israel as one which is directed, first and foremost, at answering the country's water needs. These researchers claim that Israel annexed the Golan Heights because it controls part of the Jordan's sources, and aims to retain control over this area in the future. Similarly, the same researchers claim that, to a large extent, the Lebanon War of 1982 was designed to assure Israel's control of the source of the River Litani. These statements, supported by insufficient evidence, indicate the need for more all encompassing research, which will examine both the influence of water on regional geopolitics and the influence of regional geopolitics on the development of the river systems.

A7: The role of water in regional international relations

From these examples, it is clear that differences of opinion over the use of river water in the Middle East is one of the most important active issues in regional politics, both overtly and covertly. Overtly, we can see the issue clearly when agreements are signed, or complaints filed with the United Nations or when a military threat is felt. Covertly, the river waters can be seen as an important strategic factor when states in the region consider political manoeuvres and these political manoeuvres influence the development of the river systems.

The use of joint river systems and the utilization of their waters is particularly complex from a legal standpoint. International law with respect to water provides a poorly developed framework for international discourse and for the foreseeable future the legal arguments will be subordinate to political considerations. International law is also ambiguous, in for example the interpretation of the principle of 'no harm'. A state's territory undoubtedly includes the water flowing through it, "national waters", but national waters, flowing in rivers, may reach the territory of another state, becoming the national waters of that state. Water, being part of the territory, but temporary and flowing, makes the definition of the concept "territory" problematic, and raises complex questions in international law *(Berber, 1959, 4)*. When "unfair" use of river water is made by other states, international law refers to this as "destructive use". "Destructive use" can be caused by a change in the flow of the river in such a way that the water is not returned to the existing system for the use of others, or brought about if an upstream state uses more than an agreed amount of water. Although some of the water may return to the river system, it may do so in marginal amounts and be of such poor quality, that it cannot be used by the other partners *(Naff & Matson, 1984, 158)*.

Typical of the views held by states which share water systems with others is the claim by an upstream state that its sovereignty is full thus allowing it to use the water within its borders in any way it sees fit, without taking into consideration the ensuing effect upon the downstream states. In many instances, the downstream states are those which begin the confrontation, demanding that the historical river flow into their territories continue without any change. The principle guiding international law in such issues is "Use your own water so that you do not undermine the use of those using it after you" *(Berber, 1959,13)*.

The best expression of the principle of communal water utilization can be found in the Dubrovnik draft (1956), the Helsinki rules (1966) and the ILC draft (1991), which have become the accepted legal foundation for the utilization of international rivers (see chapter F).

A7.1: The Euphrates catchment

The Euphrates river is shared by Turkey, Syria and Iraq, and the sources of the river are two principal tributaries which rise in the mountains of Armenia in eastern Turkey, a region with a mountainous Mediterranean climate which determines the flow regime of the river. The river flows through a pass in the Antitaurus Mountains towards the plains of Jezirah in Syria, when three additional tributaries join it - the Sajur, the Balikh and the Khabur. From here to the Persian Gulf, there are no further additions of water to the river.

The river is 2,330 km long, and its average flow is 31.8 billion m^3/yr. However, the flow is greatly influenced by the amount of precipitation, and the flow in a drought year has been measured at 16 billion m^3 whereas, in rainy years, it has been measured at 43 billion m^3. These irregular flows have stimulated the construction of reservoirs to channel a constant flow of water through the river over the years.

The area of the drainage basin of the river is 444,000 km^2 of which 28 per cent is in Turkey, 17 per cent in Syria, 40 per cent in Iraq and 15 per cent in Saudi Arabia (see table B.1). In contrast to these figures, conservative estimates will claim some 88 per cent of the river water originates in Turkey and 12 per cent in Syria, whereas Iraq contributes nothing to the river water *(Beaumont, 1978, 38)*. According to Kolars (1986), 98 per cent of the stream flows from Turkey when all factors are considered *(Kolars 1986a, 54)*.

All three states, at one point began to prepare intensive development plans to utilize water from the river. The purpose of the development plans in each of these states was to increase self-sufficiency in food in order to keep up with the rapid rate of population growth and reduce the level of political and economic dependence on the import of food. They wished to reduce unemployment, raise the standard of living in backward regions, prevent migration from the rural areas to the large cities, supply raw materials to local industry (cotton and sugar beet), and produce hydroelectricity. In order to realize the agricultural development plans, raise living standards and develop industry, each of the states involved needed to increase the use of water. During a tripartite meeting in Baghdad in September 1965, Iraq demanded at least 18 billion m^3, Syria 13 billion m^3 and Turkey 14 billion m^3 *(Naff & Matson 1984, 92)*.

Many meetings have been held since 1965 involving representatives of the three states concerned in an attempt to reach agreement over water distribution. The last such meeting was held in Ankara in June 1990 where Turkey refused Iraq's demand for a flow of 700 m^3/sec, and was unwilling to concede the average of more than 500 m^3/sec offered by Turkey *(Dateline, 30 June, 1990)*. It would appear that Turkey is not interested in reaching a final agreement over dividing the waters of the river before the exact quantity of water needed for the Southeast Anatolia Development Project (GAP) finally becomes clear. Turkish development projects have greatly influenced the flow regime of the river and will have an increased impact in the future, on the quantity and quality of the water reaching the downstream states. Turkey's political influence, through interfering with the flow of water to downstream states can only increase. Turkey already has considerable power today since its ability to store water behind the dams already constructed is more than double the annual flow of the river.

Without any doubt, the sharing of the Euphrates water is a very important geopolitical issue which has already created political tension and military posturing between the states several times in the past.

A8. The purpose of the study

There has been relatively little research on the possible linkages between the growing scarcity of fresh water and potential for future conflicts, although the interconnection of the water factor with other key factors has been demonstrated.

The Euphrates river system, where the problems of water use are at an advanced stage, exemplifies many such problems, and is a case of a resource conflict over fresh water with many associated economic and political factors involved. In this kind of conflict, it is not possible to assert which factor is foremost at any given time. A dispute over fresh water resources may, for instance, spill over to political conflict or economic factors and disputes may cause the sharpening of the water conflict.

The central aim of this research is to examine the utilization of the Euphrates River, by Turkey, Syria and Iraq and to analyse current supplies and future supplies which will be available as a result of supply management policies in terms of foreseeable water demands by the riparians to determine the extent to which supplies will match demands.

The Euphrates is a very important case study and provides significant insights into the environmental, economic, social, legal and political issues which have to be addressed when riparians attempt to optimise their national interests while claiming to take the rights and interests of neighbouring states into account in the attempt to avoid conflict. The study will analyze the factors which influence the relations between these states, using data on hydrological, territorial, legal, political, economic, historical, social, demographic and military variables. The study will also examine the river and its tributaries as a geographical phenomenon (the river basin as one ecosystem unit) influenced by these relationships.

The research will review issues on both the theoretical and practical levels. On the theoretical level, points of both contention and cooperation concerning the joint waters will be examined through the use of geographical models taken from the field of regional planning, models from relevant international legal regimes (Helsinki Rules on the uses of the waters of international rivers) and models dealing with international conflicts connected with the joint use of river systems. A primary theoretical tool used to analyse the significance of water as an emerging national and international issue will be the use of cognitive maps. The second tool will be quantitative indicators of vulnerability arising from water shortages, and the third will be a matrix model. On the practical level, the Euphrates river system will be examined by evaluating the water-related components of the disputes in recent and past international conflicts which have taken place between states of the basin and possible future conflicts.

The main contribution of the study will be to provide a rigorous examination of the current hydropolitical situation based on a more comprehensive review of the hydrological and socio-economic data than elsewhere attempted. So far, the evidence, assembled from environmental and socio-economic information, is consistent with the thesis - that there will be sufficient water in the Euphrates system to meet the foreseeable demands made by the developing political economies of the states which share the catchment and that the riparians will continue to make the economic and political adjustments necessary to avoid conflict. The only factor which could negate this analysis is the unusual political and economic predicament of Iraq following the Gulf War of 1991. This is an important conclusion since it contradicts the popular, and irresponsible, contention found elsewhere in supposed scientific literature that armed conflict is inevitable *(Coley, 1984 ; Naff & Matson, 1984 ; Starr, 1991; Musallam, 1989).*

In order to establish the thesis that there is enough water in the Euphrates system, with supplements from the Tigris, it will be necessary to qualify the natural flow in the system. Chapter B examines quantitative and qualitative aspects of the Euphrates flow and of its tributaries. The management of Euphrates water is the major using sector - irrigated agriculture. It is shown that a variety of environmental and economic factors will tend to restrict the use of water in agriculture, confirming the prime thesis. The overall position for all three riparians and for all using sectors is analysed in chapter D and it is again demonstrated that water is not the constraining element on the socio-economic development of the Euphrates countries.

B. The Euphrates River - A General Description

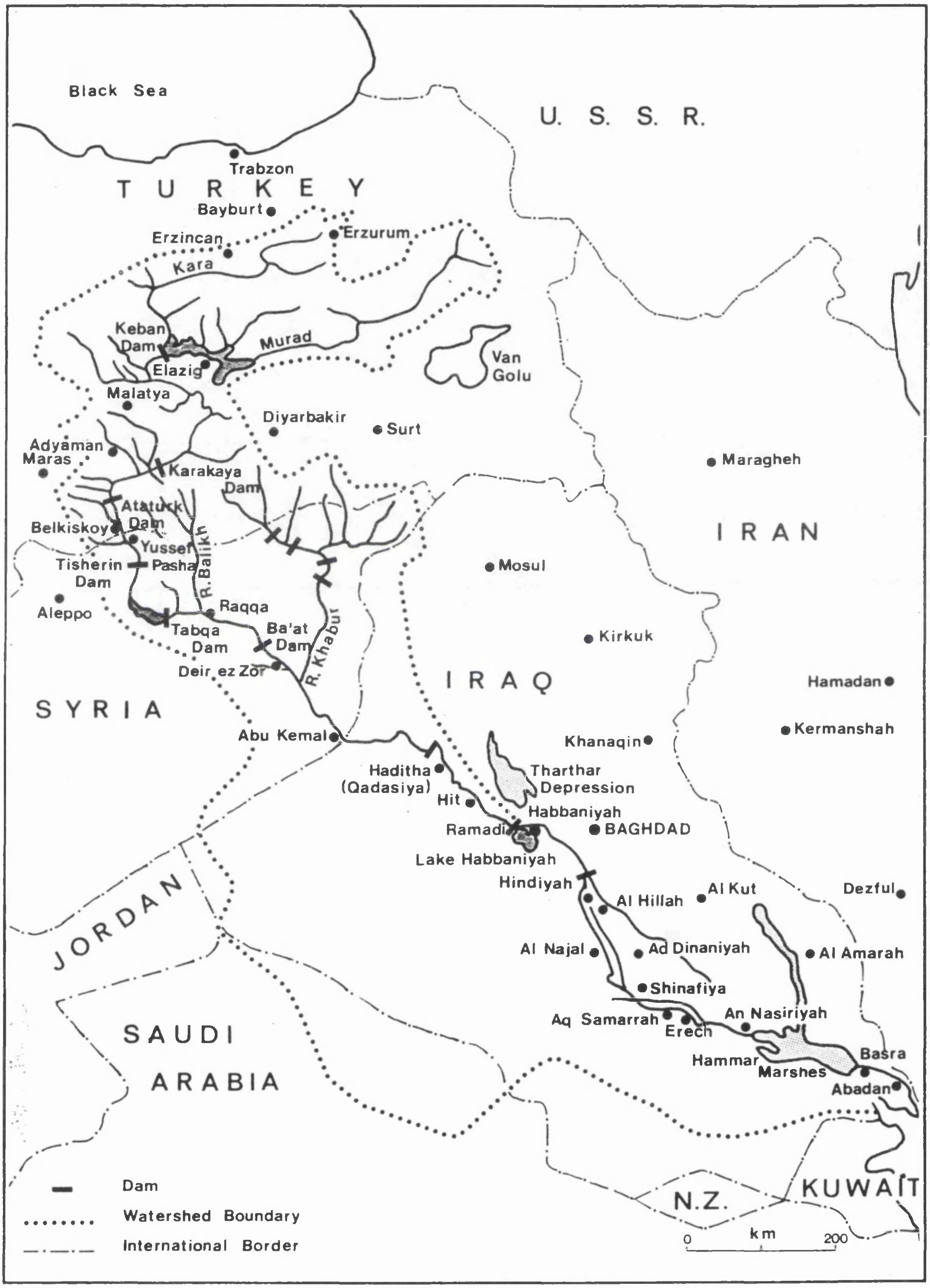
The policy-making process for the development plans in the Euphrates drainage basin is influenced by the physical conditions of the valley, and these factors constitute an essential basis for a discussion of the topics to be considered later.

The Euphrates River rises north of Erzerum in Turkey, where the highest mountains are more than 3000 metres above sea level. The sources are situated between the Black Sea and Lake Van, and the river is formed by the confluence of two tributaries, the Murad-Sue, which originates in the many springs in the area of Ala-Dag, and flows from the south, and the Kara-Sue, which begins in the Kargapazari Mountains, north of Erzerum and flows from the north to meet at a point near the village of Keban. The Murad-Sue river is 650 km long and the Kara-Sue river is 450 km long, but from the height of 1,000m, above sea level, the river is then known as the Euphrates *(Al-Hadithi, 1979, 45).* These tributaries contribute 75 per cent of the Euphrates water.

Ten kilometres downstream from the confluence, there is a narrow gorge, where the Keban Dam has been constructed. Downstream from the Keban Dam many tributaries and wadis join the river, increasing its discharge. The most important tributary is the Tokhma Sue which drains the Taurus mountains and joins the Euphrates near the town of Malorteya. Below the village of Keban, the Euphrates flows down the steep slopes on the southern margin of the mountains of the Kurdestan and Armenian areas, and enters the region of the eastern plains of Syria. The total length of the Euphrates in Turkey, from the point of confluence of the Kara-Sue and Murad-Sue until it enters Syria at the town of Trablus, is 455 km. The Euphrates has three tributaries in Syria. The Sajur joins the Euphrates on the right bank about 30 km downstream from Jerablus; the Balikh joins on the left bank halfway between Jerablus and Dier-ez-Zor while below Dier-ez-Zor, the river broadens out somewhat and now contains numerous rocky stretches, shallow rapids and islands and is joined by the last important tributary, the Khabur, about 30 km below Deir-ez-Zor. The Khabur rises on the south-facing slopes of the Taurus mountains in Turkey and drains into north-eastern Syria. South of the Balikh river the Euphrates river receives no further discharge from any source, but a number of dry river beds indicate that in relatively recent geologic time a number of tributaries flowed into the Euphrates from what are now the Syrian and Arabian deserts.

The total length of the Euphrates in Syria is 675 km and it enters Iraq at the Husaiba Settlement, after flowing through Abu Kamal in Syria. Having crossed the Iraqi border, it continues its flow in a south-easterly direction, crossing the desert uplands and narrow wadis which end at Ramadi and enters the Mesopotamian plains. Because there is no

Map B.1 : The drainage basin of the Euphrates river



great difference in elevation between the river beds and the surrounding irrigated areas, gravity canals are used to divert the water for irrigation *(Al-Khashab, 1958, 8)*. Although the Euphrates comes very close to the Tigris near the town of Falluja, it again flows away from it, but the water level in the Euphrates is higher than that of the Tigris at a similar point. This is why the land between the two rivers can be irrigated by diverting Euphrates water from its left bank by means of canals. Downstream from the town of Mussaiyab and upstream of the Hindiya barrage many large canals draw water from the Euphrates River, and the most important is Shatt-al-Hilla (called Shatt-al-Hindiya at this point), which passes the Hindiya barrage and then flows through the towns of Hindiya and Kifil. Downstream from Kifil it bifurcates into two branches - the Kufa branch on the west and the Shamiya branch on the east. The Kufa branch again bifurcates downstream from the town of Abu Shukhir into the Jehad and Mishkhab branches and the Jehad branch ends in an area of agricultural land where its waters are completely utilized for irrigation purposes. The Mishkhab branch continues to flow in a southern direction and passes through Mishkhab, Qadisiya and then to the south of Shinafiya. Here the river then flows into many branches which join one another to the north of the town of Nasiriya. From Nasiriya the river again flows into many branches towards the town of Souk-al-Shiukh and all these branches discharge into the Hammar Marshes. From the Hammar Marshes the Euphrates waters flow into Shatt-al-Arab, near Karmat-Ali.

The total length of the Euphrates in Iraq is about 1200 km and the total length of the Euphrates from the confluence of the Kara-Sue and Murad-Sue to its confluence with Shatt-al-Arab near Karmat-Ali is about 2330 km. The Euphrates and its tributaries drain an enormous basin of 444,000 km^2 in area, 28 per cent of which lies in Turkey, 17 per cent in Syria, 40 per cent in Iraq and 15 per cent in Saudi Arabia *(Naff & Matson, 1984, 82)*. In its course, the river flows through four topographic regions:

a. The high mountainous region which is located in the northern part of the basin, from the sources of the river to the area south of the village Cungus in Turkey. Here the region rises to an attitude of 1,500 to 3,000 metres above sea level, where the river flows through narrow and deep wadis and, later through a line of basins and wadis until it reaches the Anti-Taurus system. In this region, the river flows rapidly and is characterized as an Alpine River.

b. The foothill region and the Kracali heights which are located south of the mountainous region south to Chingiz (740m) and Birecik (420m) in southern Turkey. This is the transition zone between the mountains and the lowlands and most of this area is located in Turkey. The Euphrates flows in a cleft that is partly covered with lava accumulations and the river cuts down into a deep and curved valley 20-30m beneath the surrounding area.

Here the river's stream becomes wider and its flow weakens.

c. The Plains of Gezira which are located south of the foothills stretch, from Birecik (420m) to Hit in Iraq (52m). In this area the river flows in a series of extensive flood plains. The river meanders through a wide, valley and geological circumstances cause the river to flow between elevated bluffs

d. The Plains of Iraq and the Delta from Hit until the Euphrates joins the Tigris river, the region is a flat, delta-like plain. The river flows across an alluvial plain built up from eroded material upstream. The river gradient is small (sometimes no more than 510 cm per kilometre). In the plains region, there are wide areas of marshy lands including streams and meanders which have been abandoned *(Abbas, 1984. 69).*

BI: The climate of the basin

The Euphrates River, from its sources in north-east Turkey up to its confluence at Shatt al-Arab, flows through three climate zones which differ significantly from one another (see map B.2). These are:

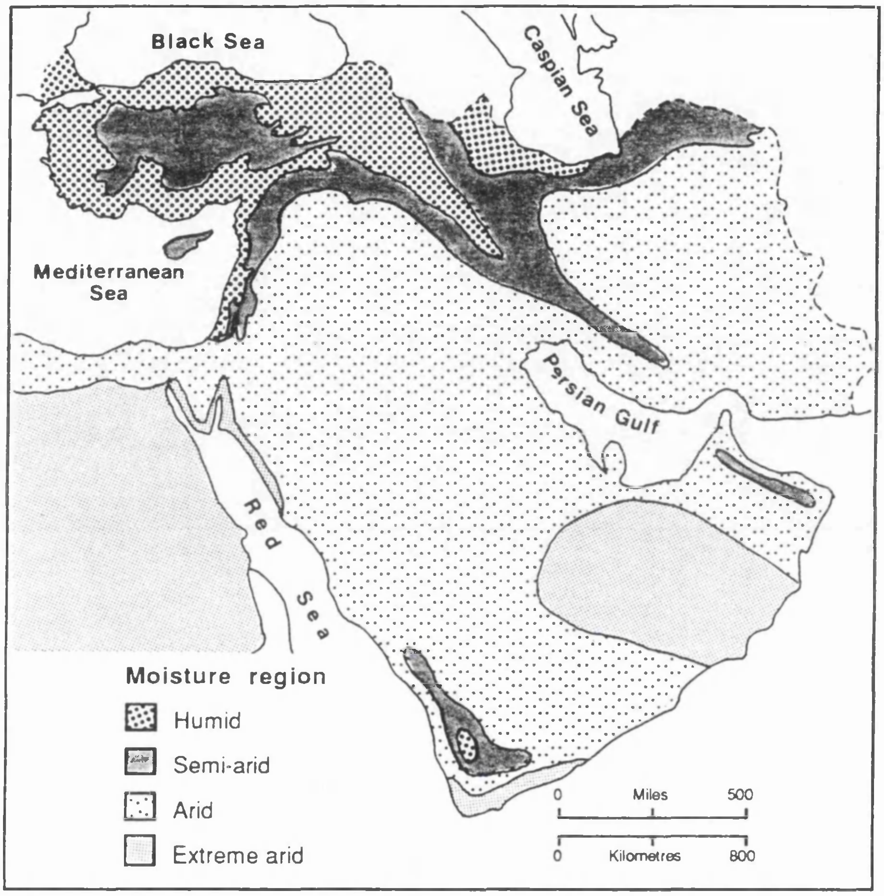
a) The Mountainous Mediterranean Climate Zone - climate determines the flow regime of the river. Temperatures in the mountains frequently fall bellow 0°C during the winter and the Euphrates is largely fed by precipitation falling over the uplands of Eastern Turkey, where the annual total precipitation often exceeds 1,000 mm. As most of this precipitation occurs during the winter months as snow, it tends to be locked up as snow and ice, but with rising temperatures in spring and early summer, the snow fields melt. The rainy season starts in October and ends in April *(Beaumont, 1978, 35).*

b) The Semi-Arid Mediterranean-type Zone which includes those areas where there is a small winter water surplus. Such areas can be described as having a steppe type vegetation, climate and land use. Temperatures in the winter months in Urfa, Turkey, a site with a climate typical of the foothills region, range from 5°C to 7°C, and, in the summer, they range from 27°C to 30°C. The average rainfall is 300 mm per annum near the Turkish-Syrian border *(Abbas, 1984,* 79).

c) The Arid Zone of South Syria and Iraq. Rainfall in the plains is characterized by a low average precipitation, of 150-200 mm per annum which occurs mainly in the November-April winter season. The rainfall is not reliable in any part of the plains, and the records show large fluctuations from year to year. Summer in this region is intensely hot, with day shade temperatures frequently reaching a maximum of 45°C in July and August and from

30°C to 35°C in the Al-Jazira subregion. Throughout the entire basin, the winter season (December, January, and February) is the most humid, with over half of the annual precipitation in the valley falling during these months, while the summer season is very dry and brings little precipitation. The average annual temperature in Turkey is 17°C, in Syria 20°C, and in Iraq 23°C *(McLachlan, 1976, 41).*

Map B.2: The Middle East climatic regions



Source: Smith, 1970, 415

The effectiveness of the winter rainfall regime is well illustrated by the Thornthwaite type of water-balance graph which plots potential evapotranspiration, reflecting water needs compared seasonally against precipitation *(Smith, 1970, 411).*

The evaporation rate in the upper part of the Euphrates valley in Turkey is about 700 mm per annum, and about 900 mm per annum in southern Turkey, near the border with Syria. At Deir ez Zor in southern Syria the evaporation rate is 1,356 mm per annum and at Haditha the evaporation rises to about 1,450 mm per annum *(Beaumont, 1978, 38).* According to the Haigh report, the annual evaporation losses at Abu Dibis is about 1,900 mm per annum, and on Habbaniyah Lake about 1,800 mm per annum *(Haigh, 1951, 33).*

The large amount of evaporation that characterizes the arid and semi-arid climates has a great influence on both the water consumption for agriculture, and the potential productivity of dryland agriculture.

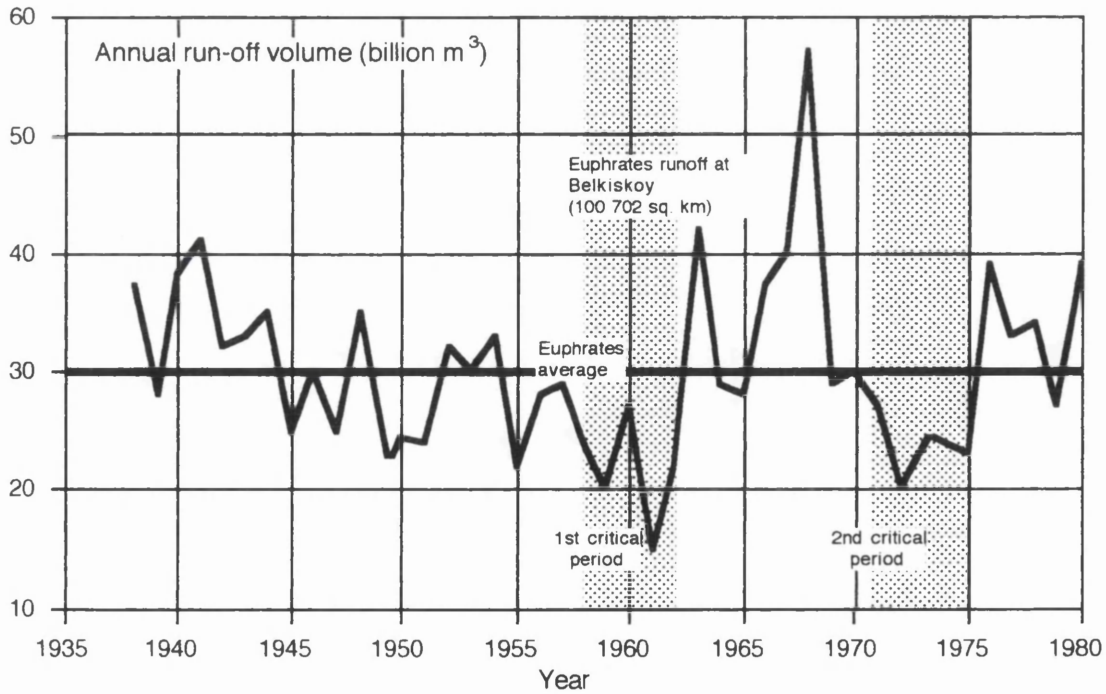
B2. The river hydrology

An assessment of the amount of water naturally flowing in the river is essential for an examination of the developmental possibilities of major water using sectors such as agriculture in the riparian states as well as for an analysis of the effects of reservoir building and irrigation upon the amount of water flowing in the river. One must also remember that, in order to implement international law which recommends co-operative sharing of the river water between the riparian states, there is a need for basic data on the amount of water naturally flowing in the river

The amount of water in the Euphrates river, the third largest river in the Middle East after the Nile and the Tigris, varies considerably from month to month and from year to year (figures B.1 - B.3).

Clawson (1971), using the report of the International Bank, which made estimates of irrigation diversions in the riparian countries, assessed "natural" river flows at Hit Iraq at 33.69 billion m^3/yr., for the period 1937-1964 *(Clawson, 1971, 205).*

Figure Bl:
Euphrates river: historical annual run-off at Belkiskoy (1937-1980)



Source: Bagis, 1989, 34

According to discharge records obtained between 1937 and 1980 at the Belkiskoy (Birecik) gauging site, just upstream from the point where the Euphrates crosses the Syrian border, the annual average flow is 30.37 billion m^3 per annum*(GAP, 1990, Vol. 4, E6)*. This figure is very similar to the World Bank figure for flows of the Turkish - Syrian border which Clowson (1971, 205) recorded as 33.69 billion m^3 per annum.

Table B.l:

Hydrological data for the Euphrates river

	Turkey	Syria	Iraq	Saudi Arabia	Total
Drainage area (1,000 km^2)	125	76	177	66	444
% of total area	28	17	40	15	100
% of country	16	41	39	5	

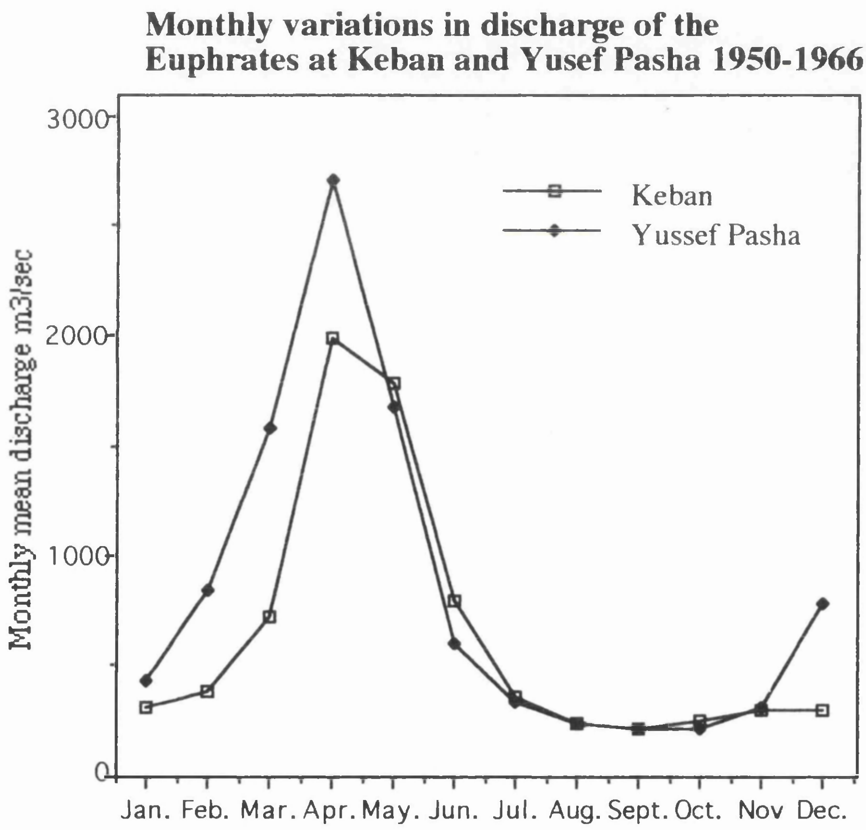
Annual discharge (10 /m^3) (1937-1963)	Turkey OUTFLOW	Syria INFLOW	Syria OUTFLOW	Iraq INFLOW
Minimum	12,600	12,600	14,000	14,000
Mean	28,400	28,400	32,400	32,400
Maximum	42,000	42,000	45,000	45,000
% of mean discharge	88	12		0

Source: Beaumont, 1978, 37

Since the discharge value of the Sajur, Balikh, and the Khabur in Syria has been measured at about 2.05 billion m^3, the average "natural" river flow at Hit should be about 32.4 billion m^3/yr. This figure is 1.3 billion m^3 less than calculated by Clawson but Ubell (1971), Beaumont (1978), and Gischler (1979), used the amount of 31.8 billion m^3/yr. as the annual average volume of flow from 1931 till 1969 *(Ubell, 1971, 3; Beaumont, 1978, 35; Gischler, 1979, 100)*. According to Abbas (1984) the average annual flow of the river is only 29.26 billion m^3 *(Abbas, 1984, 87)*. Another source, Al-Khashab (1958), quoted the lowest amount of the average annual water surplus of the Euphrates river at Hit, at 26.4 billion m^3 based on 22 years of measurements (1925-1946), and the Haigh report (1951), calculated the same amount *(Al-Khashab, 1958 46; Haigh, 1951, 39)*. The annual discharge varied from 16.8 billion m^3 per annum in 1961, to a maximum of 53,5 billion m^3 per annum in 1969 and 65 per cent of this discharge occurred during the flood *(Beaumont 1978, 36)*.

From the examination of the data in the amount of river water, upon which the various researchers base their findings, it is no wonder that there is, in fact, no agreement about the amount of water naturally flowing in the river. The natural flow can only be calculated up to the Winter of 1974 when Turkey began to fill the reservoir behind the Keban Dam and Syria began to fill the reservoir behind the Tabqa Dam. This intervention by states in the process of the river's natural flow makes it virtually impossible to calculate the natural flow after the event. There is no doubt, however, that due to the very large perennial variation in the amount of water flowing in the river (which can be seen in figure Bl.), calculation of the average flow becomes a statistical manipulation and there are long periods in which the amount of flowing water is significantly greater than or smaller than the average. It is difficult, however, to explain the differences in the flow as is presented by various researchers, distorted by partial national water recording agencies. One way to explain the different results may arise out of relating to different periods of time those studies took place. One must also consider that the amount of water in a river is a mathematical calculation of data - something which produce the possibility of making arithmetical errors.

Figure B2:



Source: Beaumont, 1978, 39-40

Minimum instantaneous discharge, according to Cressey, is 181 m^3/sec (equivalent to 5,700 million m^3/yr.), while maximum instantaneous discharge is 5,200 m^3/sec (equivalent to 164,000 million m^3/yr.) *(Beaumont 1978, 37)*. There were two severe droughts in the Euphrates area between 1937 and 1980 (see fugure B1). The first was in

1958-1962, with the most severe period (with an annual flow as low as 14,883 million m^3 at the Turkish/Syrian border), being in 1961. The second critical period began in 1970 and ended in 1975, the lowest flow being in 1973, when the annual flow fell to 62 per cent of the annual average flow over the 1937-1980 period. Total flow reached a peak in 1969 when it was recorded at 53,548 million m^3 which represented 86 per cent increase over the average *(GAP, 1990, Vol. 4, E6).*

Table B.2:

The average water flow of the Euphrates river at selected locations

Gauging station	Years	Watershed area (km^3)	Average flow (Billion m^3/yr.)
Keban, Turkey		64,100	20.12
Tabqa, Syria		120,700	28.84
Hit, Iraq	1924-1970	264,100	29.36
Hindiyah, Iraq	1930-1971	274,100	19.50
Shinafiya, Iraq	1954-1971	280,000	14.90
Al-Nasiriyah, Iraq	1930-1971	289,000	15.00

Source: Abbas, 1984, 90

At the Keban station in Turkey the mean annual flow of the Euphrates is about 20.12 billion m^3 (see table B.2) and the flow increases between Keban and Tabqa to 28.84 billion m^3 per year. Further downstream at Hit, Iraq, near the Syrian border, the annual flow of the river reaches 29.26 billion m^3 per year while still further to the south in Iraq at the city of Al-Nasiriyah, (as a result of diversions and evaporation), the average flow of the river drops to about 15 billion m^3 per year. Table B.2 shows the annual flow of the Euphrates river.

The annual cycle of the Euphrates River discharge can be divided into three parts (see figures B2-B3):

a. Period of high discharge - March to June

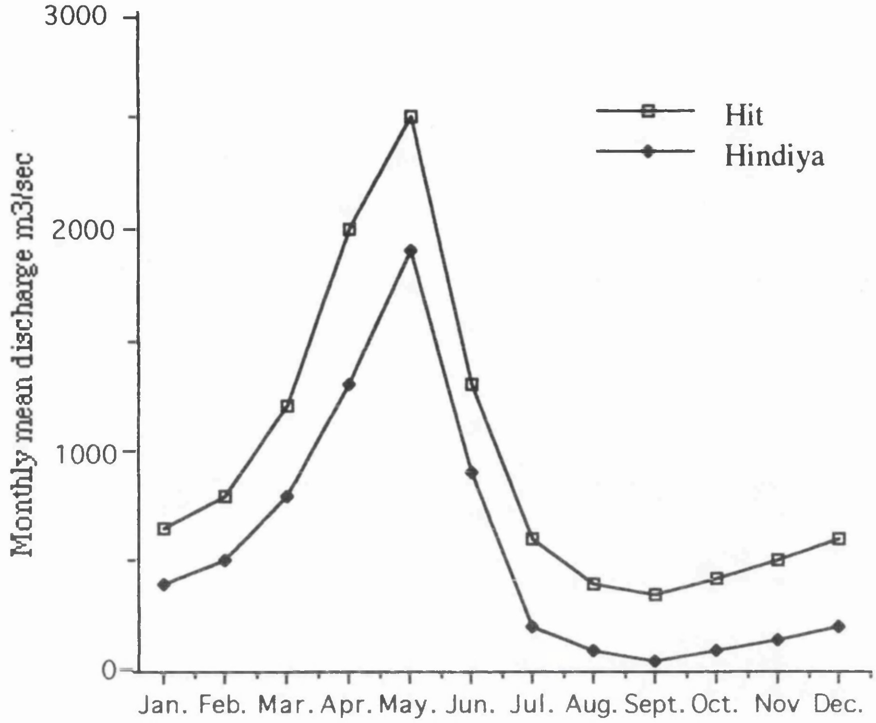
b. Period of low discharge - July to October

c. Period of average discharge - November to February

The melting of the winter snow in the uplands of Turkey releases large quantities of water into the river to produce a discharge peak during April and May, when the discharge at Hit, Iraq averages 2,400 m^3/sec. The discharge drops sharply in June and July as the frozen precipitation of the winter season is exhausted and the nearly rainless summer begins.

Figure B3:

Monthly variations in discharge of the Euphrates at Hit and Hindiya 1931-1966

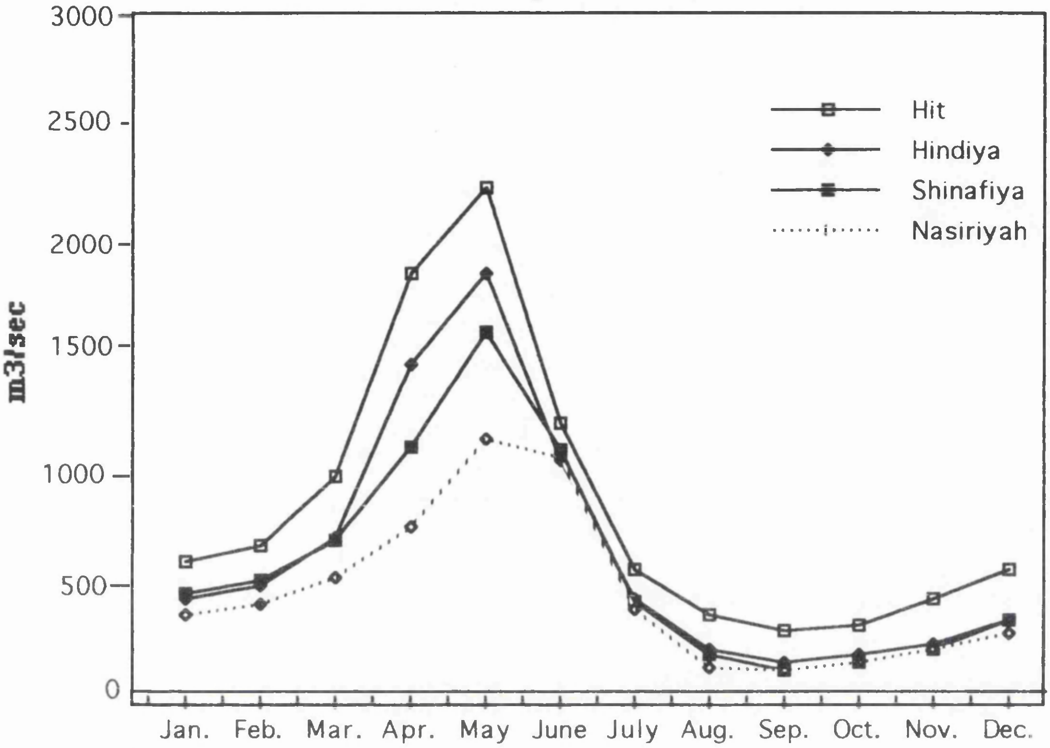


Source: Ubell, 1971, 6

In August, September and October the mean discharge at Hit is around 300 m^3/sec. In a year of heavy winter precipitation, however, the peak discharge in May can reach 4,300 m^3/sec, while there is little increase in the average summer flow level. After a dry winter the discharge in April or May can be as low as 1,300 m^3/sec and may drop to about 100 m^3/sec in August and September. Thus, in one year, as much as twice the average amount of water may flow in the Euphrates while, in another, little more than half the average annual discharge will be generated. The discharge of the Euphrates diminishes systematically with distance downstream after its confluence with the Khabur, primarily as a result of evaporation and infiltration into the subsurface. In the swampland of region the upper delta, both before and after confluence with the Tigris, the influence of large scale transpiration by aquatic vegetation further diminishes the flow (GAP, *1990, Vol. 4, E6)*. An examination of the origin of the content and discharge of the river reveals that 88 per cent of the mean annual content is generated within Turkey and virtually the whole of the remaining 12 per cent in Syria (Table B.1). This means that Iraq's contribution to the total content of the river, under average conditions, is practically nil *(Beaumont 1978, 36)*.

Figure B4:

The Euphrates river mean monthly discharge in Iraq: 1926-1948



Source: Haige, 1951, 3.2

The seasonal distribution of the water supply of the system does not coincide with crop needs. Winter crops in the riparian countries need water from May onwards, but the low water season, lasts from July to December and, during this period, the mean water discharge of the Euphrates is 421 m^3/sec - thus the river reaches its lowest levels in September and October when water is badly needed.

When the crops are either half-grown or almost ready for harvest, and water is no longer so badly needed, the fields are subject to the danger of inundation since spring is the flood season During this period the mean water discharge of the river is 1,765 m^3/sec.

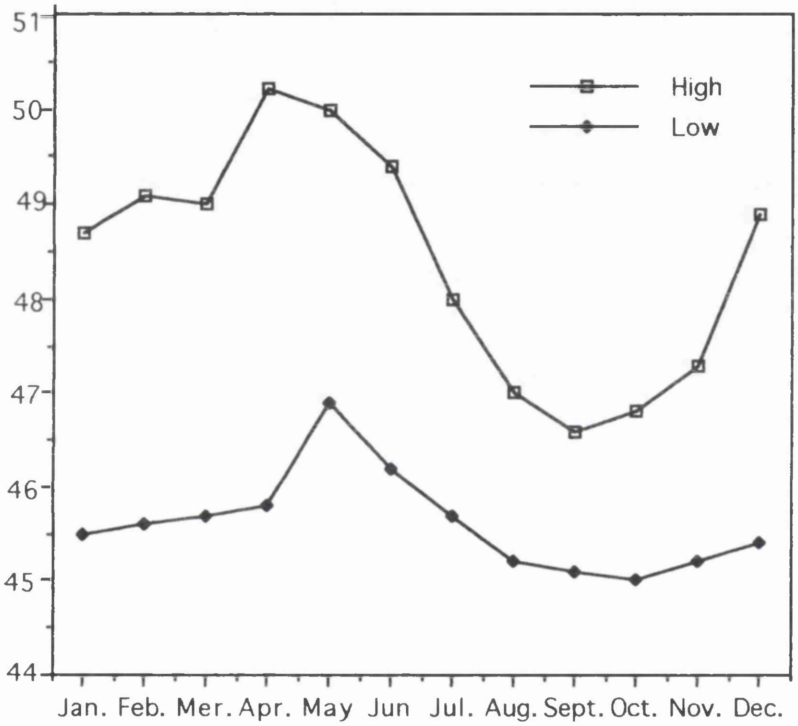
In the case of summer crops which need water from April to September, the situation is reversed. At first they receive abundant supplies, and then the supply declines gradually until it reaches a low point in September *(Qudain, 1960, 57)*. The normal difference between high and low levels is about 3.3m (see Figure B5).

Storage of the river water is desirable because it increases the water available for economic use, especially in Turkey, but also in Syria and Iraq. The flow in low of low years at the Syria-Iraq border illustrate the problems for cultivators depending on the natural flow of the river. Regulating the flow also addresses the problem of the timing of the flood which is too late for the winter crops and too early for the summer ones. Once major storage has been effected perennial irrigation can be extended in each of the riparians allowing two crops a year to be grown on the same land. Another reason for storage is to achieve flood control and the utilization of the water for the generation of hydroelectricity *(Ubell, 1971, 3).*

Figure B5:

High and low levels of the Euphrates: 1911-1932

(in metres above sea level)



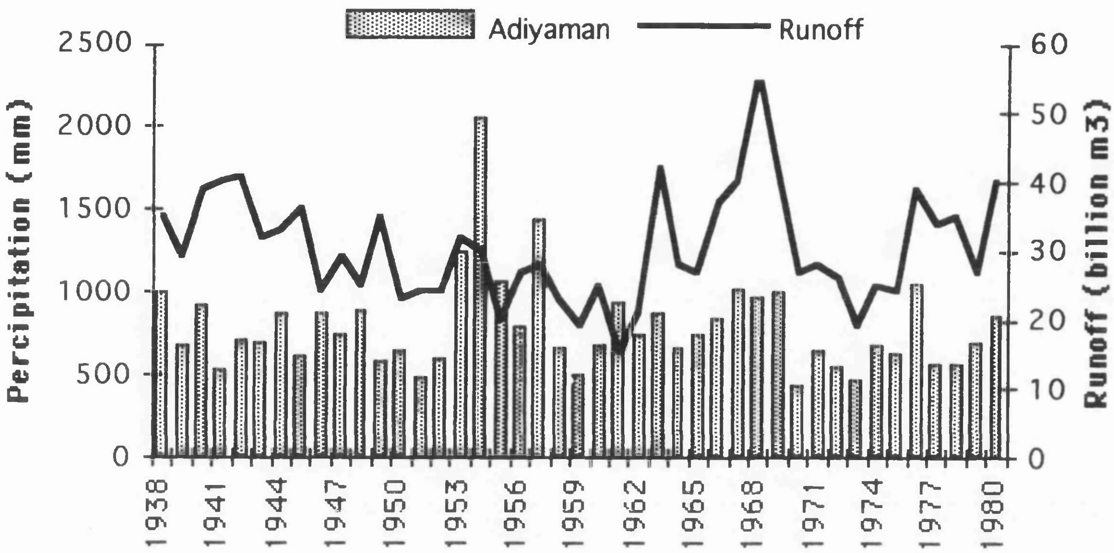
Source: Ionides, 1937, 3

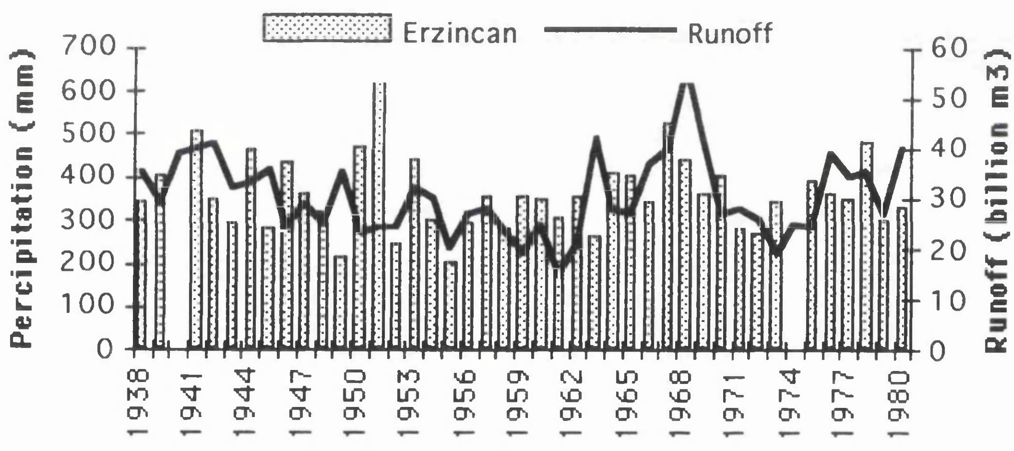
B3: The correlation between annual rainfall and annual discharge of the Euphrates

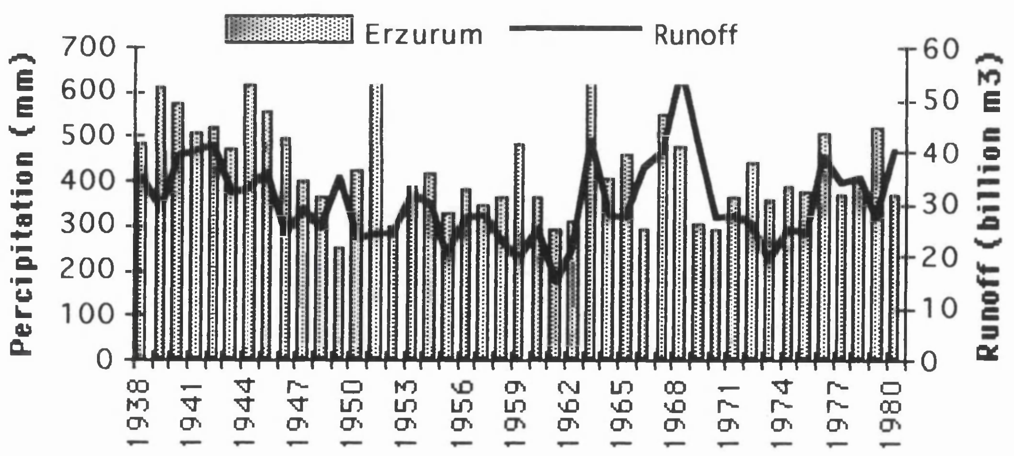
In studying the flow regime of the upper Euphrates basin, it is evident that the component of base flow, due to spring discharge, is an important factor in the flow regime.

A high correlation between rainfall and flow discharge, is expected in a watershed where the slope overland flow is a major contributor. The correlation between annual rainfall and annual discharge is low in drainage basins where the slope overland is less

Figure B6: The correlation between annual rainfall at Adiyaman, Erzincan and Erzurum, and annual discharge at Belkiskoy: 1938-1980







important and base flow due to spring discharge is affected by rains of previous years.

In order to test this assumption for the upper Euphrates basin, annual rainfall data from the three rain gauging stations, Adiyaman, Erzincan and Erzurum (see locations in map B.1) were correlated to the discharge data in Beliskoy, next to the Syrian-Turkish border as published in Turkish sources *(GAP, 1990, Vol. 4, 37)*. It is recognised that the rainfall data are neither comprehensive nor ideally distributed for catchmnet analysis, but they represent two parts of the basin which together contribute over 90% of the Euphrates flow. The Erzurum station and the Erzincan station are located in the part of the catchment which contributes 75 per cent of the Euphrates flow. The Adiyaman station represents a much less significant element of the catchment representing approximately 15 to 20 per cent of the flow. Clearly the Erzurum and Erzincan stations are likely to be more clearly correlated with the flow at Belikskoy.

Figure B6 for Erzurum and Erzincan demonstrate a close correlation between precipitation and flow except in 1950 and 1951. The data for the Adiyamam station and flows are relatively poorly correlated, with especially strong departure between 1962 and 1970. As the Adiyaman segment of the catchment contributes a small proportion of the flow the minor impact of the unusually high rainfall on downstream flow is explicable.

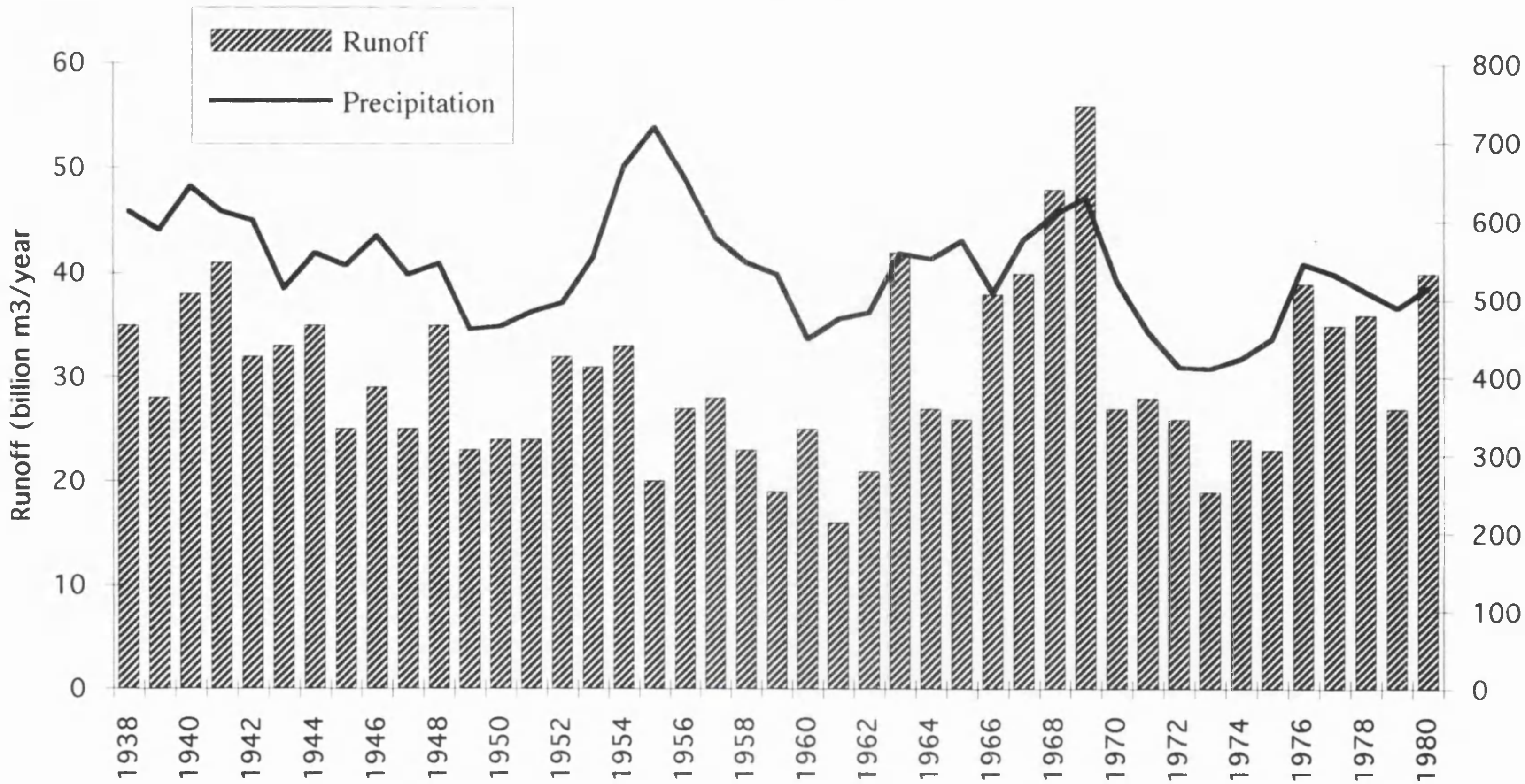
An important part of precipitation in the Erzurum and Erzincan segments of the basin falls as snow. Attempts to obtain snow data from the University of East Anglia Climate Research Unit archives as well as from D.S.I. in Ankara failed. UEA CRU did not hold such data and D.S.I officials would not provide data concerning the absence of detailed flow data in the upper parts of the catchment and it was not possible to model the likely contribution of snow melt to Euphrates flow. The present relationship between precipitation and flow is entirely consistant with a contention that variations between precipitation and flow could be explained by variations in year to year snowfall.

There seems to be a bias in the hydrometerological records since the hydro-political significance of meteorological and river flow data make them very susceptible to manipulation.

The correlation between rainfall data in each individual rain gauging station and the flow regime, was low (R=0.10 - 0.28), in order to find the relationship between rain and runoff, the average rainfall for the three stations was calculated . In addition, the running average of rainfall for a periods of two, three and four years was also calculated. Figure B7 presents the relationship between the correlation coefficients of runoff versus rainfall for the various running averages.

It is clear that the correlation coefficient for the three years running average is much better that the correlation coefficient for a one year rainfall amount, a result which supports the initial assumption (see figure B8).

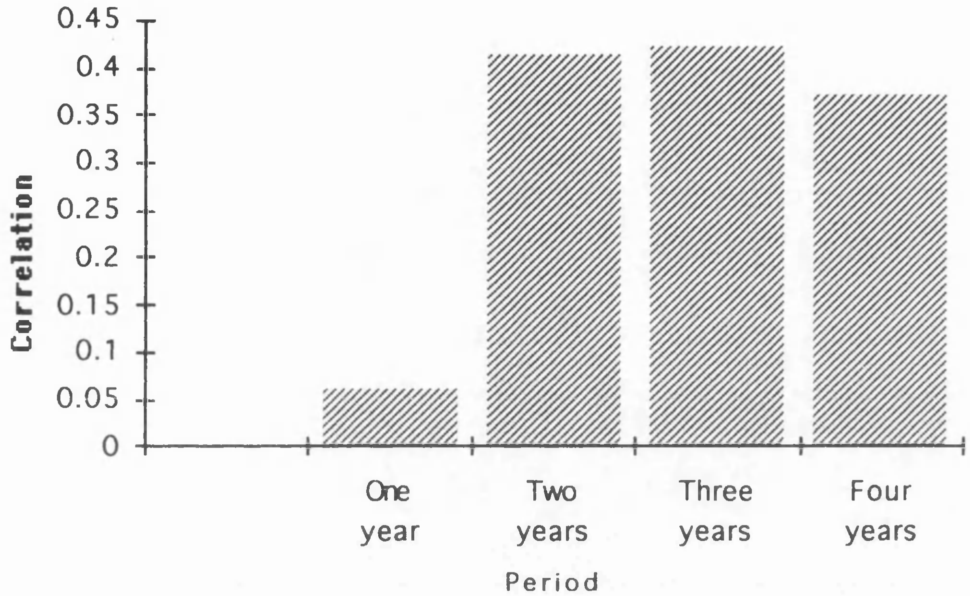
Figure B7: Runoff at Beliksoy and three years average precipitation of the upper Euphrates (1938-1980)



Sources: GAP, 1990, Vol.4, 26-37; University of East Anglia, Climatic Change Unit, (1993)

Figure B8:

Correlation between Euphrates basin precipitation and runoff at Beliksoy



Yet, a correlation coefficient of R=0.425 between rainfall and runoff data is considered low. The low correlation in this case study is probably caused by three possible factors:

1. The three rain gauging stations are the only available source of data for the upper Euphrates basin and therefore they do not necessarily represent the rainfall for the whole basin. An analysis of the rainfall map reveals that there are more rain gauging stations but their data are not available *(GAP, 1990, Vol. 4, 35)*. The precipitation map shows a high variation of rainfall. It can be seen that a difference of 700 mm a year exist over distances of 50 km.

2. The rainfall data used for the calculation of the correlations is, the gross annual rain amounts only. No data are available for important parameters such as rainfall intensity, or the snow component of the precipitation. These parameters have an important influence on the flow regime.

3. The low correlation can also be explained by a technical problem. The rain data refers to the calendar year whereas the runoff data refers to the hydrological year.

During the last twenty years three big dams have been built on the upper part of the Euphrates, and several more are planned. The storage capacity of the dams is 90 billion m^3. Consequently the flow of the river will be controlled to meet economic needs and by political decisions. Hence, an even lower correlation between rain and runoff is to be expected after 1974 and especially in future. Meanwhile the impact of climate change is not clear. Global and regional climate models have proved to be sound with respect to temperature and the Euphrates Basin will experience the minor increases in temperature predicted by the models. Climate models have proved to be very unreliable in predicting precipitation which is the most important variable with respect to modelling surface run-off. It has to be assumed that the jury is still out on the rainfall future of the upper Euphrates. It has to be assumed that rainfall could either decline or increase, but for the foreseeable future such natural impacts will be minor between 0 and 10 per cent compared with the supply management impacts which have increased the volume of usable water of 80 per cent though the works constructed since 1974.

It should be noted that the complete control by the Turkish authorities over rainfall and runoff data, makes it possible for them to publish selective data or to decline to publish them at all.

C. Irrigation Development Projects

C1. Irrigation in early history

The history of international relations and law is vital to an understanding of the conditions and problems in any international drainage basin since the history of a region may either facilitate or impede international agreements over water.

In the period between the two world wars no conflict existed among the three countries over the use of the Euphrates' water at that time. Turkey was engaged in one boundary dispute with Iraq over the Mosul province but, despite its seriousness, after these conflicts were resolved it did not affect the water issue *(Abbas, 1984, 172)*.

Until the mid-1960s, the only country which made large-scale use of the waters of the Euphrates was Iraq. In Syria limited irrigation was practised alongside the river, while in Turkey the waters of the Euphrates were used even less *(Beaumont, 1978, 35)*. Any debate over the subject of irrigation in ancient times will therefore, focus naturally upon Iraq. In ancient times irrigation was practised by digging ditches to bring water from the river to the fields. For a country such as Iraq with regular summer temperatures of 45^{o}C in the shade and no rain for eight months in the year, the distribution of water to man, beasts and plants has always been vital. Therefore, one could say that water has always been the basic requirement for existence in this arid area and that the utilization of it has been a civilizing factor since the beginning of recorded history. The history of Sumer and Babylon was largely the history of a struggle for control of the water supply because land without water in Iraq is valueless.

Since Sumerian days, rulers have struggled against flood, on the one hand, and the need to provide an irrigation system, on the other. Irrigation engineering by trench and canal had already been brought to a fine art in Babylonian times and the waterways, seen from the air, show a complete network of ancient dead canals. These numerous dead canals may never have been in simultaneous operation since the Tigris and the Euphrates waters contain a heavy proportion of salt and silting has been brought down by the two rivers for countless centuries. The silting and salting between them evidently forced the inhabitants to periodically abandon their canals and dig new ones; hence the land, after a certain length of time of exploitation, became useless.

The method of farming used was simple seasonal method where farmers used to cultivate half of the field one season and leave the other half for the next season. The tools used were the simple wooden plough drawn by two cows, or oxen, making such animals very important to the cultivators in Iraq. The cultivators used one of the simplest and probably earliest devise for lifting water called a "Naur" which was equipped with paddles so that the water could be raised by the force of the current in the stream. Next came the horizontal water-wheel which was run by the power of draft animals and both of these devices have been used since the ninth century (B.C.E).

The old-fashioned water wheels or current wheels, especially on the upper Euphrates river, were turned by the velocity of the stream to lift water from the river to a level where it could flow to the fields through small waterways constructed especially for this purpose. The wheel is still used and is built from strong local woods without using any kind of metal, and with even the nails being made of wood. To hold the water, a kind of bucket is locally made of "fired mud". However in order to construct the wheel, the installation and the buckets, there was need for special technical knowledge and certain families specialized in each one of these occupations. The efficiency of the wheel varies according to the strength of the current since it converts the energy residing in the flowing stream into the mechanical energy of motion. At the beginning the problem for the cultivators was how to locate the water wheel in the stream, where there was a steep near rocks after which a dam, whose function was to provide the drop or "head", could be artificially located to both provide a water way and fill the function of storing water. By means of these wheels, the people can irrigate their fields and raise crops since the device, though very primitive, is economical as a basic irrigation system when linked to an aqueduct called a "Korya" which is a waterway constructed once and forever from stone and locally produced cement. The farmers then only need to renew the wheel once every two or three years at a relatively low cost because they use the timber from their own fields - and no money is involved. The primitive wheel keeps running day and night for years without any other expense involved *(Al-Dahiri, 1969, 42).*

An important feature of the rivers system which has had a favourable effect on agriculture is that the bed of the Euphrates, from north of Falluja southwards until the two rivers meet at Qurna, is slightly higher than that of the Tigris. In modern times, as in the past, this difference of elevation has been utilized to build a network of gravity flow canals from west to east to irrigate large areas of land *(Qubain, 1960, 70).*

Canals from the Euphrates, either old, reopened, or entirely new, form a system and the most important canal is the Naher Isa, named after a relative of Al-Mansur who re-excavated it. It connects the Euphrates with the Tigris at Baghdad and, since it is navigable, it also acts as a communicating link between the Euphrates and the Tigris *(Al-Dahiri, 1969, 42).*

In 1253 Hulagu, a grandson of Ghinghiz Khan, moved westward in force, captured Baghdad in 1258 and thus brought an end to the Abbasid Caliphate. With its population decimated, the canal system fallen into disrepair, and the old skills forgotten, Iraq became the victim rather than the beneficiary of its rivers. Seasonal floods made life along the river banks precarious, and misuse of the waters salinized large areas of once fertile soilIt seems that there is no other similar case in world history, where the destruction of irrigation canals so badly influenced a state for a period of more than 600 years. Only at the beginning of the 20th century did new technology, borrowed from the West, begin to open the way for the re-establishment of human control over these streams *(Harris, 1958, 206).*

Irrigation was neglected during Turkish rule except at the last stage when a group of young Turks came into power. In 1908, Sir William Willcocks, a well-known engineer at that time who had built regulatory systems for irrigation in India and Egypt, was invited to make a report on the possibilities of irrigation development in Iraq. He brought a dozen engineers with him from Egypt and, in 1911, presented a comprehensive report which is still considered to be a basic source of reference on irrigation development for Iraq.

During this same year, 1911, the Turkish government accepted his suggested projects and began work on the Al-Hindiya barrage on the lower Euphrates. This project, completed in 1913, was a major installation, according to the Committee of Officials of Iraq and the barrage controlled the Hilla canal system, the largest canal in Iraq served by a single in-take. With its four main branches, it serves some 2.7 million dunams of land in the Euphrates basin, even today but one of its branches, the Dagharra, has deteriorated to the point of becoming useless *(Qubain, 1960, 57).*

C2. The transitional period

The transitional period began during the First World War with the end of Turkish rule and was followed by the British Mandate rule in Iraq, and the French mandate in Syria which ultimately led to the establishment of new forms of governments, in newly independent Iraq and Syria. During this time, the basic political economy which has affected development ever since was created and the more important aspects included the establishment of the system of government and, the provision of social overhead capital for projects such as railroads, land transportation, electric power, water supply, and the ports of Iraq, as well as telephone, telegraph and postal systems. This was the time which saw the beginnings of a new phase of agricultural development, including markets and the introduction and establishment of numerous national innovations, including the beginnings of modern industry, the establishment of financial institutions, the public health system and the educational system *(Al-Dahiri, 1969, 49).*

The use of the telegraph as an aid to the prevention of flooding in the plains is a good illustration of the new technology introduced into the area. In this connection the Franco - Syrian authorities supplied, readings of the Euphrates at Jarablus and Dair-as-

Zor, by wireless thus providing five days' warning to those in Iraq about what was in store for them south of Ramadi.

In Iraq, towards the end of the First World war, a Military Department of Agriculture was organized and, in 1919, the department was transferred to a civil administration. One of the major projects of the department was to initiate agricultural education and the spreading of new innovations.

Partly as a means of making maximum use of scarce funds, pump irrigation increased considerably during this period. The British army had encouraged the use of pumps as early as 1918, and the government encouraged their use by granting tax exceptions to crops produced on pump irrigated land, both through granting state land on favourable terms to those willing to install pumps, and by making pumps exempt from customs duty. Here, the legislation played a major role in directing the economic activities. The pumps were privately owned but the installations were controlled through a licensing system. Pump irrigation (technically called lift irrigation) extended along both banks of the main rivers throughout the delta and, occasionally, on the higher reaches, but it was also found on the banks of the main canals where the pumps were sited on high ground *(Sassoon, 1987, 141).*

In 1927 the Ministry of Communication and Works declared all rivers and waterways in the country to be "irrigation works", a term which covered all irrigation and flood protection installations. Since then all irrigation works of public importance, have been constructed, maintained, and managed by an irrigation department where government irrigation engineers determine the dimensions of canals and waterways, and the department controls water distribution - only interrupting supply when necessary *(Harris, 1958, 206).*

The British Mandate Government began to examine closely some of the large works which the Irrigation Department had been considering for years. One such major irrigation project was the Habbaniya barrage and flood-escape system whose main purpose was to use Lake Habbaniya, situated on the right bank of the Euphrates, for flood relief in times of dangerously high floods. The Habbaniya scheme was to provide a run-off lake from the Euphrates near the town of Ramadi, with a channel which would run into the great Habbaniya depression and fill it whenever the river reached a certain level. Thereafter, in any given year, one of two things would happen. If the flood proved to be exceptionally big, another channel at the south end of the depression would be opened and the additional surplus water in the river, after entering Habbaniya, would dissipate itself in another and still greater depression, the Bahr-al-Milh. In a normal year, however, the release to the south would not be used, since the Euphrates water would be normally stored at Habbaniya itself until the summer when an outlet near Fallujah would be opened to allow the impounded water to run back into the river. This scheme was first proposed to the Turks by the late Sir William Willcocks. Its virtues were that it would protect the lands of the lower Euphrates from severe flooding in the spring and give the cultivators of Central Iraq the assurance of more water for their thirsty crops in the late summer, when supply is usually exceedingly poor. The scheme was criticized by the Iraqis on the ground that it was a Machiavellian policy of Britain which wanted to create a big lake at Habbaniya for the use of flying-boats and seaplanes. Today, the Habbaniya Reservoir has a capacity of 3.25 billion m^3 and many irrigation projects rely upon it *(Al -An'i, 1977, 35).*

The development of the irrigation projects and the use of pumps increased the use of the river water and the approximate disposal of water supplies calculated for a normal September month (low water season) before the Abu Ghurib canal, was established and regulated (1937). The Euphrates canals in 1937, altogether, drew approximately 31.5 per cent, from the river above the Hindiya barrage in the low-water season with lift irrigation to minor canals and directly to fields and gardens accounting for another two per cent, and evaporation calculated at about 3.5 per cent. The amount that passed on down the Hindiya channel was therefore about 63 per cent of the volume available at Hit, but none of the water drawn off above the barrage in the low-water season found its way back to the Euphrates lower down *(Iraq, 1944, 36).* The country's irrigation area expanded substantially as a result of the water projects and the growing use of pumps to lift water from the rivers directly onto the fields.

The Hindiya and the Ramadi dams merely served as large weirs to control the water level at the intake points of irrigation canals and it is only since about 1960 that river control schemes have become technically and economically feasible in the riparian countries. This has been made possible through the construction of dams large enough to store the seasonal flood surplus and regulate flow downstream through-out the year, thus producing the man-made reservoirs which hold surplus water from especially wet years which can be released during drought years *(Smith, 1970, 417).*

C3. Modern development projects in Turkey

Until the nineteenth century Ottoman Turkey was the dominant power in the Middle East with an empire which covered 4.7 million km^2. The Ottoman hold on this vast territory was, however, seriously weakened, partly by internal instability but, more importantly, by the growing strength of the major European industrial nations. Consequently, at the time of outbreak of the First World War, which was to prove disastrous for Turkey, the Ottoman Empire had already been reduced to under 40 per cent of its previous size. After the war, and the subsequent conflict with Greece, more territory was lost and, today, Turkey covers only 776,980 km^2 - less than 17 per cent of the land area of the Ottoman Empire *(Wilson, 1979, 87)*.

In 1913 there were only 269 factories in the whole empire, employing less than 17,000 workers; most of whom were concerned with either food processing or textile manufacture while agriculture was the most common economic activity.

Against this economic background, under the leadership of Kemal Ataturk, Turkey became the first state in the Middle East to draw up a five-year development plan and, within a few years of the announcement of this initiative, Turkey embarked upon an economic experiment that was to be emulated in several countries following World War II *(Richards & Waterbury, 1990, 188)*. Since 1963, when the first five year development plan was launched, the economic development policy of Turkey has centred around state enterprise initiative and imports substitution through industrialization. The policy has been effective in attaining high economic growth, in a period when the basic economic infrastructure was insufficient to expect private enterprises to flourish in competitive markets. Agriculture and water development, however, have received relatively little attention, with the exception of power generation projects that were needed to provide energy for new industry. This emphasis on power generation has led to the development of a number of multipurpose water projects, particularly on the Euphrates river *(Turkey, 1958, 5)*. The gross national product (GNP) grew, on an average, by 6.7 per cent and 7.1 per cent per annum respectively in the first and the second five year plan periods (1963-67 and 1968-72). Such high economic performance was frustrated by a series of sharp increases in petroleum prices in 1970's, coupled with other unfavourable factors such as stagnate agricultural exports *(GAP, 1990, Vol. 2, 2.1)*.

Throughout this period of economic development agriculture has remained the main source of employment despite the rapid growth of industry averaging 11 per cent per annum *(Wilson, 1979, 95)*. The share of agricultural goods exported as a per cent of total exports decreased from 57.5 per cent in 1980 to 21.6 per cent in 1985 *(Demirgil, 1990, 193)*.

In the seven year period between 1979 and 1986 Turkey's GDP grew at an average annual rate of 4.1 per cent. The industrial sector contributed twice as much as the agricultural sector to the increase in GDP during this period by attaining 5.4 per cent per annum average growth. In particular the average annual growth of the manufacturing industry was 5.8 per cent and that of the agricultural sector in the same period was a modest 3 per cent. The per capita GDP of Turkey grew in this seven year period at an annual average rate of 2.3 per cent while the per capita GDP of Turkey's 16 statistical regions ranged from 48 per cent to 150 per cent of the national per capita GDP *(GAP, 1990, Vol. 2, 2.2).*

The population in Turkey increased between 1950 and 1985 at about 2.5 per cent per annum, reaching its peak during the 1955-1960 period (since when the rate of increase has gradually decreased) and, according to the 1990 census, stood at 57 million people. Over the last 40 years, however, the annual population growth rate has never been below 2 per cent. The annual population increase between 1980 and 1985 was about 2.49 per cent while in the same period the rate of urbanization was to 5.14 per cent. According to the preliminary results of the last census of October 1990, as well, the overall total population increase came to 2.35 per cent and the rate of increase of urbanization was calculated at 3.59 per cent between the years 1985-1990, whereas the same figures for rural increase was only about 0.68 per cent. Urbanization is expected to continue because of the development of the socio-economic structure and the increase in population.

Given the current average annual population growth rate of 2.2 per cent, and an increase in per capita demand for food of around 1.2 per cent per annum, Turkey needs to maintain an annual growth rate in food production of around 3.5 per cent to meet the requirements of domestic demand *(Bilen & Uskay, 1991, 4.1).*

Until the 1950's Turkey was predominantly an agricultural country with around 85 per cent of its population employed in agriculture, compared with 58 per cent in 1980; industry employed 17 per cent in 1980, compared to 7 per cent in 1950; and services employed 25 per cent in 1980 compared to 6 per cent in 1950 (see table C1.1) .

Table C1.1:

Turkey's sectorial distribution of the labor force, 1950-1980 (%)

	1950	1960	1970	1980
Agriculture	87	78	68	58
Industry	7	11	12	17
Services	6	11	20	25

Source: Richards & Waterbury, 1990, 74, 12

The fifties witnessed the introduction of modern technology and marketing methods in agriculture which resulted in a massive rural to urban migration. The ratio of urban population to total population grew steadily from 1950 and, by the year 1985, the country had more than half of its population living in urban areas. The highest rate of migration has been in the three largest cities: Istanbul, Ankara and Izmir. The Thrace, Marmara, Aegean and Mediterranean coasts, that is the western and the south-western regions, show the highest rate of population increase. These regions, as the result of industrial development and increased employment opportunities in the tertiary sector, attract migrants from other parts of the country.

It is expected that the urban population will increase further from the present rate of 53 per cent to 70 per cent by the year 2000 and while 33 million people lived in urban areas in 1991, this number is expected to exceed 45 million by the year 2000.

The high rate of growth in total population and the even higher rates of increase in urban population, together with changing household structures and social preferences, have led to an increased demand for water with the total water supplied for drinking and utility purposes increasing almost 2.5 times throughout Turkey. In 1980 the total amount reached about 1.6 km^3 per year, increased to 2.8 km^3 annually by the end of 1985, and rose to 4.0 km^3 by the end of 1990. The situation of drinking water supply with respect to population served for the years 1980 and 1990 is summarized below.

Table C1.2:

The supply of drinking water and per cent of the population

Type of access to	1980		1990	
drinking water	Urban	Rural	Urban	Rural
Water piped to home or by standpipe	64.2	62.0	97.7	85.0
Served by other means	21.8	20.0	1.8	12.0
No access to water	14.0	18.0	0.5	3.0

Source: Bilen & Uskay, 1991, 4.17

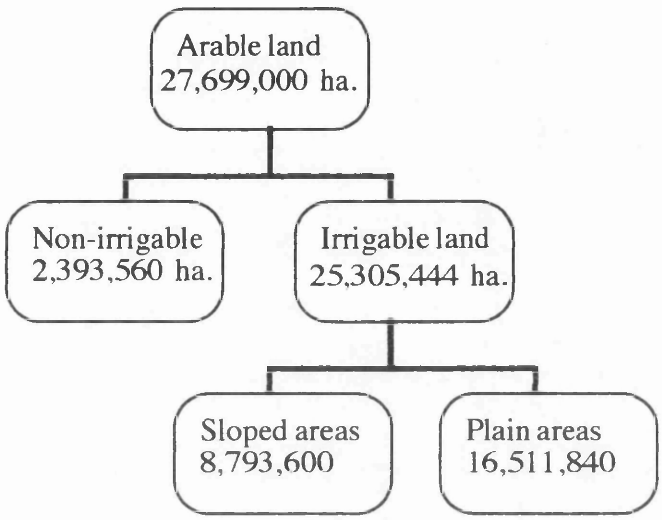
As can be seen from the above table, a great effort was made during this decade to supply water through a network or by standpipes to the population which increased from 64.2 to 97.7 per cent in urban areas and from 62 to 85 per cent in rural areas.

The total land area of Turkey is 77.9 million hectares, made up of 27.7 million hectares of arable land, 21.7 million hectares of pastures and common grazing lands, 1.1

million hectares of water surface areas, 23.4 million hectares of shrubs and forests, 3.3 million hectares of unused land, and 569,400 hectares of residential areas.

Figure C1.1:

Turkey: arable land for irrigation



Source: Gulbahar, 1991, 531

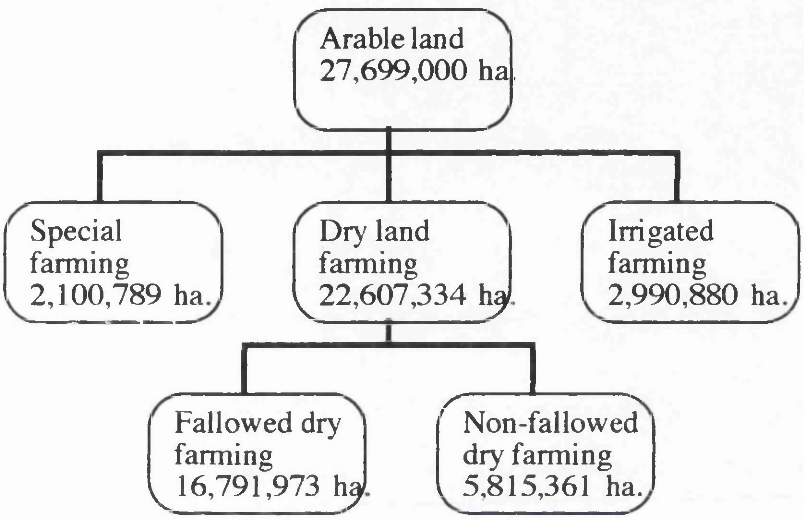
Of the arable land, 25.3 million hectares are irrigable (see figure C1.1). With current available water resources it would be economically feasible to irrigate an estimated 8.5 million hectares with major and minor irrigation works and a further 16.8 million hectares using advanced technology. At present both groundwater and surface flow are used to irrigate 3.2 million hectares *(Gulbahar, 1991, 531).* By the beginning of the 1990's, about 2.5 million hectares of irrigation infrastructure was developed in the public sector and an area of about 1.3 million hectares was provided with supplementary water by small scale, privately owned irrigation schemes, making the total area under irrigation about 3.8 millions ha. or 45 per cent of the potential total (*Bilen & Uskay, 1991, 1.4).*

The growth of urban areas and the creation of an urban middle class has produced a rapid rise in per capita water consumption. In rural areas water consumption for domestic purposes was once probably less than 50 litres per day while in urban areas, it often reaches as high as 200 litres per day. This pronounced growth in per capita demand has meant that water needs have grown much more rapidly than population data alone would suggest.

Water supplies in urban areas are expected to deteriorate and, since sustaining a healthy urban economy requires substantial investments in water supply and sanitation, enormous strains have been placed on water resources. The growing pollution from sewage has also been associated with the increased use of water in urban areas *(Bilen & Uskay, 1991, 2.9).*

Figure C1.2:

Turkey: arable land use



Source: Gulbahar, 1991, 531.

One of the most important concerns regarding population growth is how to ensure the present and future needs of all people in terms of food, fibre and so on. Opportunities have been made available to either increase the cropped area, increase yields from the same area or some combination of the two *(Bilen & Uskay, 1991, 2.11; Richards & Waterbury, 1991, 141)*. According to Morvaridi (1990), two phases can be seen in Turkish land use policy as regards agriculture from 1950-1960, first mechanical innovation (e.g. the introduction of tractors) and secondly the expansion of arable land. Turkish agriculture underwent a major transformation in the 1950s as a result of state intervention and technical change supported by US aid and from 1960 biological innovation and the intensification of land use was introduced. The number of tractors in use increased from 1658 in 1948 reached 40,282 in 1955, and rose to 637,449 in 1987. In addition to mechanical innovation, the area under crop cultivation increased by 61 per cent between 1948 and 1960 *(Morvaridi, 1990, 306)*. A major response to the increasing food and fibre demand in Turkey, has been the expansion of irrigated agriculture sponsored largely by government agencies. In contrast to other developing countries, Turkish agriculture has undergone a complete land reform program, in which more than

80 per cent of the farmers in Turkey own and work small farms of less than 10 ha. of land *(Morvaridi, 1990, 304).*

Because of the Mediterranean and semi - arid conditions, with a hot and dry summer, the critical growing period for most crops is during the months of June, July, and August and, during this period, most of the rivers carry base flow only. Water storage, therefore, is indispensable. At present 141 dams are in operation and 57 dams are under construction making about 70 per cent of major irrigation projects fed with water from reservoirs or lakes *(Bilen & Uskay, 1991, 4.2)*

The past two decades have seen a transformation in Turkish energy production. The Turkish government, realising the crucial importance of a sufficient energy supply for a sustained and balanced economic development, has given priority to the energy sector in its economic policies and adjustments particularly since 1980 *(Bagis, 1989, 61).* Turkey is steadily increasing its energy consumption, much of which must come from hydro-carbon sources beyond its border. The present installed capacity of power is about 16,488 MW of which 6,755 MW come from the hydro power plants and, in 1990, the total net consumption of electricity was about 46,770 GWh with a total gross generation of 57,800 GWh.

Table C1.3:

Electricity demand projection (base condition)

Years	Demand Power (MW)	Demand Energy (GWh)	Per Capita Consumption KWh / capita
1990	16488	57000	1017
1995	15005	92984	1472
2000	22435	139213	1978

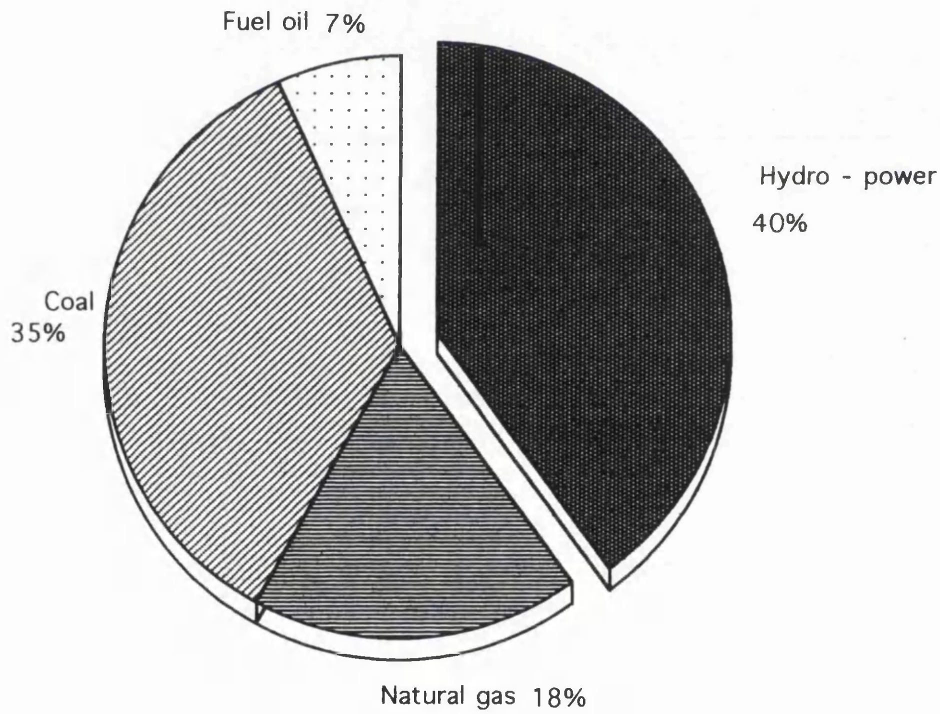
Source: Bilen & Uskay, 1991, 4.9

In order to balance the regional deficiencies 220 GWh of energy was imported in 1990 and 917 GWh of energy was exported in the same year. In the early 1970's, the high level of dependence on imported oil was a dominant factor in the pattern of energy consumption in Turkey. Following the oil shocks in the second half of the 1970's the government embarked on a programme of indigenous resource development, especially encouraging hydro-power and lignite schemes to reduce the burden of imported energy on the national economy *(Bilen & Uskay, 1991, 4.7).* In 1985, 24 per cent of public sector investments went to the energy sector making it also the second largest sector receiving foreign capital. In 1986 total reliable energy consumption in Turkey, including non-commercial energy, was 45 million tons petroleum equivalent (KPE). Over the 1975-1985 period, total reliable energy consumption grew at an annual average rate of

4.2 per cent and average energy consumption per capita rose from 703 kg (KPE) in 1975 to 861 KPE in 1986. Energy consumption at home, including household and services, takes the major share of energy consumption although this fell from 39 per cent in 1975 to 33.4 per cent in 1987 while the manufacturing sector steadily increased its share from 23.3 per cent in 1975 to 25 per cent in 1986. The third sector in energy consumption is transportation and here it fell to 15.4 per cent in 1986 from 18.2 in 1975 *(Bagis, 1989, 61).* Nearly 39 per cent of the energy consumed in the nation in 1983 was derived from imported petroleum and, when imports of coal and electricity are also considered, this makes for two - fifths of all the energy used in Turkey originating from foreign sources. Petroleum imports currently amount to some four billion dollars per year, an amount that equals approximately one third of total imports *(Kolars, 1986, 53).*

Figure C1.3:

Share of hydro power in energy sector-1990



Source: Bilen & Uskay, 1991, 4.13

The share of hydro-sources has increased substantially from 30 per cent at the beginning of 1970's to more than 40 per cent of the total supply recently (see figure C1.3). In order to maintain this percentage, there needs to be an increase of about eight per cent per annum *(Kolars, 1986, 53).*

Turkey is petroleum poor but water rich. The nation receives about 509 billion m^3 of precipitation annually, and 38 per cent of this (186 billion m^3) ends up as surface runoff, much of which into the USSR, Iraq, Iran, Syria, and the surrounding seas. Turkish estimates indicate that only a little over half of this surface runoff (95 out of 185 billion m^3) and 9 billion m^3 of groundwater can technically be used for domestic, irrigation, and industrial purposes within Turkey. The actual consumption of surface water is 25.2 billion m^3 per year indicating that only 26.5 per cent of surface water development potential is consumed presently while the actual annual consumption of groundwater is 5.4 billion m^3 *(Bilen & Uskay, 1991, 1.3).*

Driven by its need for new sources of energy and because only 20 per cent of the hydropower potential has been developed so far, Turkey has turned to the hydro - electric potential of its many rivers, the greatest of which is the Euphrates. With this end in mind Turkey has undertaken a gigantic development project on the river. The Southeast Anatolia Development Project (Turkish acronym: GAP). This project is intended not only to provide hydropower but also to earn foreign exchange for the country through the sale of agricultural products to be raised on over a million hectares of land irrigated with water drawn from the river *(Kolars, 1990, 59).* GAP's total hydroelectric generation capacity will increase the country's present total generation capacity by 70 per cent. *(NewSpot, 28 June, 1990, 2).* According to the fifth five year development plan (1985-89), Turkey estimated there would be a steady increase in its total need for water.

Table C1.4:

Turkey: total need for water (billion m^3)

Utilization unit	1985	1990	1995	2000
Drinking & using	4.73	5.95	7.38	9.07
Irrigation	31.80	42.00	54.10	57.60
Industry	4.00	5.10	6.20	7.30
Total	40.53	53.05	67.68	73.97

Source: Turkey's fifth five year development plan, 1987, 188.

According to the table, there has been a steady increase in water demand in all consumption sectors for domestic, irrigation and industrial needs. The total additional consumption from 1985 to 2000 is expected to be 24 billion m^3 - an increase of 70 per cent.

Turkey is in a position to achieve agricultural self-sufficiency and possibly have food surpluses to sell to the Middle-East and elsewhere. Agricultural products in 1991 constituted a fifth of the total annual export volume of about $ U.S. 13 billion, and there were only minimal imports while the all-important wheat crop rose to around 16 million tons, leaving a large exportable surplus. The annual meat production total in 1991 was around 1.1 million tons, about half of which is exported, primarily to Middle Eastern markets *(International Herald Tribune, 13 July 1992, 9).*

The GAP is a massive, planned development program within the Turkish portions of the Euphrates and Tigris river basins which account for about 30 per cent of the country's total surface runoff making the GAP program the most ambitious development activity ever undertaken in Turkey. The area referred to as "South-eastern Anatolia" consists of six provinces corresponding to 9.5 per cent of the total area of Turkey and occupies the south-eastern part of Turkey bordering on Syria to the south and Iraq to the south-east. The project includes land along the border with Syria and on the plains between the Euphrates and Tigris rivers. The GAP, in turn, could provide water to irrigate 1,641,000 ha. (about 30 per cent of all possible irrigated land, as well as 43 per cent of projected hydropower from all such projects) *(Kolars & Mitchell, 1991, 2 ; GAP 1990, Vol. 2, 2.2).* The GAP will include dams, hydroelectric power plants, irrigation projects and an infrastructure supporting, not only agriculture, but other economic and social quality-of-life improvements - such as urban development, transportation, non-farm employment opportunities, and improved education and health services. Given that the GAP will create economic, social and spatial changes once energy and irrigation schemes come on line, the Turkish Government views the project as a comprehensive "irrigated region development project" *(Inan, March 1990, 4 ; Kolars & Mitchell, 1991, 19)* The economic future of south-eastern Turkey, the future supply of energy to Turkey itself and the security of the national economy depend on the success of the GAP. If all goes according to plan, energy and agricultural output can be expected to take off as the GAP development project comes into its own during this decade.

Not only is Southeast Anatolia Turkey's poorest region, but it also contains the bulk of Turkey's Kurdish population, and has experienced cross-border terrorist attacks by militant Kurds from Iraq and Syria. Turkey hopes that this difficult political situation can be stabilized by improving the local standard of living *(Briefing, 27 January 1992, 7 ; MEED, 13 October 1989, 5).*

C3.1 The GAP project

The south-eastern Anatolia project (GAP) region is defined as having jurisdiction over eight provinces: Adiyaman, Diyarbakir, Gaziantep, Mardin, Siirt, Sanliurfa, Sirnak and Batman. It occupies the south-eastern part of Turkey bordering on Syria to the south and Iraq to the south-east and, covers a land area of 75,000 km^2 corresponding to 9.5 per cent of the total national land area (see map C.1). Population growth rates in the GAP region have been consistently higher than those of Turkey for any five-year period since 1945. Consequently the population of the region as a share of the total population has steadily increased from 7.0 per cent in 1945, to 8.5 per cent in 1985 and to 9.2 per cent according to the 1990 census *(GAP, 1992, 4)*. All provinces of the region are considered to be areas of emigration, yet the average annual population growth over the past two decades has increased from 2.9 per cent, to 3.9 per cent which is higher than the national average of 2.4 per cent *(Morvaridi, 1990, 308 ; GAP, 1992, 4).*

The GAP region was classified as a less developed region in 1985 in Turkey and its per capita gross regional product was 47 per cent of the per capita gross domestic product of Turkey. 8.5 per cent of the Turkish population lives in the region, with about 50 per cent living in urban areas, while the average population density is 58/km^2, (below the national average of 65/km^2) and the agricultural sector employs 70 per cent of the labour force *(Morvaridi, 1990, 308).* Although the GAP region is one of the underdeveloped parts of the country with a per capita gross product of only 47 per cent of the national average in 1985, the region has attained self-sufficiency in basic foodstuffs including wheat, meat and milk. The region is also a significant producer of several agricultural products, with a high share of the national production. According to the 1990 census 5.27 million inhabitants live there, so the region is not yet overpopulated, but it could reach 10 million when the consequences of the current investment come into being and room has to be found for Turkey's rapidly increasing population *(GAP, 1990, Vol. 1, 1).*

Table C1.5:

Comparison of the GAP region and Turkey by selected indices (1985)

Index	Unit	Turkey	GAP Region	GAP Share (%)
Land Area	km^2	779,459	73,863	9.5
Total population		50,664,458	4,303,567	8.5
Population growth (1965-85)	% p.a.	2.4	2.9	-
Population density	/km^2	65	58	-
Urban population	% to Total	53.0	49.9	-
Economic structure	% in GDP/GRP			
Agriculture		17.7	39.6	(9.0)
Manufacturing		25.2	11.7	(1.9)
Gross domestic product	10^9 TL	83,785,419	3,365,559	4.0
Per capita GDP/GRP	10^3 TL	1,822	862	(47)

Source: GAP, 1990, Vol. 1, 1

The GAP project is the largest project yet carried out in Turkey. It is multi-purpose and integrates a development project comprising dams, hydroelectric power plants and irrigation facilities to be built on the Tigris and Euphrates rivers. This gigantic project also includes investments for the development of agriculture, transportation, education, industry, health, as well as social, cultural and other sectors in the region *(NewSpot, 19 July 1988, 5)*.

The GAP, a combination of 13 major projects primarily aimed at irrigation and hydropower generation, includes the construction of 22 dams and 19 hydroelectric power plants on the Euphrates and Tigris and their tributaries *(GAP, 1992, 4)*. The area has a favourable environment for large scale intensive agriculture and irrigation will provide the region with an opportunity to utilize this agricultural potential to the full. Therefore a significant increase is expected in crop yields which will create a new basis for developing agro-industries and agricultural input - producing industries that depend largely on market opportunities *(Inan, 1989, 49)*.

C3.2 Basic characteristics of the GAP region

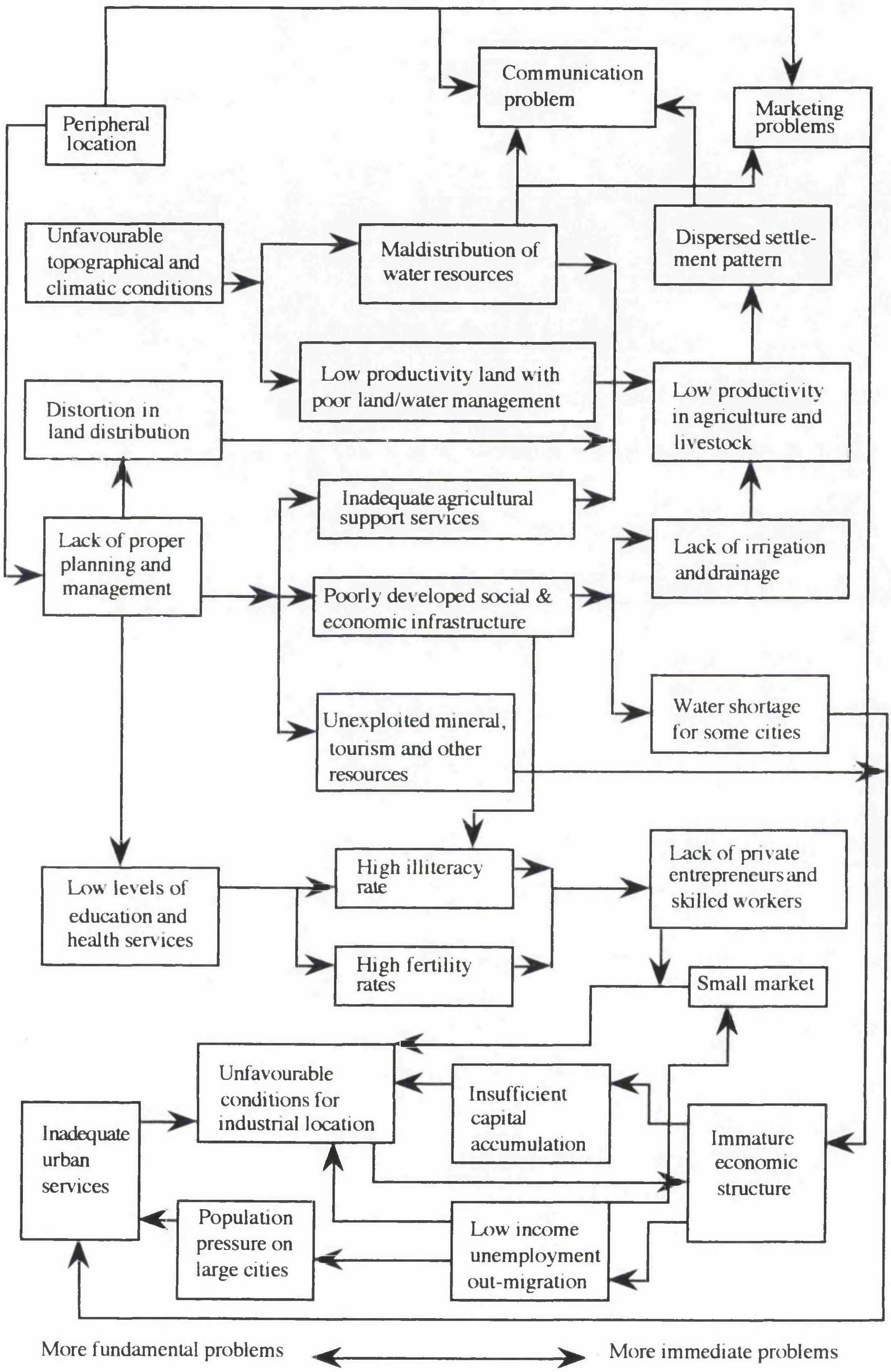
The Euphrates and Tigris river systems act as the source of life for the region and South-east Anatolia is endowed with a large quantity of high quality water, although it is both unevenly distributed and neither fully nor efficiently used throughout the region.

The Sanliurfa and Mardin plains, situated in the centre of the region and extending between the Euphrates and Tigris basin, are drained by most of the small rivers in the region. Some of these rivers which flow along the Gaziantep plains also cross the Syrian border and ultimately merge with the Euphrates in Syrian territory *(Bagis, 1989, 25)*.

The climate of the GAP region is of a continental nature, with dry hot summers and cold rainy winters. While the region reaches very high temperatures of around 45'°C during the summer season, the temperatures drop to around -13' to -24'°C in winter. The hottest areas of the region extend southwards towards Syria.

The mean annual rainfall over the region is relatively low compared to other regions of Turkey and ranges from 280 mm in the Southwest of Sanliurfa near the Syrian border to 1,300 mm in the foothills of the mountains which divide the Tigris river basin and the Murat river basin. The mean annual precipitation has been measured and found to be 660 mm in the Euphrates river basin, 880 mm in the Tigris river basin and 490 mm in the other small river basins, but between June and September there is no rain. Dry farming techniques currently dominate the region with wheat being the major crop *(Morvaridi, 1990, 308)*.

Figure C1.4:
The GAP region's problems



Source: GAP, 1990,Vol. 2, 17

Another peculiar characteristic of South-eastern Anatolia's climate is the high degree of pan evaporation (see table C1.6) due to the high temperatures and a lengthy dry season with evaporation ranging from 2,400 mm near the Syrian boundary to 1,470 mm at Gaziantep. This constitutes on obstacle to rainfed farming in the region and makes the need for irrigation urgent *(Bagis, 1989, 30)*.

While the present agricultural production is limited to one harvest every two years, with irrigation and modern technology, the soil and climate can sustain two or three harvests annually *(Tekeli, 1990, 208)*.

Table C1.6:

Annual pan evaporation in the GAP region

Station	Annual pan evaporation (mm)	Record length (years)
Diyarbakir	1,935	33
Gaziantep	1,466	15
Cizre	2,424	16
Sanliurfa	2,048	23
Ceylanpinar	1,834	14
Elazig	1,519	15

Source: GAP, 1990, Vol. 4, E4

C3.3 Current use of land

Almost half of the land (42.3 per cent) in the GAP region is presently devoted to agriculture and, of the total cultivated area, 36 per cent (or 262,870 ha.) is used for dry farming while irrigated farming accounts for only 4 per cent (or 12,070 ha.). The rest of the cultivated land is used for horticulture and various other purposes but intensive farming, which properly employs modern production techniques, is only sporadically practised in the region.

In addition to the Euphrates and Tigris rivers, the GAP region has quite a high ground water potential especially in the lowlands of Sanliurfa, Mardin and Diyarbakir (see table C1.7). Part of this ground water is used to provide domestic water to the cities but it is also used for small-scale irrigation purposes. The ground water potential of the region (estimated to be 1,526 million m^3) represents 78 per cent of the total in the Sanliurfa province *(Bagis, 1989, 45)*. There are areas in the region which have not yet been the subject of hydrogeological investigations, so proven ground water sources in the region may be greater. Crop cultivation covers 42 per cent of land with 85 per cent of this in dry farming, 4 per cent under irrigation, and the remainder devoted to horticulture *(Morvaridi, 1990, 308).*

Table C1.7:

Ground water potential in the GAP region

Province	Yield (million m^3/ year)
Sanliurfa	1,202.0
Diyarbakir	190.0
Mardin	113.0
Gaziantep	15.0
Adiyaman	6.0
Siirt	0.0

Source: GAP, 1990, Vol. 4, E8

Although the region is sufficiently rich in water resources, the degree to which the water has been used for agricultural purposes is very low because the sources have not been developed.

C3.4 The economic structure of the region

Agriculture is the most widespread and dominant economic activity in the GAP region and its share in the regional economy is about 42 per cent. Although the agriculture uses backward technology and no irrigation, the region is a major grower of certain crops within the country. The agricultural sector is sensitive to climatic conditions because of its structure, lack of integration with the market and the absence of irrigation, modern inputs and advanced agricultural techniques - all which lead to low yields in agriculture.

Industry's share of the regional economy in 1985 was 17.5 per cent, mostly in manufacturing (75 per cent). The service sector has the largest share within the Regional Gross Product, with 43.9 per cent, mainly from two centres: Gaziantep and Diyarbakir.

An imbalance in the inter-regional distribution of economic activities characterizes the region which has a low share of the national economy relative to its physical and human conditions. The regional economy cannot break out of two major vicious circles: poverty characterised by the inability to save because of low income levels which results in the inability to invest and increase income levels (see figure C1.4); and a small market that is limited in its ability to sell the produce, (again because of low income levels), and in the limited possibilities for maintaining production or expanding the size of the market *(Bagis, 1989, 110).*

C3.5 Development objectives and strategy

Analysis of the present conditions in the GAP region which deals with the resource base and constraints as well as the national economy and national development objectives has the following objectives and basic strategy for the region's development.

Overall development objectives

1. To raise income levels in the GAP region by improving the economic structure and narrowing the income disparity between this and other regions.
2. To increase productivity and employment opportunities in rural areas.
3. To enhance the assimilative capacity of larger cities in the region.
4. To contribute to the national objectives of sustained economic growth, export promotion and social stability by efficient utilization of the region's resources.

Agricultural development objectives

1. To raise income levels in rural areas by enhancing agricultural productivity and diversifying farming activities.
2. To provide sufficient inputs for agro-processing industries
3. To increase employment opportunities in order to minimize the drift of population out of the rural areas.
4. To contribute to the production of exportable surpluses.

Industrial development objectives

1. To serve, on the one hand, as a driving force for the economic development of the GAP region and, on the other hand, as a demand generator for education/training and technology development, in order to enhance the region's image, social welfare and the people's motivation.
2. To contribute to the reduction of inter-regional income disparity by expanding high income employment opportunities
3. To contribute to the national objectives of export promotion and foreign exchange earnings/savings *(GAP, 1990, Vol. 1, 4)*.

C3.6 Projects for developing water resources in the GAP region

The Euphrates and Tigris basins have always been a focus of interest for basin planners as they constitute the most important part of the potential land and water resources of Turkey. Research studies in the Euphrates basin began in the early years of the republic and, in 1936, the Keban gauging station was built at a section near the axis of what is now the Keban Dam. This marked the beginning of one of the earliest hydrological observation activities in Turkey but the development planning for the region was delayed by World War II and the general Directorate of State Water Works (DSI) was only established in 1953.

According to Kolars & Mitchell (1991), the development of large hydroelectric projects has benefited from the fact that Suleyman Demirel, the premier and former chairman of the disbanded Justice Party, received his degree in hydrological engineering. He became the director of DSI in 1955 and earned the nickname the "King of Dams". Demirel became prime minister in 1965 and it was during his period that the plans for the GAP were prepared. During this same period, Turgut Ozal, destined to become prime minister in the 1980's, finished graduate work in the United States in economics and engineering and returned to Turkey during the late 1950's. At that time he directed studies of the Euphrates and Tigris rivers and their hydroelectric potential. In the political campaigns of the mid-eighties, both Turgut Ozal and Suleyman Demirel were important in the development of the Keban Dam and the GAP region *(Kolars & Mitchell, 1991, 25)*.

The GAP project implementation is expected to take 30-40 years. The status of the project varies from preliminary level through master plan, design plans, and construction with components already under way, and some operating.

The Keban Dam

The Keban Dam is a compacted rock-filled dam with a clay core whose reservoir holds 30,6 billion m^3 and covers an area of 675 km^2 (see photo 1). It is intended both to regulate the seasonal fluctuations of the river and generate power (see photo 1). During full production, the average annual amount of electricity generated is expected to be approximately 6 billion KWh *(Kolars & Mitchell, 1991, 35)*. In 1966, the main contract for construction of the Keban Dam was signed between the Turkish government and SCI - Impreglio, a Franco-Italian consortium. The foundation of the dam was laid in 1966, while the reservoir was filled and power production began in 1974. Although the Keban Dam is an integral part of the overall Euphrates development scheme, and does not fall within GAP, it has a significant effect on the planning of water resources in the GAP region due to its huge storage capacity *(GAP, 1990, Vol. 4, E11).*

With the completion of the Keban Dam and reservoir, the government announced that it had established river flow at a minimum of 450 m^3 second and a maximum of 1,000 m^3 second. Although the Keban Dam has consistently been referred to in Turkish publications as solely a hydroelectric generating facility a recent news release refers to a proposed "Kuzova Project" which will irrigate 30,000 hectares of land with water from the Keban reservoir *(Kolars & Mitchell, 1991, 26).*

The Euphrates basin development plan is shown in figure C1.5 in the form of seven sub-projects.

1. The Lower Euphrates project
2. The Karakaya project
3. The Suruk-Baziki project
4. The Kahta-Adiyaman project
5. The Adiyaman-Goksu-Araban project
6. The Gaziantep project
7. The Frontier-Euphrates project

1. **The Lower Euphrates project.**

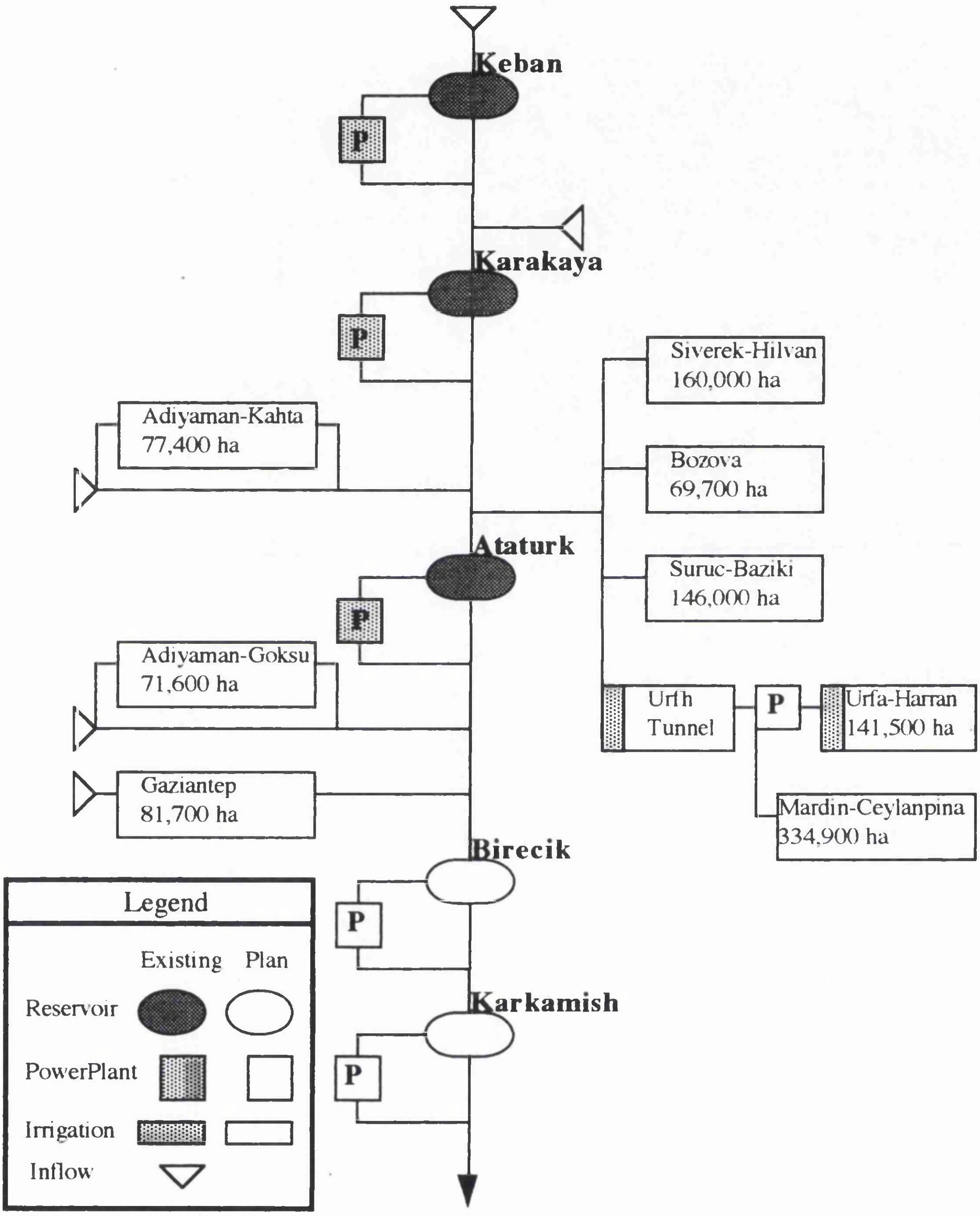
The Lower Euphrates project is the largest and the most comprehensive of all the GAP power generation projects. It is planned to be completed in several stages by the year 2002. The Ataturk Dam and Hydroelectric power plant currently under construction, is not only the largest individual project and most important unit of the GAP project, but also the most costly.

The Ataturk Dam

The Ataturk Dam, being built on the Euphrates proper, is located some 180 km downstream from Karakaya and 60 km to the Northwest of Sanliurfa. The dam, which is the key structure for the lower Euphrates development, is 184 metres high from the foundation and has a gross storage capacity of 48.7 million m^3 (see photo 2). It is planned to have an active storage capacity of 19.3 million m^3 and the reservoir surface area will impound an 817 km^2 lake *(GAP, 1990, Vol. 4, E13).* The dam site chosen is located where the Euphrates enters a limestone mountain pass. Since the dam is in an active seismic zone, the dam design is said to be able to withstand an earthquake of a magnitude of 8 on the Richter scale - that is an earthquake of force that can be expected to occur once in 500 years *(Kolars & Mitchell, 1991, 41)*.

Figure C1.5:

Euphrates river, main stream model



Source: Gap, 1990, Vol. 2, 36

The Ataturk Dam is important to the completion of the lower Euphrates project and even the entire GAP project, because it is the water source for the four irrigation projects in the 852,781 hectare area. This area represents slightly more than half of the total 1,641,282 ha. to be irrigated when all the GAP project is completed but, the irrigation water requirements of the Suruk-Baziki and Adiyaman-Kahta projects will also be mainly met from the Ataturk dam. Thus, the total area to be irrigated from the Ataturk Dam will reach approximately 1,000,000 ha. *(Bagis, 1989, 50).*

The dam whose first two power unit turbines began operating in July 1992 will have a generating capacity of 2,400 MW from eight turbines, and will generate 8,100 GWh energy annually, but this will drop to 5,300 GWh when all the irrigation projects are complete. In addition, the Ataturk Dam, (by regulating the water flow throughout the year) will contribute to the hydroelectric power plants planned within the framework of the frontier Euphrates project. Part of the water in the Ataturk Dam reservoir will go to the Sanliurfa-Harran and Mardin-Ceylanpinar plants through the Sanliurfa tunnels under construction and small pumping irrigation projects are planned along the west bank of the reservoir *(GAP, 1990, Vol. 4, E13).*

The impounding of the reservoir of the Ataturk Dam began in January 1990, and, in May 1991, the first of the eight units planned for the power plant was commissioned *(Bagis, 1989, 51).* It will still require two or three good years of heavy snows to fill the reservoir to the required maximum elevation of 542 meters but, at the height of 526 meters, the twin Urfa tunnels come into operation.

The second important component of the lower Euphrates project, after the Ataturk Dam, is the Sanliurfa tunnel system through which the main canals of the irrigation area of the Sanliurfa-Harran plants and Mardin-Ceylanpinar flow along a system whose total length is 57.8 km. The output capacity of the tunnel totals 328 m^3/sec, and consists of two lines of pressured water way of 7.62 meters inner diameter. The tunnel was completed in early 1993 (see photo 3). Water flowing through the tunnels will reach the forbear of the Sanliurfa power plant which is located on this canal and has a drop of 50 meters; it will generate 124 GWh energy annually *(GAP, 1990, Vol. 4, E14).*

The Sanliurfa-Harran irrigation area which is 141,500 ha. in size stretches from the low plains south of the city of Sanliurfa to the Syrian border. In addition to this surface water irrigation, a small-scale ground water irrigation system which irrigates an area of 13,000 ha. has already been established to the south of the low plains, near the Syrian border (see photo 4).

According to the GAP master plan, the Mardin-Ceylanpinar irrigation area of 334,900 ha. will be completed in the year 2000. The Ceylanpinar ground water irrigation areas are located to the south of the surface irrigation projects and, in this area, 9,000 ha. of land is currently irrigated from wells. Thus it is estimated that a total of 60,000 ha. can be irrigated with ground water.

Photo 1: Keban Dam (July 1992)

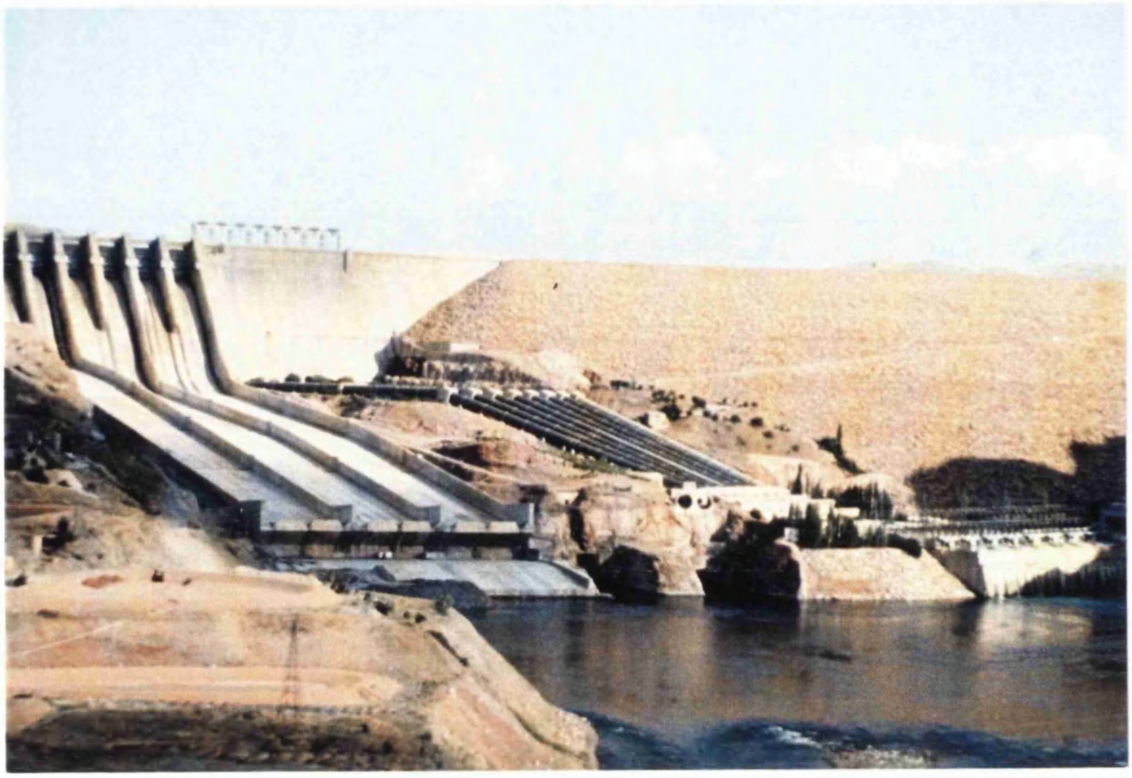
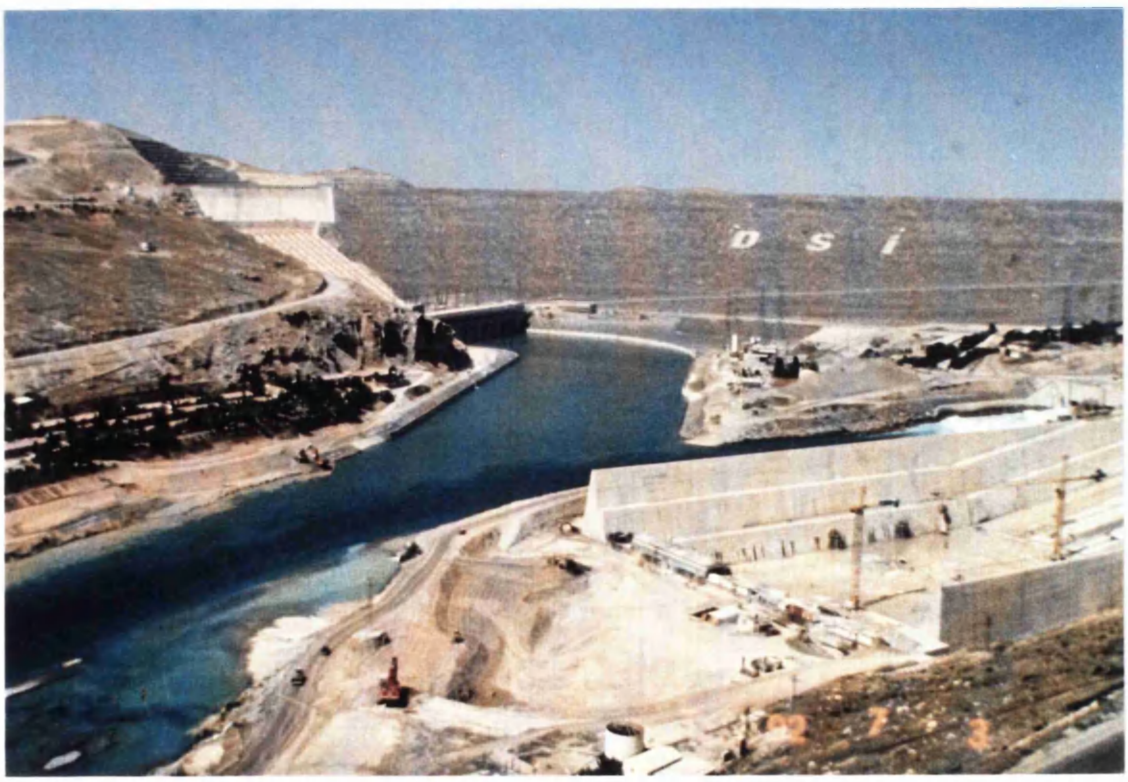
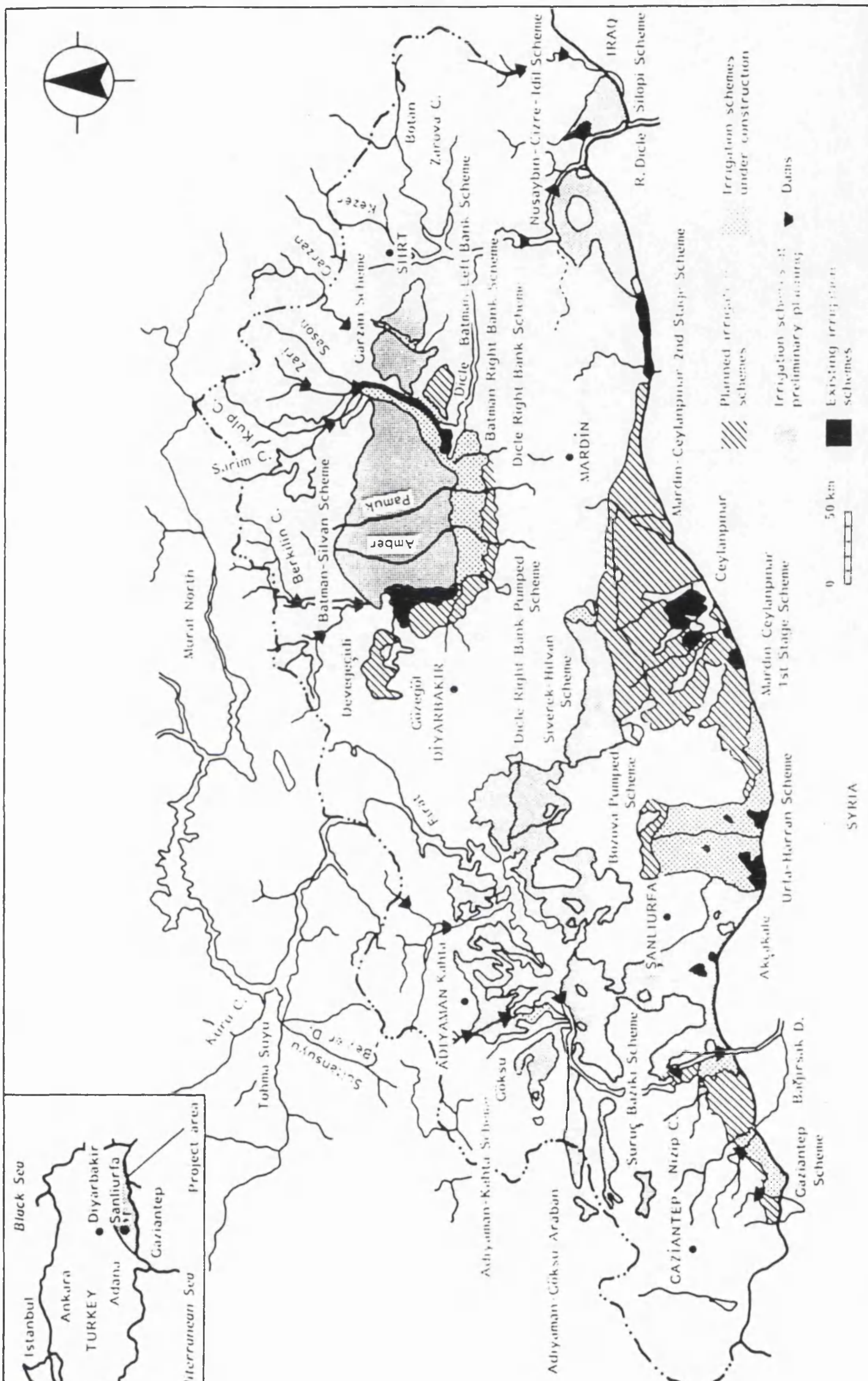


Photo 2: Ataturk Dam (July 1992)



Map C.1:
Location of water resource development schemes in the GAP project



Source: GAP, 1990, Vol. 2, 35

The Siverek-Hilvan pumping irrigation area, covering a total area of 160,105 ha., will be fed from the Ataturk Dam reservoir, seven pumping stations and 17 small reservoirs planned in the network system.

In the hilly terrain between the Hilvan and Bozova districts, the area to be irrigated is 69,702 ha. gross, but it is necessary to elevate water 260 m above the reservoir water level through six steps of pumping *(GAP, 1990, Vol. 4, E15)*. The irrigation will be carried out by raising water from the Ataturk Dam reservoir and, according to the GAP schedule, the Bozova irrigation scheme will be completed in 1995 *(Bagis, 1989, 53)*.

2. The Karakaya Project

The Karakaya Dam is located about 166 km downstream from the Keban Dam, near Cungus in the Diyarbakir region. The Karakaya, with a planned 1,800 MW capacity from six 300 MW units, each was completed in late 1988 and will have an annual electricity generation of between 7.3 and 7.5 billion KWh *(NewSpot, 4 March 1988, 5)* .

The Karakaya, a concrete arch-type dam with a height of 187m (see photo 5). and a total reservoir volume of about 9,500 million m^3 of water, will regulate the Euphrates runoff and supply an incremental firm yield of an estimated 1,000 million m^3 a year when it is operated for power generation with a 41 per cent plant factor *(GAP, 1990, Vol. 4, E16)*. The Karakaya Dam is similar to the Keban Dam in that its dual purpose is to regulate stream flow and generate hydroelectric power.

3. The Suruk-Baziki Project

This large-scale irrigation project, consisting of various pumping stations, is designed to irrigate an area of 146,500 ha. located along the Euphrates river near the Ataturk dam, to the west of the Sanliurfa-Harran irrigation area, and extending towards the Syrian border in the form of low plains. The water is planned to be pumped from the Ataturk reservoir into three reservoirs (Tozluca, Aylan and Tasbasan) making 27 million m^3 of total active storage which are yet to be built *(GAP, 1990, Vol. 4, E17)*. According to the GAP master plain, the project will be completed in the year 2000.

4. The Adiyaman-Kahta Project

The Adiyaman-Kahta project is a multipurpose project in the central and northern part of the Adiyaman province and aims to develop water resources on the right bank of the Ataturk Dam reservoir. The project consists of five irrigation schemes, four storage type hydropower plants and one run-of-river type hydropower plant.

Photo 3: The Sanliurfa-Haran tunnel (July 1992)

Photo 4: The Sanliurfa-Haran irrigation area (July 1992)

Photo 5: Karakaya Dam (July 1992)

Photo 6: Karkamish area near the Syrian border (July 1992)

The total irrigation area will amount to 77,409 ha., of which 30,000 ha. will be irrigated from the Ataturk reservoir *(Bagis, 1989, 55).*

5. The Adiyaman-Goksu-Araban Project

This project will first cover the south-western part of the province of Adiyaman and the north-western part of the province of Gaziantep. The main purpose of the project is to supply water for irrigation to 71,598 ha. of land gross and municipal water to Gaziantep, but a run-of- river hydropower plant is also planned. The 112m high Cataltepe Dam, the key-structure of the project, will be built on the river Goksu, 7 km Northeast of Golbasi, and will create a reservoir of 627 million m^3 of active storage capacity. Water from the reservoir will go to irrigation areas through 200 km length main feeder canals *(Bagis, 1989, 55).* Two dams (Harmancik and Catabogazi) are planned on small tributaries of the Karasu river near Araban and will have a total active storage capacity of 420 million m^3 *(GAP, 1990, Vol. 4, E18)*.

6. The Gaziantep Project

This project is designed to supply irrigation water to a 89,000 ha area along the Syrian border to the south of the Gaziantep province by pumping from the Birecik Dam. Four dams are planned for small streams along the main feeder canal and, of these four dams, the already completed Hancagis Dam, with 83 million m^3 of active storage capacity, is planned to cover 7,300 ha of irrigation area. The Gaziantep irrigation project envisaged to be completed in 1997, contains 400 km of main canals and nine large pumping stations *(Bagis, 1989, 56).*

7. The Frontier Euphrates Project

The Frontier Euphrates project is divided into two sub-projects comprising the Birecik Dam and HPP and the Karkamish Dam and HPP. The Birecik Dam, with 6 of the 112 MW hydroelectric power stations, falls within the scope of the GAP project. The energy production will be affected by both the operation of the Ataturk dam for irrigation water supply and an irrigation development of the Adiyaman-Goksu-Araban planned in the tributaries upstream of the Birecik, as well as the Gaziantep project *(GAP, 1990, Vol. 4, E16).* The Birecik Dam which is planned to be built approximately 92 km downstream from the Ataturk Dam will have an active storage capacity of 972 million m^3 and will supply a significant part of the water for the Gaziantep irrigation project which has been planned to take water mainly from the Birecik reservoir *(Erimtan, March 1990, 21).*

The Karkamish Dam which will be located on the Euphrates river 33 km downstream from the Birecik site and 4.5 km upstream of the Syrian border (see photo 6) is a single purpose project aimed at energy production. The future annual energy production for this dam is estimated to be 680 GWh but this will be reduced to 450 GWh when all the planned upstream irrigation projects are completed *(GAP, 1990, Vol. 4, E17)*.

The GAP, it is estimated, will cost about US$ 20 billion, and an additional US $ 11 billion for the lower Euphrates project. Due to the international flow of the river, and no international agreement, it has not been possible for Turkey to secure international finance. However, determined to start GAP implementation, Turkey has awarded the construction contract for the Ataturk Dam to a Turkish constructor and has managed to fund the project from its own sources *(Tekeli, 1990, 208)*.

Table C1.8:

Main features of the South-eastern Anatolia Project (GAP)

Project	Irrigation area (ha)	Power generation (MW)	Irrigation water required (million m^3)
1.Lower Euphrates Project			
Ataturk Dam and HPP	-	2,400	-
Urfa Tunnel and HPP	-	48	-
Urfa-Harran Irrigation	141,535	-	1,481
Mardin-Ceylappinar Irr.			
1. First Stage Irr.	230,130	-	2,302
2. Second Stage Irr.	104,809	-	1,049
Siverek-Hilvan Pumped Irr.	160,105	-	1,428
Bozova Pumped Irr.	69,702	6	622
2.Karakaya Dam and HPP Project	-	1,800	-
3.Frontier Euphrates Project			
Birecik Dam and HPP	-	672	-
Karkamish Dam and HPP	-	180	-
4.Suruc-Baziki Project	146,500	44	1,525
5.Adiyaman-Kahta Project			
HPP (5 Projects)	-	196	-
Irr. Projects (5 Projects)	77,409	-	590
6.Adiyaman-Goksu-Araban Project	71,598	-	517
7.Gaziantep Project	81,670	-	590
TOTAL (1 to 7)	1,083,458	5,346	10,104

Source: Bagis, 1989, 52

C4. Modern irrigation development projects in Syria

Until 1918 the area within the present frontiers of Syria was part of the Ottoman empire and was governed from Istanbul, as were the areas we know as Iraq, Jordan, Israel and Lebanon. The Turks lost all of these territories because of the defeat in the First World War. As a result of the Sykes - Picot agreement, Syria became a French sphere of influence and, until 1946, France ruled Syria as the responsible mandatory power creating the modern Syrian economy. Although economic and social development was not rapid during the French mandatory period, it was far from negligible; internal security was imposed, roads were built and education and health services improved. Few modern industrial plants were built, but a start was made on irrigation projects and a gradually increasing area of land was cultivated *(Lewis, 1987, 7)*.

Syria covers an area of 185,180 km^2, of which about nearly half is poor steppe or semi-arid land, with 30 per cent agricultural land, and only 9 per cent of the agricultural land is irrigated. Potential irrigable land is about 1.6 million hectares with the greatest potential located in the Khabur - (85,000 hectares), and the Euphrates projects - (640,000 hectares) *(Mitchell, 1982, 4)*. The uncultivated land provided some of the fodder required by Syria's several million sheep and farming of all kinds (including sheep rearing) contributed a larger proportion of the gross national product supporting more people than any other activity. The report of the United Nation Economic Survey for the Middle East in the year 1949 claimed that more than two - thirds of Syria's entire population derived their source of livelihood directly from the cultivation of the land, whilst its raw products were the source upon which a large proportion of the remaining population subsisted *(United Nation, 1949, 22)*.

Syria is usually divided into five regions: the Mediterranean coast and mountains in the Northwest; the central plains, which extend from Homs north to Aleppo and then east to the Euphrates river; the south-western area around Damascus; the north-eastern plains along and beyond the Euphrates; and the desert region.

The main areas of cultivation are a narrow strip of land along the coast, from the Lebanese to the Turkish frontiers, which enjoys a Mediterranean climate, is exceedingly fertile and produces fruit, olives, tobacco and cotton. East of this strip lays the northward extension of the Lebanese range of mountains, which falls sharply on the east to the Orontes river valley whose marshes have been reclaimed to form part of Syria's most fertile areas. In central Syria this valley joins the steppe - plain, about 150 km wide, which runs from the Jordanian borders north - eastward towards the Euphrates valley.

The plain is traditionally Syria's major agricultural area, with cereals as the principal crops. In this region one also finds the country's main cities: Damascus, Homs, Hama and Aleppo. This area may be termed the core of the nation since it contains nearly half of the total population. The importance of this plain is now being challenged by a fourth area, the Gezira, which lies between the Euphrates and the Tigris rivers. Although fertile lands along the banks of the Euphrates and its tributaries have previously been cultivated, the Gezira's value was only recognized in the early 1950s when large - scale cotton cultivation was introduced in former pasture lands. The Damascus - Southwest region, separated from the core by the northern fringes of the Anti - Lebanon mountains, has a more varied landscape and contains about 27 per cent of the total population *(Taylor, 1972, 151-153).*

The most significant changes in the geographic distribution of the population have occurred as a result of urbanization. Although the distribution of the population may not have changed greatly at the province level, within provinces there has been a significant redistribution of people with a continuing movement from village to town. In 1960 about 37 per cent of the population was classified as urban but, by 1985, the proportion had risen to 49 per cent *(Drysdale, 1987, 73)*. The urban population increased at an annual rate of 5.5 per cent in 1980 - 1985, compared with 4.5 per cent in 1965 - 1980 with the fastest rates of urban growth in some of the least urbanized provinces. The process of urbanization has put a strain on services in the cities and has led to the growth of shanty towns along the edges of large urban centres such as Damascus and Aleppo. The population of Damascus trebled between 1950 and 1975 and, since then, has increased by another 50 per cent. This growth is fuelled by a continuing influx of people from the country side which cannot possibly support its own rapidly growing population *(Lewis, 1987, 15)*. The most dramatic urbanization occurred in the Al-Raqqa province which was eight per cent urban in 1960 but 39 per cent in 1981. This growth is a result of the Euphrates dam and related irrigation and agricultural projects.

Agriculture retains its position as the mainstay of the Syrian economy despite the existence of a traditionally strong trading sector and partially successful attempts at industrialization. In 1984 the agricultural sector employed 25.4 per cent of a total labour force of 2,246,300 compared with 31.8 per cent in 1979 and 50 per cent in 1975, while manufacturing employed 15 per cent in 1984, compared with 15.6 per cent in 1979 and 11.5 per cent in 1975. Services employed 24 per cent in 1984 compared with 19.4 per cent in 1979; building and construction employed 16.3 per cent (compared with 13.7 per cent); and trade and catering employed 11.3 per cent (compared with 10.2 per cent).

Table C4.1:

Syria: sectoral distribution of the labor force, 1950-1980 (%)

	1950	1960	1970	1980
Agriculture	58	54	51	32
Industry	18	19	21	32
Services	24	27	28	36

Source: Richards & Waterbury, 1990, 74

Irrigation is the only strategy which can make agriculture secure in dry countries such as Syria. Yields from irrigated land can be five times those on rainfed tracts, and a secure water supply enables more flexibility in cropping as well as enabling an effective high input and high output system of farming *(Allan, 1987, 28)*. Because of its heavy dependence on rainfall, the agricultural output of Syria was considerably affected by adverse weather conditions during several years in the 1970s and by a prolonged drought from 1982 to 1985. As Syria's principal crop, and one which is cultivated mostly on a rainfed basis, cereals suffered particularly seriously from inadequate rainfalls *(Meyer, 1987, 44)*. This is the main reason why the expansion of irrigated areas to reduce dependence upon rain - fed cultivation has been the stated goal of successive Syrian governments since the 1940s.

Table C4.2:

Syria: land use: 1963-1990 (thousand of ha.)

	1963-66	1975	1980	1985	1990
Forest	465	445	466	516	723
Steppe and pasture	5,803	8,631	8,378	8,328	7,869
Uncultivable	3,470	3,487	3,520	3,547	3,777
Cultivable	8,780	5,955	6,154	6,127	6,149
Uncultivated	2,261	479	470	504	523
Cultivated	6,519	5,476	5,684	5,623	5,626
Fallow	3,143	1,776	1,791	1,653	160
Rain-fed	2,826	3,184	3,354	3,318	4,773
Irrigated	550	516	539	652	693
Total	18,518	18,158	18,158	18,158	18,518

Sources: Manners & Nejad, 1985, 265 ; Syrian Arab Republic, 1991, 6/4.

The final report of the United Nations Economic Survey Mission provides some insight into the structure of the Syrian economy at the end of the 1940s. According to the report about 90 per cent of the cropping in that period was rain-fed and only very limited action had been taken to develop the water resources of Syria for irrigation purposes. The irrigation area was estimated at about 280,000 hectares or one-eighth of the land under cultivation. Most of the water was derived from river supplies while wells and springs made only a small contribution *(United Nation, 1949, 22)*. The 1950s and 1960s saw a considerable increase in irrigated farming (table C4.3) with the greatest change during this period occurring along the Euphrates where the use of river pumps enabled large areas of land to be brought under irrigation. For the first time in 1955, the irrigated area in Syria probably amounted to around 400,000 hectares approximately 250,000 hectares of which were believed to have been irrigated by pumping and the balance by gravity flow from rivers, springs and underground qanats *(Manners & Nejad, 1985, 259)*. By 1990 the irrigation area in Syria amounted to about 693,000 hectares, and approximately 559,000 hectares were probably being irrigated by pumping *(Syrian Arab Republic, 1990, 8/4)*.

Table C4.3

Syria: irrigation area by source of water, 1955-1990 (hectares)

Pump irrigation	1955	1963	1980	1985	1990
River pumps		393,700	186,000	204,300	216,900
Groundwater wells		158,100	237,700	250,300	342,000
Total	250,000	551,800	423,700	454,600	558,900
Gravity flow					
Water Wheels		8,100	1,200		
Diversion from rivers, springs		111,300	114,100		
Total	150,000	119,400	115,300	119,300	134,100
Total	400,000	671,200	539,000	651,900	693,000

Sources: Manners & Nejad, 1985, 259 ; Syrian Arab Republic, 1991, 8/4.

According the figures in table C4.3, there was actually a net loss of irrigated land from the early 1960s until the 1990s. This decline is variously attributed to inundation, water logging, salinization, and the impact of the land reform program which set a ceiling on the ownership of irrigated land. Since the mid 1980s, there has been a new expansion of irrigated land but, according to Meyer (1987), more than 30,000 hectares of old irrigated land were flooded in the reservoir area between 1973 and 1975, and some 4,000 hectares went out of production every year because of increasing salinity in the Lower Euphrates valley *(Meyer, 1987, 44)*.

In 1955, only 48,000 hectares of land were covered by government irrigation schemes and, within the next 15 years, around 140,000 hectares were reportedly irrigated by government schemes. Particular importance was placed upon the Ghab reclamation project which transformed an area of marsh and swampland in the Orontes valley into some of the most productive farmland in Syria. With the completion of the Ghab project in 1968, attention was turned to making fuller use of the Euphrates and its tributary the Khabur *(Manners & Najed, 1985, 261)*.

Syria suffers from a shortage of agricultural products, which forces the authorities to increase imports of food products from foreign markets and in 1988, for example, food made up about 71 per cent of the country's overall imports *(Syrie & Monde Arabe, 1988, No. 408, 1)*. This situation was caused by a sharp growth in population and it is predicted that the demand for food will increase by 3.1 per cent annually, a figure that is higher than the annual rate of actual increase in food production, which amounted in the past two decades to 2.8 per cent. Thus food security has become one of the most important elements for the progress and development of Syria.

After a directive from President Hafez Al-Assad in February 1986, Syria began to pay special attention to agriculture and the livestock sector with the aim of achieving self- sufficiency, abundant production for export and, consequently, achieving food sufficiency at the regional level *(Syria & Monde Arabe, 1988, No. 408, 2)*.

Syria has the potential to feed its increasing population and even export basic food staples such as wheat and barley, but over the last thirty years, the picture in the agricultural sector, despite the bright prospects, has been one of stagnation. Some of the blame for this can be levelled at the adverse climatic conditions that have occurred from time to time, but the problem is also political *(Mitchell, 1982, 22)*. Industry became the country's main priority in the fourth five year plan and, with the rush of agricultural workers from the land, small farmers turned to cash crops such as water melons, sugar beet and pistachio nuts. This trend was reversed for the fifth five year plan (1981-1985), which has given agriculture a high priority *(The Middle East, 1984, 28)*. According to Syrian statistics the success of the Syrian fifth five year plan reached almost 75 per cent for total production and around 60 per cent for agriculture and industry *(Syria & Monde Arabe, 1988, No. 409, 3)*.

With population rising at a rate of well over three per cent per year for several decades and with changes and improvements in domestic food consumption taking place, at the same time the need to increase food output has been inescapable. As a result policies to improve land, as well as the rural infrastructure and rural institutions associated with agricultural production, have been a basic element in national policy and planning for almost three decades. An increase in production is immediately required to meet the national demand for grain which has resulted from the rapid rise in population. Additional pressure has been the steady increase in demand for livestock products

(Allan, 1987a, 22). According to Syrian officials, in 1991 the total amount of water for irrigation in Syria was 10.6 billion m^3 while domestic and industrial water was 2.5 billion m^3. The Syrian experts believe that, because of the annual growth and further demands by industry and agriculture, by the year 2,000 Syria could suffer from a shortage of water *(CICH, 6 November 1991, 4)*.

C4.1 Surface water flows in Syria

The total annual surface water resources are estimated at 33.7 billion m^3, of which 27.4 billion m^3 come from the flow of the Euphrates river and 4.1 billion m^3 from the flow of springs that feed a number of rivers during the year .

Table C4.4:

Flow rates of Syrian rivers

Rivers	Minimum m^3/sec	Maximum m^3/sec	Average m^3/sec	Average bil/m^3/yr.
Euphrates	250.0	5200.0	830.0	27.40
Sajour	0.5	25.0	3.1	0.08
Balikh	5.0	12.0	6.0	0.19
Khabur	0.0	421.0	35.0	1.78
Orontes	7.0	12.4	10.1	0.32
Afrin	1.4	15.7	8.6	0.27
Queiq	0.0	7.8	0.3	0.01
Alkabir	0.2	6.4	2.3	0.07
Sinn	7.0	21.0	4.0	0.44
Barada	5.0	25.0	7.0	0.22
Awaj	0.4	20.6	1.9	0.06
Yarmouk	7.0	100.0	15.0	0.22
Al Kabir	0.7	37.0	5.6	0.17
Banyas	0.5	11.8	1.6	0.05
Sybarani	0.2	7.9	1.6	0.00
Total				31.4

Sources: Syrian Arab Republic, 1986, 40 ; Kolars & Mitchell, 1991, 108 ; Wolfart, 1967, 229.

Syria, as the second riparian user of the Euphrates river, contributes water to the system and also extracts large amounts of water from it. According to table C4.4 the total annual flow of the Euphrates in Syria before reaching the Iraqi border is about 31.4 billion m^3; and the volume of the Euphrates main stream, before reaching the Turkish - Syrian border at Karkamish is about 27,4 billion m^3. The next measure of annual stream flow (80 million m^3) is from the Sajur, which rises in Turkey and enters the Euphrates a short distance (48 km) inside Syria on the right bank. The Balikh is the next tributary which enters on the left bank and receives the bulk of its water from the Ain-Arous in Syria, near the Turkish border. In Syria this river is heavily utilized for irrigation, along its 116 km length. The final contribution to the flow of the Euphrates comes from the Khabur river system, which joins the mainstream 40 km downstream from Deir ez-Zor. The length of the Khabur in Syria is 442 km and the natural flow of the stream is about 1,780 million m^3/yr. The total annual water added to the Euphrates in Syria is about 2 billion m^3 *(Kolars & Mitchell, 1991, 110).*

Water storage in Syria

According to table C4.5 the storage capacity of the present water projects of the Euphrates river in Syria is about 13.8 billion m^3. with the Tabqa dam having a capacity of 11.6 billion m^3. and all other dams having a total capacity of about 2.2 billion m^3.

Table C4.5:

Dams in the Euphrates river basin in Syria

Dam / project name	Storage capacity	Reservoir area
Tabqa (800 MW)	11,600 Mm^3	625 km^2
Tishreen (1.6 MW)	1,300 Mm^3	70 km^2
Ba'ath (64 MW)	90 Mm^3	2.7 km^2
Western Hasakah (12 MW)	73 Mm^3	1,020 ha.
Eastern Hasakah	200 Mm^3	3,100 ha.
Khabur (8 MW)	540 Mm^3	9,580 ha.

Sources: Kolars & Mitchell, 1991, 153; Al-Tawara, 21 January 1991, 3

According to report of The Arab Economist in 1982, The Syrian Ministry of Public Works and Water Resources introduced a policy that aimed at setting up an extensive network of small to medium sized, low cost surface dams throughout the country. These dams collect rainwater during the winter, forming small lakes from which water is drawn during the dry summer months. The surface dams vary in storage capacity from 700,000 m^3 of water to more than 25 million m^3 and are mainly used to supply water for agricultural purposes, such as irrigating crops watering livestock and, to a lesser extent, as a supply of water for human use in some of the more isolated rural villages. Up until 1982, seventy one surface dams had been constructed with a total storage capacity of about 200 million m^3 of water, most of them located in the regions of Al-Badia and the coast; but another thirteen dams with a total storage capacity of 130 million m^3 were still yet to be built. Surface dams are also desirable because they are relatively simple to build and do not require the large injections of capital and labour that large capacity dams do *(The Arab Economist, 1982, 20)*.

Ground water is available in the main water - bearing formations. In descending importance these formations are: the carbonate rocks dating back to the Jurassic and Cretaceous times; the marine limestone rocks dating back to the Palaeocene and Miocene times; and the basalt rocks. The annual replenishment is estimated at 1,625 billion m^3, through pumped wells, and is found primarily on the coastal strip, the lower plains and the internal plains of the west and the Northeast *(Baasiri, 1990, 22)*. Perhaps the most serious problems involve groundwater development. Prior to 1950 the water of the Euphrates was little used and traditional lifts, often camel powered, brought what little water reached fields along the river's banks. Following independence, however, speculation in cotton by Syrian merchants led to a rapid increase in the number of gasoline pumps drawing water from the river *(Kolars & Mitchell, 1991, 144)*. The number of pumps used for agricultural purposes has continued to increase, rising from about 21,000 in 1963 to more than 47,000 in 1980, and more than 73,000 in 1985 *(Syrian Arab Republic, 1986, 181)*. A serious overdraft situation now exists in several parts of the country, notably in the vicinity of Damascus and Aleppo and in the Orontes basin *(Manners & Nejad, 1985, 263)*. According to Allan (1987), by 1975, the area irrigated from groundwater exceeded that fed by water pumped from rivers and by 1984, groundwater was commanding an area just a little less than the total fed from surface flows, both gravity and pump fed. The complete picture of the potential of the ground water resources in Syria is still unclear, although the pumping rate in some aquifers has reached the critical limit, as is the case in the basins of Damascus, Al-Assi, Aleppo and the Central Euphrates. Certainly the rates of increase for this type of irrigation in the 1970s and 1980s will not be sustained in the future *(Allan, 1987a, 31 ; Baasiri, 1990, 22)*.

Although, today, the Euphrates accounts for around 85 per cent of the nation's surface water resources, in the 1960s probably less than one fifth of the country's irrigated area was located within its basin. Horizontal expansion is probably the one area of greatest potential for irrigation. The Euphrates and Khabur projects will carry cultivation into areas formerly too dry to be economically viable, but, combined with this, there is the effect of irrigation on vertical production expansion. Certain varieties of wheat yield twice as much under irrigation as under rainfed conditions, and cotton yields on irrigated land is 4.6 times higher than on rainfed land. Horizontal expansion together with vertical expansion, as the result of not only irrigation but also a variety of other factors, hold the key to Syrian future agricultural prosperity *(Mitchell, 1982, 22)*. After being the subject of repeated engineering studies, financial and technical assistance was finally secured from the USSR for a large-scale, multi-purpose project involving hydroelectric power generation and irrigation. This was an important economic contribution to a country poor in energy resources. It was hoped to increase agricultural production and productivity dramatically in the Northeast through land reclamation and extended irrigation. The plan was to reclaim an area officially estimated at 640,000 hectares of irrigation and the scheme would not only double Syria's total irrigated area by the end of the century, but would also eliminate the uncontrolled flooding of the Euphrates *(Manners & Nejad, 1985, 261 ; Rabo, 1986, 32)*. The Syrian authorities pinned great hopes on the Euphrates Dam project, not only from an economic point of view but also because they believed that it would help to create a developed modern society, based on socialism rather than capitalism. The project was also expected to help create a new class of skilled manpower and personnel who would ultimately be of great benefit to the country's development. This implied the establishment of new cities and towns, the provision of health services, education, communications and other social services to a rural area in order to provide a new focus of socio-economic activity and help counter the growing urbanization of the country *(The Arab Economist, April 1978, 18 ; October 1979)*.

Euphrates water is the key to any significant transformation of the Syrian agricultural sector. The central element in the Euphrates project is the Tabqa Dam, a large earth fill structure, sixty metres high and four and a half kilometres long. It retains a lake of 630 km^2 which is 80 by 8 km in area at its greatest extent. Begun in 1968, the dam was finally completed in 1973 at which time Lake Assad, with an ultimate storage capacity of 11.6 billion m^3 (of which 7.4 billion will be live storage) began to fill.

C4.2 The Euphrates project

Syria's Euphrates basin, chiefly in the two provinces of Raqqa and Deir ez Zor, is part of the country's vast, but under-populated and underdeveloped, eastern hinterland. For centuries, with the collapse of strong government and irrigation, the region had become de-populated, a trend which has only really been reversed since independence. In 1970, only 8.3 per cent of the population and 16.7 per cent of the cultivated land were located in these arid provinces where cultivation is almost entirely irrigation dependent and the growing of cotton along the river is the main source of income. The dry expanses are given over to sheep husbandry and, mostly in Raqqa, some precarious and extensive grain cultivation. The population in 1975 was 73 per cent rural compared to the national average of 54 per cent and illiteracy was much higher-57 per cent for males compared to 32 per cent nationally *(Hinnebusch, 1989, 233)*.

A major dam on the Euphrates was envisaged as early as 1927 by the French, but it was not constructed. Shortly after independence in 1946 , Sir Alexander Gibbs and Co. conducted a preliminary study for a dam near Yusuf Pasha which would have irrigated

100,000 ha. but nothing came of it. This effort was followed by a twelve - volume study made by the Soviets published in 1960. Next came a study by the West German government in 1961 and another by the Dutch consulting firm, NEDECO (also engaged on the Ghab project), in 1963-1964. The disruption of the U.A.R. and the breakdown of relations with the Germans in 1965 left the way open for Soviet participation in the building of the Tabqa Dam, which was officially inaugurated in July 1973 *(Kolars & Mitchell, 1991, 145).* The Soviet proposal originally spoke of some 850,000 ha. that could be irrigated with the waters of Lake Assad but this estimate was quickly downgraded by the Germans to 650,000 ha. and then slightly revised by the Syrians to 640,000 ha. In theory, 420,000 new hectares could be brought under irrigation, 150,000 already irrigated along the river but threatened with salinity, were to be reclaimed, and a dam on the lower Khabur would add another 70,000 new hectares, for a total of 640,000 ha. Besides the Euphrates valley itself these areas included the Balikh basin north of the river, the lower Khabur basin to the east, the Mayadin area on the south bank of the Euphrates near Iraq, the Rassafe basin south of the river near Raqqa, and the Meskene plain between Raqqa and Aleppo. The project was to double Syria's irrigated surface *(Hinnebusch, 1989, 236).* This total was made up from the six districts shown on map C.2 below as well as in table C4.6.

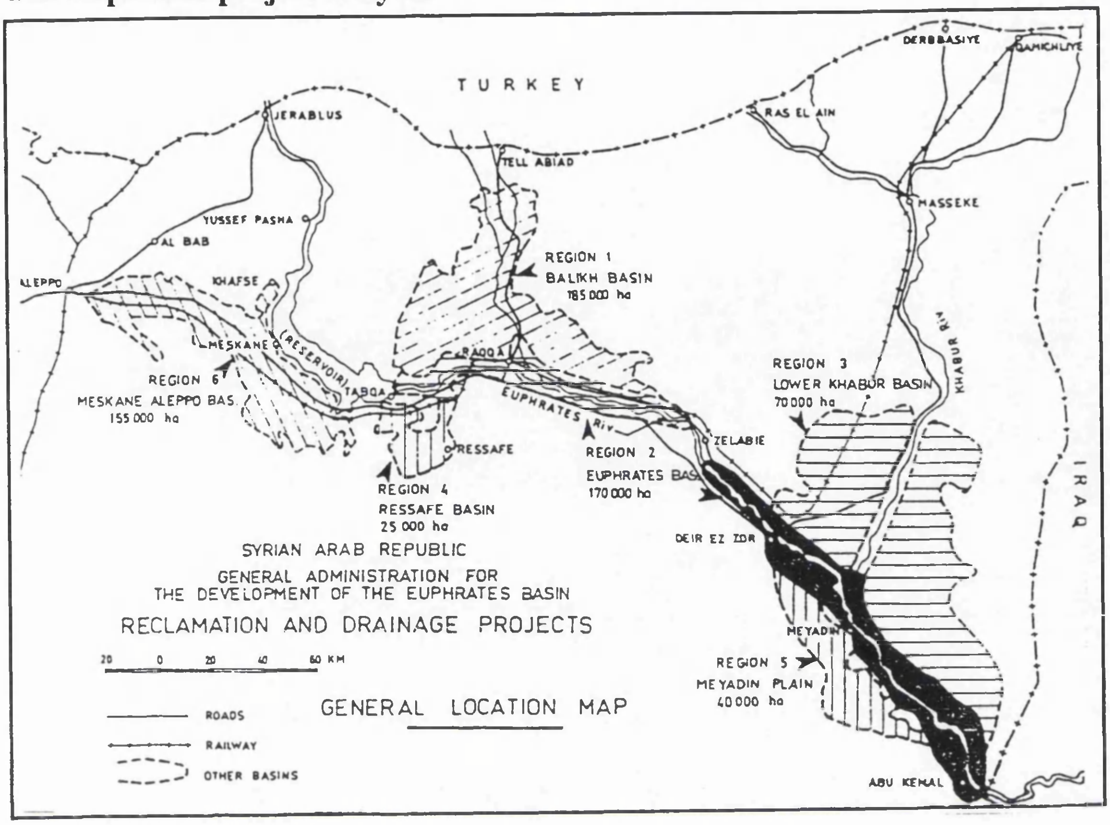
The Euphrates project has always had a high political priority. Not only is it the showcase of the Ba'ath development drive but, by having the dam-created lake named after himself, President Assad's personal prestige has been attached to it. Administratively, the project is overseen by the High Committee for the Euphrates headed by the prime minister. The Ministry of the Euphrates was specially created to carry out the project and was generously provided with the funds to attract the best personnel at exceptional salaries (by public sector standards) and at the expense of the traditional agricultural sector *(Hinnebusch, 1989, 236).*

C4.3 Physical background

The Euphrates river flows through some of most arid land in Syria and almost all its 600 km length within Syria runs through areas below 300 mm rainfall per annum. The average rainfall at Raqqa on the Euphrates is 250 mm, at Deir ez Zor 170 mm, and at Abu Kemal, (on the Iraqi frontier), 130 mm. Outside the immediate alluvial flood plain of the river itself little cultivation has been possible, and pastoralism has been the traditional means of supporting the admittedly sparse population *(Mitchell, 1982, 68).*
The Euphrates river is Syria's most valuable surface water resource and the figures in table C4.4 show that the average flow of the Euphrates represents 85 per cent of the total flow of Syria's 15 main rivers.

Map C.2:

The Euphrates project in Syria



Source: Rabo, 1986, 33.

Table C4.6:

Areas studied for possible irrigation and irrigable areas (ha.)

Region	Area studied	Irrigable area
1) Balikh basin	525,000	185,000
2) Euphrates valley	280,000	170,000
3) Lower Khabur	695,000	70,000
4) Ressefe basin	50,000	25,000
5) Meyadine plain	50,000	40,000
6) Meskeneh basin	410,000	155,000
Total	2,010,000	645,000

Source: Mitchell, 1982, 69 ; Rabo, 1986, 33.

Prior to the construction of the El Thawara dam (in Arabic - the revolution), the average annual flow of the river was estimated at 27.4 billion m^3 (a figure lower by about 3 billion m^3 than the Turkish calculation). The Euphrates dam was supposed to regulate this flow, prevent winter floods, and provide irrigation water in summer and throughout the year to an area far larger than could be served by simple pump irrigation to the soils of the Euphrates basin which were readily usable for cultivation.

However, the presence of gypsiferous soils, notably those of very high gypsum content in the lower Khabur basin, were the cause of a major debate in the early 1960s, in regard to the size of the new irrigated area in the Euphrates project. With its planned area officially estimated at 640,000 hectares of potential irrigated land, the scheme would double Syria's total irrigated area of 516,000 ha. in 1975 - by the end of the century *(Mitchell, 1982, 70).*

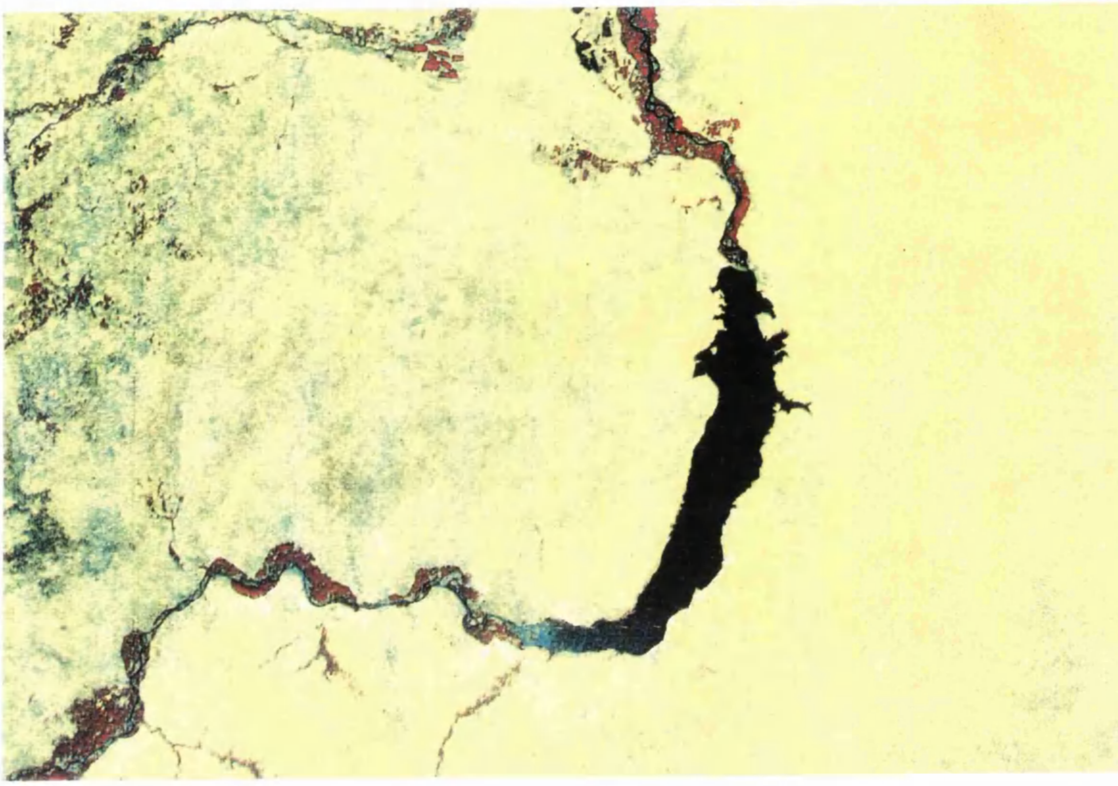
A pioneer, or pilot, project was initiated in May 1973 on the left bank of the Euphrates 18 km from the Tabqa Dam in the Raid area. The purpose of this project was to resettle nearly 60,000 villagers who had been flooded out by Lake Assad. Fifteen villages were built to replace the 59 that had been abandoned along with the 31,231 ha. of irrigated land and 7,495 ha. of rain - fed land lost to reservoir flooding *(Kolars & Mitchell, 1991, 145).* The whole basin of the Balikh region included 185,000 ha. of irrigable land of which about 20,000 ha. were designated for the pilot project, a figure which was to increase to 38,700 ha. by the end of the third five-year plan in the pilot project. Today four main pumping station control the irrigation water supply which is distributed through a 2,400 km network of drainage and irrigation channels. Cropping experiments have produced a variety of results; wheat has yielded well and rice and cotton have both been grown on a large scale, but rice has been abandoned and cotton cut back (from 3,240 ha. to 1,648 ha.) to make way for government encouraged sugar beet. Maize, potatoes, sunflowers, sesame, and Soya beans are also grown, as well as alfalfa which is grown both for fodder and to enrich the soil *(Mitchell, 1982, 71).*

In 1985 Bulgaria agreed to build two dams in the north-east on the Khabur river. The project was designed to irrigate an eventual 40,000 ha. and included a canal linking the two dams *(Fisher, 1991, 827).*

The Meskeneh basin runs from Lake Assad to the northern industrial city of Aleppo. The basin, divided for project purposes into the East and West Meskeneh, had by the end of the 1970s only produced 4,000 of its 155,000 potential irrigable hectares. Up to the end of the 1970s these two tiny projects represented all that had been done to get the new lands of the Euphrates project into production *(Mitchell, 1982, 73).*

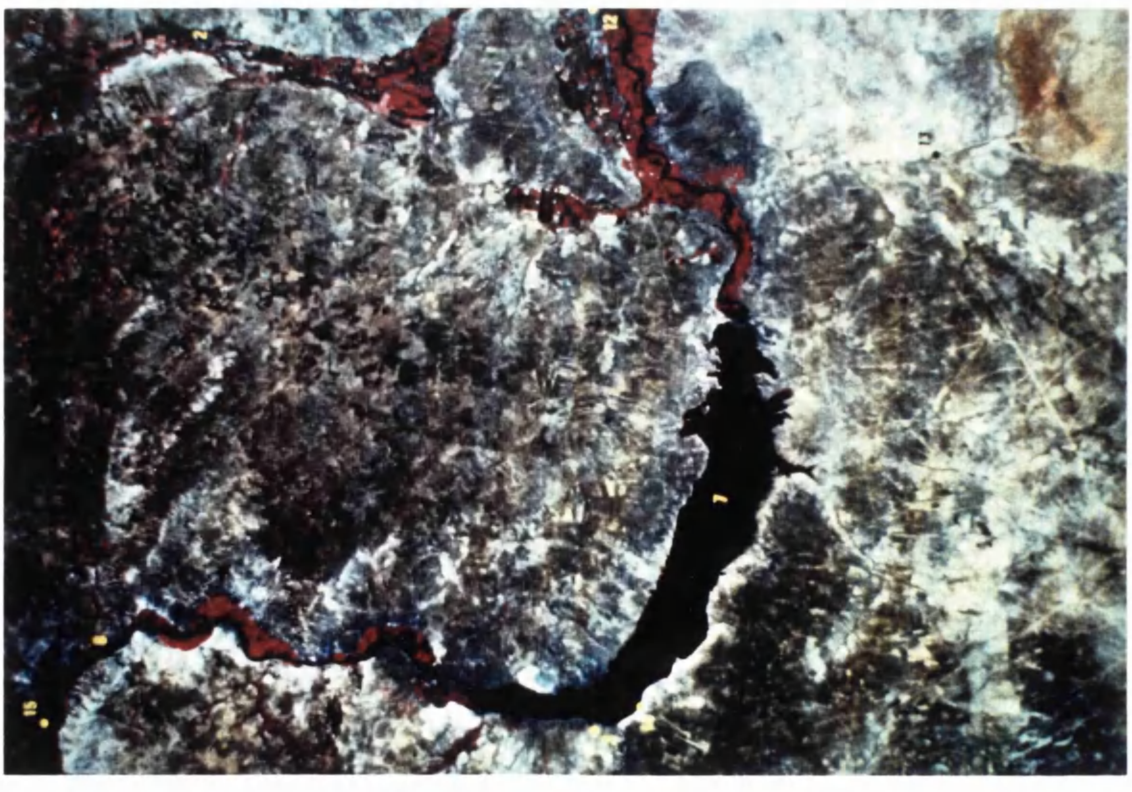
In May 1988 the first pump at the Al- Babiri Station started operating. This pump is the first of 14 principal pumps which pump water from Lake Assad to an area whose altitude is 86 meters higher than the lake. Each pump has a capacity to pump 6.5 m^3/sec and water of the Euphrates flows into a 32 km canal that carries water to irrigate 3,600 ha. of land in the valleys of West Maskanah. This land is a small part of the estimated 125,000 ha. which will eventually be irrigated by the Al-Babiri Station (*Al-Ba'ath, 18 April, 1988).*

Photo 7: The Euphrates valley and Lake Assad (September 1975)



Source: Syria Arab Republic, 1985, 29

Photo 8: The Euphrates valley and Lake Assad (1980)



Source: Illustrert Bibelleksikon, 1990, MS-16

C4.4 Revision of proposed irrigation goals

The plan for the project as a whole is to reclaim and irrigate approximately 640,000 ha. by the year 2000, but the execution of the project has fallen behind schedule. The Euphrates Basin soils in Syria are in large part gypsiferous, crusty, prone to erosion, and suitable only for careful applications of irrigation water. The canals leading to the pioneer project not only collapsed when water was channelled through them, but also lost 5 m^3/sec of water into the ground. It has been estimated that 50 per cent of the irrigated land in Syria's Euphrates valley is affected by salinization, causing crop losses of up to 300 million US$ a year *(The Middle East, 1984, 29)*. In 1984 it was reported that "cracks" had appeared in the Balikh canal because the gypsiferous soil on which it rests had been dissolved by leaks from the canal *(Kolars & Mitchell, 1991, 152)*. Salinity in the middle and lower Euphrates in the early eighties took 22,000 ha. of privately pumped, originally undrained areas out of cultivation, cut production in half in 35,000 ha. more, and threatened a 3,000 ha. annual further loss. In addition ground water pumped for a irrigated cotton up river (in West Meskene) was exhausted *(Hinnebusch, 1989, 236)*. A report from 1980 noted that less than half of the 640,000 ha. was reasonably good for irrigation purposes and suggested a goal of 240,000 ha., but by 1978 only 7,400 ha. had been prepared. To these figures should be added the lands of the upper Khabur basin, which were also to receive irrigation water and which, although originally estimated at 400,000 ha., only 137.000 irrigated *(Kolars & Mitchell, 1991, 152)*. According to Hinnebusch (1989), the Balikh basin had been slated to be reclaimed first, but all but 28 per cent of it may be too high in gypsum and a fifth of the 20,000 reclaimed ha. in the pilot project are reported to be too gypsiferous for use. By 1980, projections for East Meskene had scaled the potential irrigable surface back from 33,000 to 18,000 ha. West Meskene, where fertility is good, was then advanced in priority. The Rassafe area, three-fourths of the 40,000 ha. in Mayadin, and 45,000 of the 70,000 ha. in the lower Khabur area also look unpromising. Studies are being done of two promising basins north and south of Aleppo totalling 212,000 ha. which could compensate for the loss of potential areas further east *(Hinnebusch, 1989, 240)*. According to Fisher, only about 60,000 ha. had been irrigated by 1984, and perhaps 300,000 ha. may be impossible to develop according to the original plans *(Fisher, 1989, 780)*. According to Kolars & Mitchell (1991), the actual amount of land successfully brought into production by 1986 was about 64,000 ha, and the total lands irrigated by Euphrates waters reached about 241,000 ha. by 1990 *(Kolars & Mitchell, 1991, 154-165)*.

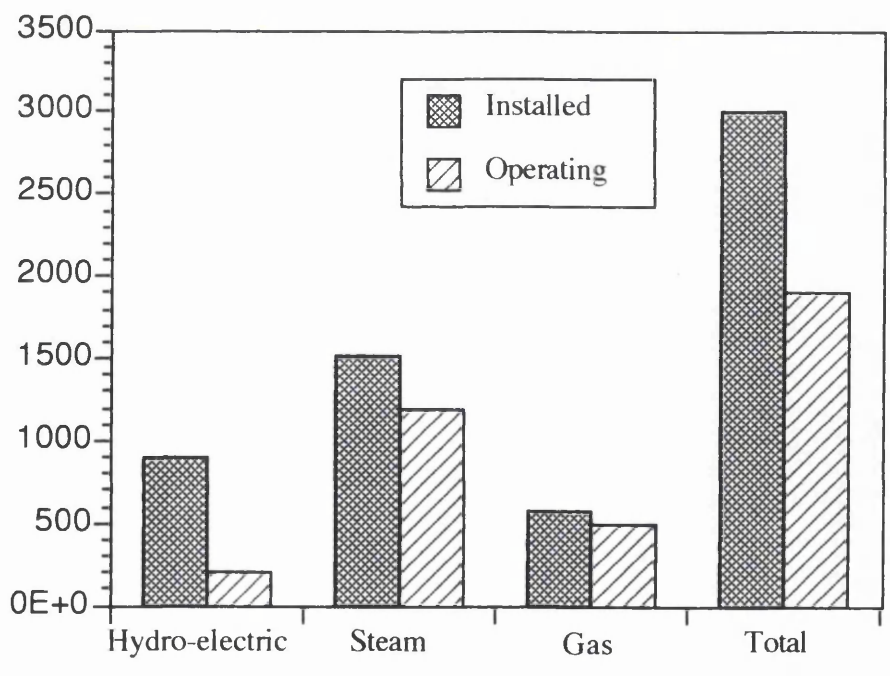
In Satellite photos of the Euphrates valley and the Lake Assad area taken for purposes of comparison in 1975 (immediately after the Lake was filled) and 1980, one cannot see any significant changes in the amount of cultivated land despite the fact that one can see the more intensive version in 1980. This estimate matches tables C4.2-C4.3 which show that only after 1980 was it possible to distinguish the extension of irrigated areas in the country (see photos 7 and 8).

C4.5 Electric power

Until recently Syria was petroleum poor, but since the mid-1980s oil production has almost tripled and it has been able to expand crude oil production to an average of 570,000 bpd in 1992 *(MEI, 16 April, 1993)*. Electricity has been one of the key areas of Syria's under - investment during the past two decades and efforts are under way to exploit natural gas as a local source of energy for power stations and industry. The increase in the generation of electricity is regarded as the key to much of Syria's future industrial development. After the completion of the Euphrates dam at Tabqa and the installation of eight 100 megawatt turbines in 1977 this problem seemed to have been solved for many years to come. The hydro-electric power station at Lake Assad was expected to generate about 80 per cent of the country's electric power, but just six years later, the high expectations were badly frustrated. The energy produced by the Tabqa power station dropped from 2,500 million KWh per annum to less than 1,500 million KWh.

Figure C4.1:

Syria: electricity installed and operating capacity (MW - 1993)



Source: MEED, 4 June 1993, 3

In 1983, and during the following years, the turbines could work at only 30-40 per cent capacity due to a lack of rainfall, Turkey's increased use of the upper waters of the Euphrates and the absence of Russian maintenance. The result is that, in 1993, the operating capacity of the dam was barely 150 MW with a further 75 MW of operating hydroelectric capacity coming from the nearby Al-Baath dam *(MEED, 4 June 1993, 2)*. As more villages received electricity, more Syrians bought air-conditioners and other electrical consumer goods, and more industrial establishments switched to modern energy consuming machinery creating a serious power shortage. The Euphrates dam was operating well below capacity, the thermal power supply was insufficient to bridge the gap, and the difference between supply and demand continued to grow even more, so that daily power cuts were extended to four hours from 1986 on wards *(Meyer, 1987, 49)*.

As a result, Syria started to developed thermal power stations to reduce the importance of the Tabqa hydro - power station and, in 1985, hydro - power generation was reduced to 40 per cent of the total production *(Maury, 1983, 322)*. In the year 2000, Syria's operating capacity will reach 5,000 MW (compared to 2,500 MW in 1993) and, as a result, hydroelectric power will be less than 18 per cent of the total production *(MEED, 4 June 1993, 3)*. It is expected that hydro - power as a form of energy supply will continue to become less important during the next century.

C5. Modern irrigation development projects in Iraq

C5.1 Physical features

Iraq, like Syria, was part of the Ottoman Empire, until World War I. An old name of Iraq, Mesopotamia, means the "Land between the rivers" indicates the main physical character of the country - the presence of the two river valleys of the Tigris and Euphrates, which merge in their lower courses. On the eastern side of this double valley the Zagros Mountains of Persia rise like wall, overhanging the river lowlands, particularly in the south, below Baghdad. North of the latitude of Baghdad the rise to the mountains is more gradual, with several intervening hill ranges. These ranges are fairly low and narrow at first, with separating lowlands, but towards the main Zagros mountains the topography becomes more imposing with summits over 3,000 m in height occur. This region, lying north and east of Baghdad, is the ancient land of Assyria ; and nowadays the hill ranges lying in the extreme east are called Iraqi Kurdistan, since many Kurdish tribes inhabit them.

On the western side of the river valley the land rises gradually to form the plateau which continues into Syria, Jordan, and Saudi Arabia, and its maximum height in Iraq is about 1,000 m. In places it is possible to trace a cliff formation where a more resistant bed of rock stands out prominently, and from this the name of the country is said to have derived *(Fisher, 1989, 452)*.

The heartland of Iraq lies in the fertile plains of the Tigris- Euphrates, where the abundant water supply provided by the two great rivers and the tributaries of the Tigris, together with the rich alluvial soils, permit intensive irrigated agriculture to be practised, particularly in the region between Baghdad-Fallujah and the Gulf coast *(McLachlan, 1976, 41)*.

The alluvial soils of the Mesopotamian Plain in Iraq are primarily a product of man's activity during the last six thousand years. They cover more than a third of the country, and are characterized by low elevation, below 100 metres, and poor natural drainage. Large areas are subject to widespread seasonal flooding, and there are extensive marshlands, some of which dry up in the summer to become salty wastelands. Most of this plain has been covered to a depth of several feet with sediments brought in suspension by irrigation water thus the soils are not pedologically developed in the usual sense. Beneath these sediments, which are the result of man's activity, lie thick layers of deposits not thus caused that are similar in composition, but which have usually somewhat coarser. It has been said *(Clawson, 1971)* that these deposits are as much as three kilometres thick.

The alluvial soils have a consistently high (usually 20-30 per cent) content of calcium carbonate and a small percentage of gypsum; they are reasonably permeable both laterally and vertically and textures are generally fine silty, fine loamy, or fine clayey but near the rivers they are coarser than this *(Clawson, 1971, 18)*.

C5.2 The Population

The population of Iraq at the end of 1991 was estimated at 19.5 million. Iraq's population growth rate has been high, reaching an annual average of 3.6 per cent during 1980-1988. The World Bank projects that this rate will slow down to 3.4 per cent over the 1988-2000 period but the high fertility rate (6.3 in 1988) and a young population pyramid suggest that the rate of population growth will remain high *(World Population Profile, 1991, A/5)*. The combination of the fertility of the Mesopotamian plain and the location there of the government in Baghdad has led to much more rapid population growth in this region than all others. There has been a general and accelerating trend for the people of the less prosperous regions to migrate to the lowlands and particularly to the major cities that are sited there. Baghdad and the governorate around the capital accounted for more than 30 per cent of the population at the time of the 1987 census. An axis of dense population developed between Baghdad and Basra as a result of migration and natural growth, leaving all other areas of the country comparatively sparsely populated; however, the missile and artillery barrages against Basra during 1986 and 1987 caused an exodus of population from Basra to safer areas of the country.

Table C5.1:

Iraq: religious groups (1987)

	Population	Per cent
Shia Muslims	8,801,000	53.5
Sunni Muslims	6,827,000	41.5
Christians	592,000	3.6
Yazidis & others	230,000	1.4
Total	16,450,000	100.0

Source: EIU, 1990, 8.

Some 73 per cent of Iraq's population is resident in towns and the annual growth rate of the urban population was estimated to have averaged 4.8 per cent during 1980-88, according to World Bank data. The major towns are Baghdad, with an estimated population of 5.4 million in 1988, Basra with 1.4 million (during 1987 its population was reduced due to heavy Iranian shelling in the Iran/Iraq War), Mosul with 1 million and

Kirkuk with 550,000. Migration to towns has eroded some of the ethnic, linguistic and religious differences between the various regions, although family, tribal, religious and cultural affiliations remain strong. The majority of Iraqis are Muslims (95 per cent), most of whom are non-orthodox Shia, (53.5 per cent of the total population) and orthodox Sunni (41.5 per cent), who are a clear minority despite their favoured political and social positions within the state (especially after excluding the Sunni Kurds). Christians make up 3.6 per cent of Iraqis, the Chaldeans being the most important, with 3 per cent of the total population. Small numbers of Yazidis and Jews make up the remainder (see table C5.1)*(EIU, 1990, 8)*.

The ethnic balance in Iraq is a major complication in an already varied religious pattern. Arabs comprise the majority of the population with 73.5 per cent, though the Kurds at 21.6 per cent are an important component of the total. A variety of other ethnic groups gathered in Iraq during Ottoman times and were augmented by Persians who visited the Shia Muslim shrines of Karbala and Najaf, and often remained (see table C5.2) *(EIU, 1990, 1991, 9)*.

Table C5.2:
Iraq: ethnic groups (1987)

	Population	Per cent
Arabs	12,091,000	73.5
Kurds	3,553,000	21.6
Turkomens	395,000	2.4
Others	411,000	2.5
Total	16,450,000	100.0

Source: EIU, 1990-91, 9

C5.3 The economy

The national economy of Iraq before independence was very weak, and almost all the population was employed in agriculture. After World War I, the advent of petroleum-powered irrigation pumps and other modern machinery began to change farming methods. Oil revenues grew in the 1930s and the government of Iraq began to spend increasing sums of money on economic development *(Abbas, 1984, 111)*.

Iraq is a socialist economy in which the public sector plays a dominant role with responsibility for 85-90 per cent of the country's GNP and 95 per cent of imports. Private sector activity is relatively insignificant though surprisingly buoyant.

The great resources of Iraq are its fertile soils, (in Northwest Al-Jezirah and in the river valleys in the Northwest and in the lowland) its water and oil. Iraq had an almost exclusively agricultural economy until expansion in manufacturing, service industries, and non-agricultural activities began in the 1950s. The successive governments have committed themselves to industrial growth and increasing income from oil production has enabled the Iraqi government to devote a considerable percentage of the national budget to industrial development and modernization of its agricultural base. Land-distribution reforms initiated in 1959, and amended by the 1970 agricultural act, co-operative rural associations, and the decline of the landed aristocracy have contributed to improved agricultural productivity and to a more equitable distribution of income.

After the Iraq/Iran war, the most immediate task for Iraq was the rehabilitation of its oil industry, from which increased oil exports would bring the funds for reconstruction and economic development. The average annual rate of growth in GNP was reported by the World Bank at 4.4 per cent for the period 1965-1973, rising thereafter to approximately 10.5 per cent until the beginning of Iran/Iraq War. As a result of the Iran/Iraq war by 1980 a serious decline in the GDP had set in. In the latter half of the 1980s Iraq's economy recorded erratic growth rates and 1987 and 1989 saw large increases in the nominal GDP largely due to a rise in oil output combined with a recovery of oil prices *(EIU, 1990-91, 13)*. The cost of repairing the industrial plant alone was estimated at 16 billion $US *(Fisher, 1989, 465)*, (these estimates were collected before the Gulf War).

C5.4 Natural resources

Iraq has been totally dependent for its recent development on the exploitation of its large oil resources since the early 1950s. In 1989, the most recent year for which figures are available, the oil sector accounted for more than 60 per cent of the GDP (see table C5.3).

Table C5.3:

Estimates of main origin of gross domestic product (%)

	1976	1980	1988	1989
Oil	59.7	63.0	60.5	61.3
Agriculture	8.4	7.0	6.3	5.1
Industry	7.8	5.0	10.4	11.6
Services	24.2	25.0	22.9	22.0

Source: EIU, 1990-91, 14.

During the 1970s the engine of economic growth was the oil sector. After oil prices dropped in the early 1980s the share of GDP contributed by oil fluctuated but, by 1989, it was 61 per cent, close to its 1980 level. Agriculture registered low and erratic growth rates, while the contribution of the services sector has remained more or less constant during the 1980s. The industrial sector, on the other hand, has shown a steady increase, reflecting the importance given to military industries during the Iran/Iraq War, and the high political priority accorded to this sector.

Table C5.4:

Real sectorial growth rates (%)

	1986	1987	1988	1989
Agriculture	-6.5	-8.1	2.8	1.7
Oil & mining	24.5	60.8	-4.0	27.0
Industry	-7.0	11.2	-22.6	41.5
Services	11.0	-0.3	-20.7	20.9

Source: EIU, 1990-91, 14.

In the period between the Second World War and 1955, when oil exports rose sharply and oil revenues began to have an important impact on the economy, development was slow and inhibited by a shortage of funds particularly a lack of foreign exchange (*EIU, 1980, 22*).

Iraq has modest mineral deposits of iron ore, chromate, copper, lead, and zinc in the north while limestone, gypsum, phosphates, and sulphur are abundant. The most important single mineral, however, is oil, which is exploited in the north, Northeast, and the south. The petroleum and natural-gas industries support domestic and export-based refining and petrochemical industries. Iraq published a major upward revision of its oil reserves in 1987, which had the effect of increasing its estimate of proven reserves by 40 per cent. In mid-1988 proven oil reserves were estimated at 100 billion barrels and probable reserves at 50 billion barrels. Iraq also estimated its proven reserves of gas at 2,690 billion m^3 in 1988, the great bulk of which is in the form of associated gas. On an energy equivalence basis, gas reserves represented 17.5 per cent of oil reserves in 1988, when Iraq's oil reserves were 14 per cent of the world's proven oil reserves and 1.8 per cent of the world's proven gas reserves *(EIU, 1990-91, 23)*. With the increase in production of crude oil, production of associated gas has increased considerably in recent years but only 15 per cent of production is utilized, the rest being flared.

Oil production in 1978 is believed to have averaged some 2.6 million barrels a day, having risen fairly steadily from 1.9 million in 1973. In the first nine months of 1980, before the outbreak of the war with Iran, Iraq's exports of petroleum averaged about 3.2 million barrels per day, making it the world's second largest supplier of crude oil, (exceeded only by Saudi Arabia). Most oil was exported in the form of crude but there are some ten refineries in the country *(Fisher, 1989, 467).*

In the 1976-80 plan there was a clear redirection of the industrialization process towards heavy industry. Official policies were expressed as an amalgam of import substitution and diversification away from oil dependence. In fact, targets were more random and tended to enhance the role of petroleum in the economy by using oil and natural gas to add value or as a basic feed stock/energy supply.

The self-sufficiency drive included the setting up of leather works and plants to produce bread, alcoholic beverages, soft drinks, baby food and date products. There was also an expansion of capacity in the construction materials industries such as asbestos sheeting, pipes, glass and prefabricated buildings. Arrangements with foreign interests, (often Eastern bloc states), permitted the establishment of projects for light industry such as electrical goods, consumer durables and telephones.

The main push, however, was in the realm of heavy industry during the 1976-80 plan period when an iron and steel industry was set up and projects were prepared for aluminium smelting and for ship repair and building. Not all were implemented - ostensibly for fear of an excess capacity of such industries throughout the Gulf and most resources were made available for the petrochemical industry *(EIU, 1989-90, 27).* The Gulf Crisis and Gulf War of 1990-1991 transformed the Iraqi economy and especially its petroleum economy. By 1994 Iraq's capacity to sell oil was still severely restricted by the international community. At the same time the price of crude oil on the international market remained low and in real terms below the prices before the 'oil-shocks' of the 1970s. Other elements of the international embargo on Iraq's trade have added to the difficulties of developing its economy. The consequences of the 1991 Gulf War are discussed in more detail in section C5.9.

C5.5 Water resources

At the end of the 1960s Iraq's potential surface water resources were estimated at 2,679 cubic metres per second, equivalent to 84,485 million m^3/year (table C5.5).

The annual volume of flow in the upper stations both of the Tigris and Euphrates and the tributaries represent the potential surface water resources (table C5.6).

The discharge of the Euphrates and Tigris is almost entirely represented by water coming from abroad, while Iraq's most important future surface water resources are carried by the tributaries, and represent part of the total discharge originating in the country itself. Potential water resources have already been reduced (45 per cent in 1969) by diversions, water withdrawal and utilization to a considerable degree especially in the Mesopotamian Plain *(Ubell, 1971, 4)*.

Although the total area of arable land has only been slightly increased, the amount of water withdrawn has grown considerably. Annual groundwater production averages about 1.2 million m^3 with a salt content of 500 - 3000 ppm *(Gischler, 1979, 100)*.

Table C5.5:

Flow rates of Iraqi rivers

	Perennial average discharge (m^3/sec)			
River and station	1940-49	1950-59	1960-69	1940-69
Euphrates at Hit	1,004	871	1,151	1,009
Tigris at Mosul	697	659	853	736
Khazir at Manaquba	30	28	30	30
Greater Zab at Eski Kelek	461	414	500	458
Lesser Zab at Altun Kupri	225	239	270	245
Adhaim at Injana	23	23	23	23
Diyala at discharge site	180	192	162	172
Total				2,679

Source: Ubell, 1971, 4

Table C5.6:

Iraqi rivers: annual volume of flow

River	Cubic metres per second	Million cubic metres per year
Euphrates at Hit	1009	31820
Tigris at Mosul	736	23210
Tributaries of Tigris	934	29455
Total	12,679	84,485

Source: Ubell, 1971, 3

C5.6 Hydroelectric power

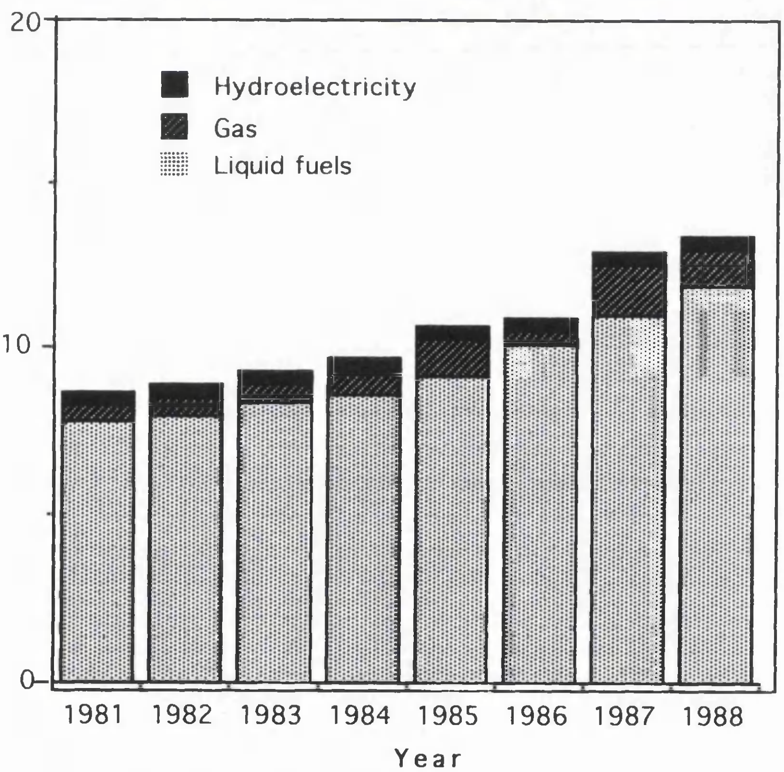
Iraq water control is handicapped by its location since the usually flat terrain provides relatively few dam sites, and most of the drainage area of both the Tigris and Euphrates lies in other countries. Unfortunately the Euphrates only falls 166m along its entire course in Iraq, and so there are no ideal sites where large dams and associated reservoirs can be created *(Beaumont, 1978, 38)*. Iraq, however, does use the river water to cool thermal power stations.

The Tigris river constitutes Iraq's main sources of hydroelectric power, especially at the upper reaches of the river and its tributaries, where there are maximum bed slopes, but the water is limited, by the seasonal flow and the largely level valleys through which it flows. The Tigris tributaries that flow from the Zagros Mountains - the Little Zab and Diyala rivers - have been developed for power generation, as has the Tigris at Wadi Tharthar. The Kut barrage was the first hydro - electric structure built on the Tigris between 1937-1939 and the second was the Sammara dam in 1956. The Derbendi Khan dam on the Diyala river was bombed by the Iranians in 1988 while Mosul dam and the lower Mosul dam were built in 1989 *(AMER, 1992, 52).*

Electricity generation from the hydro stations situated in the dam schemes has developed slowly. Only the Tharthar scheme provides significant (84 MW) capacity, though there are plans for 1,300 MW of installed capacity by 1995, and the Haditha dam (1986) is expected to generate 660 MW *(Ockerman & Samano, 1985, 194).*

Figure C5.1:

Iraq: energy consumption 1981-1988 (million tons coal equivalent)



Source: EIU, 1991, No 2, 14

In 1984 electric power generation took up 6.6 per cent of the water used in Iraq, a proportion that is expected to continue rising for some time at the expense of water availability for irrigation *(EIU, 1990-91, 22).* The main conclusion from figure C5.1 is that the amount of hydro-electric power produced continues to represent a very low percentage of Iraq's total electricity production.

C5.7 Agricultural potential

The total area of Iraq is 43,750,000 ha, of which 11,800,000 ha. is arable. Of this area, 3,500,000 ha. are irrigated and 3,350,000 are rainfed on average each year. According to Fisher (1989), the total area under cultivation rose from 3.2 million ha. in 1984 to 3.6 million ha. in 1985 *(Fisher, 1989, 466)*. The total area of both forest and pasture is 1,800,000 ha., the irrigated land that is cultivated covers 1,560,000 ha., and the cultivated land in the rainfed area is 1,300,000 ha. *(Hussain, 1990, 238)*. 20 million ha. are taken up by both the arid and barren areas of the western and southern deserts and the semi-desert of al-Jezirah in upper Mesopotamia.

Table C5.7:

Iraq: the total arable land in irrigated and rainfed areas

Agricultural land (by type)	Area (thousands of hectares)
Total arable land	11,800
Irrigated land	3,500
Cultivated (irrigated)	1,560
Rainfed area	3,350
Cultivated (rainfed)	1,300
Forest pastures	1,800

Source: Hussain, 1990, 238

Two types of agricultural activity predominate in Iraq one dependent upon rainfall in the north and the other dependent upon irrigation in the south. The rain zone which is watered by rain is also divided into two sub-zones: the mountain area which is located along both the Iraqi-Turkish and Iraqi-Iranian border, and the steppe zone *(Al-A'ni, 1977, 422)*. The best known agricultural product, (and the largest source of foreign currency revenues after oil) is the date, of which Iraq is one of the world's largest producers. Other crops include barley, wheat, linseed, lentils, and beans, as well as rice, sesame, maize, and millet while cotton production is hampered by soil salinity. Total agricultural production was 13.9 million tons in 1985, compared with 13.1 million tons in 1984 *(Fisher, 1989, 466)*.

A large land area, a small rural population and a generous endowment of water resources appears to offer the possibility of rapid and rewarding expansion in agriculture. According to Clawson (1971), under proper resource management, Iraq could offer the greatest opportunities in the region for agricultural growth *(Clawson, 1971, 52)*. The expansion of irrigation has contributed to serious drainage problems since the additional water, combined with the shallow gradient of the terrain from above Baghdad to the Gulf, has raised the water table and brought salts closer to the surface, affecting plant growth. Some observers believe that as much as 65 per cent of irrigated areas have had salinity problems and that 20 to 30 per cent of the irrigated land has been abandoned over the years because of it *(Nyrop, 1979, 157 ; EIU, 1989-90, 21)*. In fact, however, despite its high agricultural potential, Iraq is not self-sufficient in food production and almost 25 per cent of all Iraqi imports were taken up by food in 1990 *(Hussain, 1990, 237)*. On the whole, Iraq is under-populated and could support a larger number of inhabitants. Many factors affect agricultural production directly and indirectly but one of the most important factors is the establishment of a long - term strategic plan for agricultural development and efficient land use. The Iraqi government in its 1976-1980 development plans, was anxious to free itself from both reliance on foreign food sources, and from the uncertain external, capitalist / imperialist, world in order to prevent food shortages which would be politically embarrassing and which would aggravate problems of inflation. Imports of agricultural goods were worth $ US 535.8 million in 1978, of which cereal imports made up almost half *(EIU, 1980, 56)*.

Self-sufficiency in food supplies, necessitating a 25 per cent increase in the area of land under cultivation, remains a high priority. However, the 1980s, saw a substantial increase in the volume of cereal imports, originally mainly from Australia, but subsequently from the USA as a result of generous financing arrangements. Total US agricultural exports to Iraq increased from $ US 528 million in 1987 to $ US 791 million in 1989. They were due to increase to $ US 900 million in 1990 but the UN trade embargo halted all shipments during the second half of the year. The bulk of this trade was wheat, flour, feed and fodder, but also included significant amounts of cotton, sugar and tobacco *(EIU, 1989-90, 19)*. The country's food import bill, which reached $ US 3,100 million in 1984, declined to $ US 2,712 million in 1986, although Iraq still imported large amounts of frozen chicken, meat and fish. The USA was a major agricultural supplier during this period, with its share of the market reaching 13 per cent in 1986 under a credit programme.

Table C5.8:

Iraq: agricultural imports (1000 tons)

	1984	1985	1986	1989
Wheat	3,075	2,074	2,105	2,000
Wheat flour	300	370	347	..
Rice	510	550	525	500
Barley	541	130	20	..
Corn	352	245	320	320
Beef	240	159	170	..
Frozen poultry	107	73	59	..

Source: EIU, 1990-91, 20

The EEC supplied some $345 million worth of farm products in 1986, equivalent to a 12.7 per cent market share, compared with 16 per cent in 1984. Canada and Australia have always been long-term wheat suppliers and Cuba is a long-standing sugar supplier. Barley was substituted for wheat during the 1980s because of its resistance to salinity and vegetable production nearly doubled between 1975 and 1985, but local rice and sugar production were in decline, as was the date harvest, which was Iraq's only significant agricultural export. Date production in 1987 was very much affected by the war with Iran when the important date gardens near Basra were in the war zone and dropped to only 324,000 tons compared with 956,000 tons in 1976. Two thirds of the date crop was exported in 1987 but, with the imposition of sanctions, dates were promoted as a sugar substitute, resulting in higher domestic consumption *(EIU, 1989-90, 19)*.

Table C5.9:

Iraq: agricultural trade (million US $)

	1984	1985	1986	1987	1988
Exports	270	793	885	1,244	870
Imports	-2,843	-2,243	-1,778	-1,832	-2,508

Source: EIU, 1990-91, 20

Because of the ready availability of agricultural land, wasteful, 'extensive' farming methods which give a low yield are common; thus only one-sixth of the potentially cultivable territory and 3 per cent of the country's total area is in use. There can be no doubt that the mounting costs of the war and the increased rural-urban migration caused by it were virtually the main reasons for the increased deterioration of the agricultural sector. *(Mofid, 1990, 50)*

In the two previous national development plans (1970-75 and 1976-1980), priority was given to petroleum and other industries, the aim being to diversify sources of revenue (from different industrial exports). The country's increasing industrialization is reflected in the population distribution *(Fisher, 1989, 465)*. This is the reason for the size of the proportion of investment in agriculture within the development programme during the period 1970 to 1975 when it fell from 25 per cent to 16 per cent. In 1978 the figure stood at 18 per cent, indicating that the 1976-80 plan period showed more commitment to agriculture than the preceding one *(EIU, 1980, 23)*.

Agriculture retains its position as the mainstay of the Iraqi economy, despite the existence of a traditionally strong trading sector and partially successful attempts at industrialization. Of the 3.2 million persons estimated to have been involved in agriculture in 1957, only about one quarter of a million were landowners or tenants, totalling perhaps 1.2 million (with their families), while the remaining 2 million were landless farmers and their families *(Clawson, 1971, 52)*. The agricultural sector employed 33 per cent of the labour force in 1987, compared to 47 per cent in 1970 and 53 per cent in 1960, while industry employed 22 per cent in 1970, 26 percent in 1980, and 28 per cent in 1987, compared to 18 per cent in 1960. Services employed 39 per cent in 1987, compared to 31 per cent in 1970 and 29 per cent in 1960 (see table C5.10). The population directly involved with farming, is substantially smaller and indicates the presence of a substantial small scale craft or service function in Iraq's rural areas. According to Fisher (1989) about 74 per cent of the population was classed as urban in 1986, compared to 53 per cent in 1980 *(Fisher, 1989, 465)*.

Table C5.10:

Iraq: sectorial distribution of the labor force, 1950-1987 (%)

	1950	1960	1970	1980	1987
Agriculture	58	53	47	43	33
Industry	16	18	22	26	28
Services	26	29	31	31	39

Sources: Richards & Waterbury, 1990, 74 ; EIU, 1988-89, 17

C5.8 River control and irrigation

Iraq's abundant water resources - (some 0.8 per cent of the country's surface area contains lakes, reservoirs and marshlands) - carry great potential for the development of irrigation but also present significant problems in terms of water control since considerable flooding and poor drainage have been the negative attributes of the two major rivers and their tributaries.

River control policy in Iraq has three main objectives: the provision of water for irrigation, the prevention of devastating floods, and the creation of hydroelectric power. Southern and central Iraq are affected by all three types of schems, since northern Iraq is rain-fed and, for the most part, contains terrain which is unsuitable for large-scale irrigation from the stored water of major dams.

The Tigris provides irrigation water for some 2.2 million ha., in the valley of the north bank tributaries - the Greater Zab, the Lesser Zab, the Adhaim and the Diyala. The Euphrates serves approximately 1 million ha, while the joint rivers in the Shatt al-Arab provide a further 105,000 ha. The principal water sources for irrigation are the five great reservoirs at Dokan, Darbandikhan, Habbaniya, Samara and Abu Dibbis which together are reported to provide 120 km^3 of storage capacity. There will be a massive increase in storage capacity as another four dam schemes are brought into use at Himrim, Bekheme, Mosul and Fatha on the Tigris and Haditha on the Euphrates which, together, will provide another 45 km^3 of water storage *(EIU, 1990-91, 21)*. The policy to extend more effective control over Iraq's water resources has already brought benefits and in the summer of 1984 the government was able to release stored water to farmers, to offset the low levels of the Euphrates *(Fisher, 1989, 467)*. When the waters of the Euphrates and Tigris are fully utilized through dams and reservoirs the area of cultivated land in Iraq will be almost doubled.

Modern irrigation development projects in Iraq began during the later years of Turkish rule with the adoption of an irrigation and water-control scheme designed by Sir William Willcocks, and a barrage, was completed at Hindiya on the Euphrates in 1913. During the First World War several of the Euphrates canals were modernized and, between 1918 and 1934, the program continued to upgrade much of the existing canal system. Several large dams and control projects were built, some old canals were rehabilitated, and new irrigation systems were constructed. The large projects were multipurpose; to provide additional water for the irrigation of new land and the reclamation of old; to prevent flooding, and to generate electric power where possible. The country's irrigated area expanded substantially as a result of the water projects and the growing use of pumps to lift water from the rivers directly onto the fields. The area of irrigation increased from a little over one million hectares in 1918 to about 5.6 million hectares in 1953 and to about 8 million hectares in the early 1970s (although far less was cropped each year partly because of the practice of leaving fields fallow at least every other year). The number of pumps increased from 143 in 1921 to 3,775 in 1951 and to over 18,000 by 1974. The estimated water withdrawal from the Tigris-Euphrates system by Iraqis was about 19 billion m^3 in the 1940s and 49 billion m^3 in the 1960s *(Nyrop,* *1979, 157)*. According to Al-Dahiri (1969), the irrigated area served by flow systems at the end of the 1950s, was 54 per cent, 38 per sent irrigated by pumps and 8 per cent by water wheels and other means *(Al-Dahiri, 1969, 170).*

Table C5.11:

Iraq: total needs for water (billion m^3)

Utilisation unit	1975	1995
Irrigation	40.00	52.00
Domestic	0.58	3.50
Industry	2.24	11.90
Total	42.82	67.40

Sources: Gischler, 1979, 101 ; MEED, 1977, 14

According to table C5.11 there has been a steady increase in water demand for all consumption sectors: for irrigation, domestic and industrial needs; and the total added consumption from 1975 to 1995 is expected to be about 25 billion m^3. The approximate water consumption per person in the 1970s was about 150 litre/day in large cities and 100 litre/day in smaller towns. At that time, according to Al-Hadithi (1979), the total annual water supply for domestic and municipal uses, was estimated to be approximately 27 million m^3. The big industrial enterprises such as oil refineries, textile factories and cooling water for thermal power generation in the Euphrates valley, was 113 million m^3. The total amount of consumption, including 8.8 billion m^3 for irrigation, was 9.2 billion m^3 in the 1970s *(Al-Hadithi, 1979, 100)*. These figures do not take water losses, such as evaporation, into account.

A striking feature of Iraq since the 1940s has been an increasing use of the water resources of the Euphrates, largely for irrigation purposes. Calculations of the actual amounts used are difficult to make, but reasonable estimates may be obtained by examining the records of discharge from the rivers at the two gauging stations at Hit and Hindiya (see table C5.12). These records indicate that, over the thirty-year period from 1940 to 1969, utilised discharge has increased from 27.3 per cent to 45.1 per cent of the annual discharge. In absolute terms, this means an average withdrawal of 16,368 million m^3/yr. for the 10-year period from 1960 to 1969 *(Ubell, 1971, 9)*. These figures do not, of course, give any indication of the amount of water removed downstream from the Hindiya barrage or upstream from Hit, where little irrigation is carried out. In terms of current irrigation water-use in Iraq Ubell quotes an average figure of 13,300 m^3/hectare/yr. This implies using the figure of 16,368 million m^3/yr. for water withdrawal to irrigate 1,230,000 hectares between the Hit and Hindiya barrages (see table C5.12-C5.13).

Table C5.12:

Iraq: average water consumption between 1960 and 1969

River	Million cubic metres per year
Euphrates between Hit and Hindiya	17,213
Tigris and tributaries between Mosul and Fatha	4,190
Tigris between Fatha and Baghdad	14,052
Diyala	5,139
Tigris between Baghdad and Kut	8,614
Total	49,208

Source: Ubell, 1971, 4

These calculations for the withdrawal of water have been made as percentages of the average annual flow, however, it must be remembered that river-flows vary considerably from year to year, whereas irrigation demands tend to remain relatively constant. This means that if a very dry year such as 1961 (in which the total amount flow at Hit was only 16.8 billion m^3) - had recurred during the 1960-69 period, Iraq's demand for water would have been greater than the total available flow for a considerable period. By way of contrast, in a wet year such as 1963, Iraq's use of water would have represented only 40 per cent of the total flow and the total water withdrawn would have amounted to 58.2 per cent of the initial water resources.

According to Al-Hadithi (1979) it was estimated that the population living in the Euphrates basin in 1977 was 2.86 million (24 per cent of the Iraq's total population) but, in the year 2000, the population could exceed 6.3 million. Assuming a water consumption per capita per day of 300 litres, the mean annual domestic requirement will be 693.5 million m^3 for the total population in the Euphrates basin while the expected annual water required for industry located in the Euphrates basin in the year 2000 will be 256 million m^3 *(Al-Hadithi, 1979, 103-112)*. The Euphrates system can easily cope with domestic and industrial demands for water. The unpredictable demands for agricultural water is the use which may need careful regulation.

Until 1958 agricultural improvement was often inhibited by the need for adequate land reform. The reforms themselves may be divided into four phases: (1) the initial decrease of 1958 (2) the second law in 1970, (3) the extension of the reforms to Kurdish areas in 1975, and (4) a reversal of previous policy in 1981, when private enterprise in farming was encouraged for the first time *(Richards & Waterbury, 1990, 154)*.

Table C5.13:

Mean discharge (million m^3/yr.) during 10-year periods, and withdrawal of water from the Euphrates in Iraq

Gauging station	1940-49	1950-59	1960-69
Discharge at Hit	31,662	27,468	32,298
Discharge at Hindiya	23,021	17,281	19,930
Withdrawal between stations	8,641	10,197	16,368
Withdrawal as percentage of mean flow at Hit	27.3%	37.1%	45.1%

Source: Beaumont, 1978, 38.

After the revolution of 14 July 1958, the first steps were taken to formulate and pass the Agrarian Reform Law when the Iraqi government announced a new and more radical land reform project. This provided for the break-up of large estates whose owners were to be compelled to forfeit their "excess" land to the government, which would redistribute the land to new peasant owners. Landowners losing land were originally to be compensated with state bonds but in 1969 all the state's liabilities to recompense land-owners were cancelled. The reform of 1958 expropriated some 75 per cent of the privately owned land. Despite the agro-ecological diversity of the country, the state specified only two land holding ceilings, one of 250 hectares for irrigated land and the other of 500 hectares for non-irrigated land.

Table C5.14

Iraq: land tenure before the 1958 revolution

	Landowners		Land area	
Area per holding (in Iraqi dunams)*	Numbers	Per cent of total	Thousand dunams	Per cent of total
Less than 4	57,958	34.5	73	0.3
4-30	56,725	33.7	697	3.0
30-100	30,119	17.9	1,677	7.2
100-1,000	20,126	11.9	5,025	21.5
1,000-10,000	3,143	1.83	9,090	39.0
10,000-50,000	251	0.15	4,554	19.5
50,000-100,000	19	0.01	1,334	5.8
100,000 and more	5	0.00	877	3.7
Total	168,346	100.00	23,327	100.0

*one Iraqi dunams = 0.25 hectares

Source: Clawson, 1971, 61.

The Agrarian Reform Law of 1958 marked the end of feudalism in Iraq and the start of a new era. It was hoped that the reform would take only five years to complete but the application of the law was initially mismanaged and the expropriation of land consistently ran ahead of the ability of the administration's ability to distribute it. Although the FAO had estimated that some 2,000 co-operative societies would be needed to replace the landlords, there were only 25 by 1963. By the end of 1972 some 4.73 million dunams had been requisitioned from landlords and distributed to 100,646 families, but considerable areas of land still remain to be distributed although the government had been promoting the growth of co-operatives and collective farms since 1967. When the Ba'ath party returned to power in 1968, they issued a new Agrarian Reform Law where they reduced the land ceiling further and confiscated an additional 1.5 million hectares of land but, even so, by the end of 1975 only one-third of the sequestered land had been distributed. In 1984 there were 23 state farms, covering 188,000 ha. but by 1986, the land area occupied by state farms had fallen to only 52,925 ha, and by 1988 more than 220,000 ha. had been leased *(Fisher, 1989, 466).*

Politics has been as unhelpful as ecology to Iraqi reformers and the country is sharply divided ethnically and religiously, between Shi'i and Sunni, Arab and Kurd. The political situation (because of the coup in 1958) up till the early 1970's was highly uncertain, with four (typically violent) changes of government. In the light of such developments, it is little wonder that Iraqi land reforms have failed to achieve their economic goals *(Richards & Waterbury, 1990, 153).*

C5.9 The effect of wars on the Iraqi economy

Although Iraq survived the nine year war against Iran and the disastrous consequences of its invasion of Kuwait, its economy, especially the oil sector, was severely damaged. On the eve of the invasion Iraq was enjoying a period of having 'never had it so good', with years of sustained economic growth, and a rapid and unparalleled increase in oil production/exports and revenues. The significant decline in oil production / exports during the Iraq-Iran War can best be seen in figure C5.2, where the volume of oil production and exports during the 1974-91 period are noted. As can be seen, oil production decreased by 66 per cent between 1979-80 and 1980-81, falling from 170,300 thousand tonnes in 1979 to 130,000 thousand tonnes in 1980, and then again falling drastically to only 43,900 thousand tones in 1981. After 1982 the situation improved somewhat, although production did not rise to anything near the pre-war levels *(Mofid, 1990, 38).*

In all, during 1979 to 1986, oil exports value declined by 12.7 per cent on average each year while, during 1973-79, the corresponding figure had been an increase of 10.3 per cent *(Mofid, 1990, 39).*

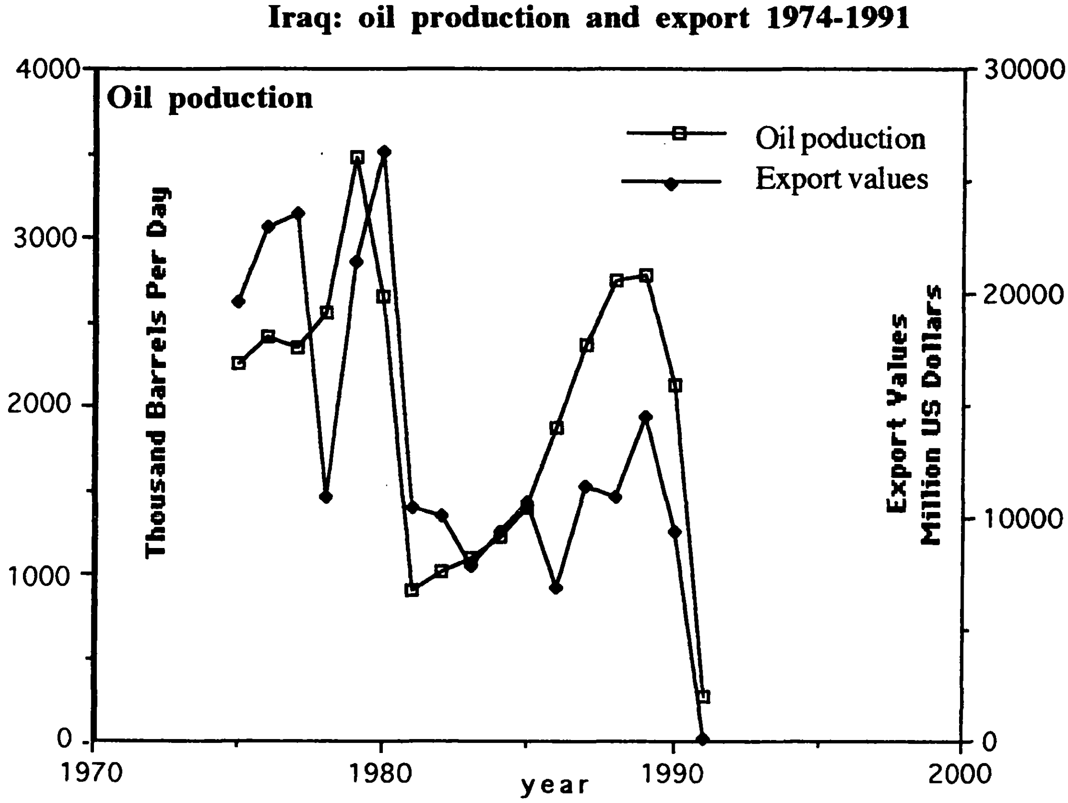
Iraq's recovery from the disasters of the Iraq-Iran War was slow. By 1990 production capacity exceeded 3.5 million b/d, with an actual output of 3.07 million b/d during the first six months. Domestic consumption in 1989 was 300,000 b/d, and production was effectively constrained by the limited export capacity available through Turkish and Saudi pipelines, the partly rehabilitated Gulf oil loading terminals and the trucking of a small volume of products and crude to Jordan. However, the imposition of the UN blockade in early August 1990 stopped all exports except those to Jordanian supplies and production was cut back accordingly. Iraq's quota according to OPEC had been 3.14 million b/d in 1990.

The war seriously affected Iraqi refining capacity throughout the country, and this was reduced as a result of Iranian bombing in 1981 causing temporary difficulties until the Salaheddin unit came on stream in 1983. Before the Iran-Iraq war, production of refined products was 1.32 million tons of gasoline, 1.2 million tons of kerosene and jet fuels, 2,379 tons of distillate fuel oils and 2.9 million tons of residual fuel oils. Iraq had a total refinery capacity of 656,000 b/d; but, as a result of the UN sanctions, there was a shortage of chemicals used for the refining process which caused in a reduction in refinery output by the end of 1990 *(EIU, 1990-91, 26).*

Power stations were a special target for the Iranian air force from the beginning of the Iran/Iraq War, and the result was frequent and severe shortages of electricity. Since that time the country has struggled to repair the damage caused and to create new generating capacity. Iraq's power generating capacity was 8,538 MW in early 1989, but it plans to double this to 17,000 MW by the year 2000. There are new plans to increase hydroelectric generating capacity (with potential hydro resources estimated at 7.7 billion KWh/yr.) and to install small generating sets in many medium sized towns. In fact before the disruption caused by the invasion of Kuwait, Iraq was in the process of constructing four new power stations, two of which were due to be completed in early 1991, while the two other plants were in an early stage of construction and were to add an extra 3,200 MW of generating capacity. In rural areas, however, there is still dependence on kerosene and wood for heating and cooking *(EIU, 1990-91, 26).*

The potential of the agricultural sector in Iraq is substantial, both in terms of abundant agricultural land and the availability of ample water resources, mainly from the Tigris and Euphrates rivers. In 1980 the importance and potential of agriculture to Iraq's overall development was once more highlighted when Saddam Hussain declared that agriculture was Iraq's "permanent oil" and that he wanted to see the country become self-sufficient and a net exporter of food within this century. This statement however was made before he ordered his army to invade Iran *(Mofid, 1990, 48).*

Figure C5.2:



Source: MEES, November 1992, D1-D3

The figures for the estimated production of principal crop products and main livestock items between 1973 and 1985 show that the average annual rate of production of many items such as wheat, rice, corn and bovine meat fell significantly during the 1979-85 period. At this point, if the pre- and post-war figures of agricultural production are compared, it can be argued that, even though the pre-war performance was far from perfect, there can be no doubt that during, and since, the war there has been a major deterioration in agricultural productivity *(Mofid, 1990, 50).*

At the beginning of August 1990 figures from the US Department of Agriculture suggested that Iraq's food supplies were extremely low and that the country would run out of beans, barley and maize in a month and wheat and rice in three months. What these estimates failed to take into account was the fact that Iraq's recently privatized agricultural sector had been improving its output, and that the 1990 harvest was a record. Totalling 1.2 million tons of wheat and 1.9 million tons of barley. The barley is usually grown mainly for animal feed, but after the sanctions were imposed bakeries started mixing barley flour with the wheat flour. The combination of such measures, such as making smaller standard loaves and effective food rationing meant that cereal stocks were sufficient to last until the early summer of 1991.

The Iraqi government has also announced various measures aimed at raising production of food next year such as ordering farmers to increase their acreage, and backing this up with fines and sanctions. As a carrot, the government offered chemical fertilisers at ultra cheap prices because of oversupply. Analysts suggests that, with favourable weather, Iraq may be able to increase its cereal crop by a further 30 per cent in 1991/92, although this order of production is not sustainable in the longer term because heavy investment is required to deal with soil deficiencies *(EIU, 1990, No. 4, 12)*.

Although the Iraqi government announced a number of major food import deals in May 1991 for the second half of 1991 with Canada (500, 000 tons of wheat), Australia (1 million tons of wheat) and Thailand (200,000 tons of rice), the problem it faces is the lack of oil revenues and the continued freeze on its overseas assets *(EIU, 1991, No. 2, 17)*.

In the 1991 Gulf-War, the UN coalition commenced the bombing and missile campaign against Iraq on 16 January 1991. All vital industrial installations were destroyed, including power plants, refineries, major industrial complexes, including factories and communication facilities. In addition, the economic infrastructure: roads, bridges, railways, airports and dams was attacked. The bombing came close to completely destroying the power system and Iraq's pre 1991 War electrical generation capacity of between 9000 MW and 9500 MW was reduced to 2325 MW as of 1 July. The devastation of the electricity system seriously hampered the operation of water supply and sewerage systems. The 160 MW Durbandikhan Dam was the only Iraqi hydroelectric project to have emerged unscathed from the Gulf conflict. Two other hydroelectric schemes, the 400 MW Dokan dam and the 220 MW Haditha Dam, were 75 per cent destroyed in bombing raids and remain non-operational, while the 808 MW Saddam Dam and 60 MW Samara Dam were completely destroyed *(World Water and Environmental Engineer, September 1991, 9)*. In order to cut off supplies to the Iraqi armed forces, the coalition commanders chose to hit any target which had any suspected or potential military utility. Thus, the transportation infrastructure was a prime target since it involved the movement of men and material. The oil refining and distribution system was hit because it provided the fuel for transportation and the electricity generation and distribution system became a target because it provided power to manufacturing plants which could be used to produce war related materials. The latter category included not only the ammunition factories, but also chemical and fertiliser plants (because of their potential for chemical weapon manufacture) and the country's iron and steel industry (because of its ability to produce shell casings and spare parts).

The definition of "command and control" centres resulted in the targeting of much of the country's telecommunications capacity. Office buildings which housed government ministries of all kinds were also regarded as military targets because of their political significance. Water supply and sewage treatment both depend upon a steady supply of electrical power and garbage disposal depends on the availability of fuel. The lack of fuel and power created conditions for epidemics of, for instance, cholera and dysentery *(EIU, 1991, No. 2, 16).*

The Economist Intelligence Unit has placed the overall cost to Iraq of the war with Iran at about $US 300 billion and the war over Kuwait must have cost Iraq tens of billions *(The Middle East Review, 1991-92, 69).* It will cost $US 12,000 million to restore pre-war power generating capacity, $US 6,000 million to rebuild the oil sector, $US 450 million for water and sanitation system, $US 2,640 million for food imports and $US 500 million for other agricultural imports *(MEED, 6 March 1992, 11).* To sum up, Iraq, which might be considered the most favoured of the three riparians because of its petroleum resources and its access to two major streams and vast arable lands, in reality, is seriously at risk from wartime destruction and poorly managed irrigation practices. Even in peacetime petroleum revenues were diverted to buy food imports and the possibility of achieving self-sufficiency in food production has remained elusive.

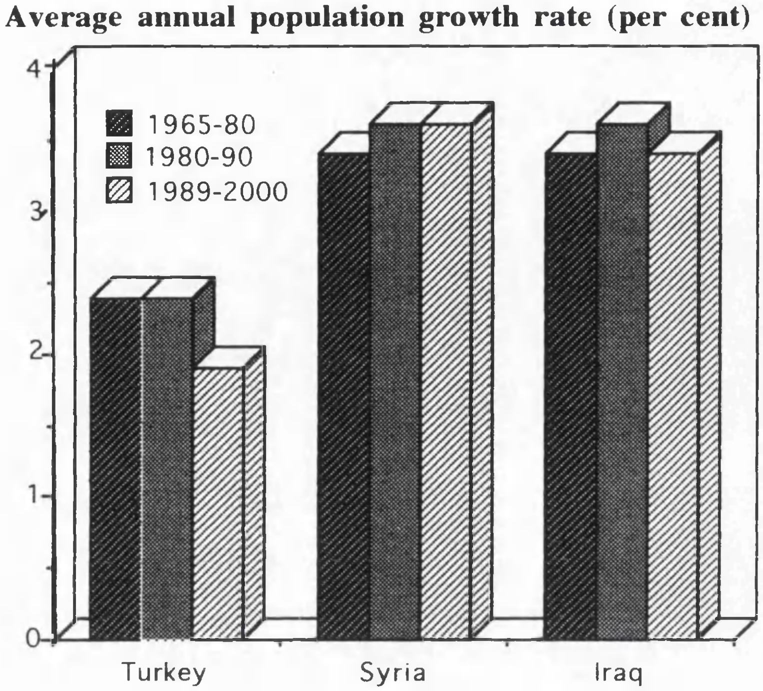
To sum up this chapter, the review made of the three states sharing the river's drainage basin shows a common picture of a rapid rate of natural population growth (see figure C5.3). As a result the all-inclusive number of the states' inhabitants will be close to 95 million in the year 2000 and approximately 180 million in 2025 (see figure C5.4).

Parallel to the rapid population growth, there is a rapid process of urbanization and industralization taking place in each of the countries. To all this must be added the rise in the standard of living (except for Iraq which has been suffering from wars and the resultant damage since the eighties).

On the one hand the rapid population growth has brought about a reduction in the amount of water available to each resident. Taking the accepted 1,000 m^3 per capita per annum as an extremely low category, it can be seen that there is a shortfall being created among the riparian countries of the Euphrates river, especially in Syria (see table C5.15).

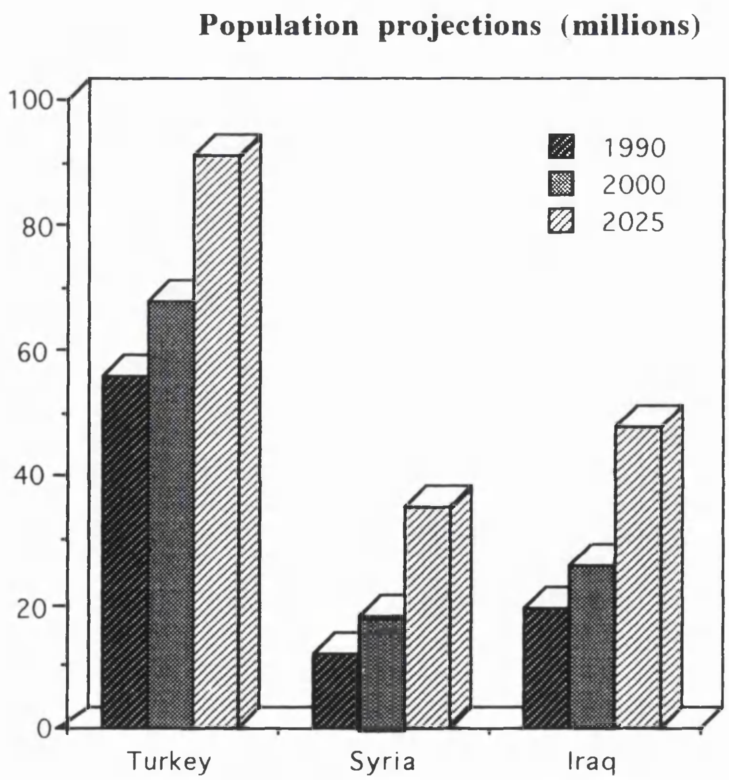
On the other, the rise in the number of inhabitants and the standard of living requires each state to significantly increase its annual production of food (above the natural rate of population increase), something which can be achieved by increasing the amount of cultivated land, by developing the cultivation of irrigated crops and by trying to increase agricultural productivity.

Figure C5.3:



Source: World Development Report, 1992, 268

Figure C5.4:



Source: World Development Report, 1992, 269

Table C5.15:

Per capita water availability: 1971 and 2000 (1,000 m^3)

	1971	2000	Per cent change in population 1971-2000
Turkey	4.9	2.3	118
Syria	3.0	1.0	165
Iraq	3.6	1.3	173

Source: The Global 2000, 1982, 156.

Since each state has planned its economic development including the projects which involve water resources without consideration of the interests of the other riparians and without consideration of the global limitations on water in the river systems, it is to be expected that these plans, will affect the network of relationships existing between the states.

In order to examine this issue we first have to examine the effects of the development programmes on the amount of water in the river (see chapter D).

D. The Influence of Development Projects on the River Water

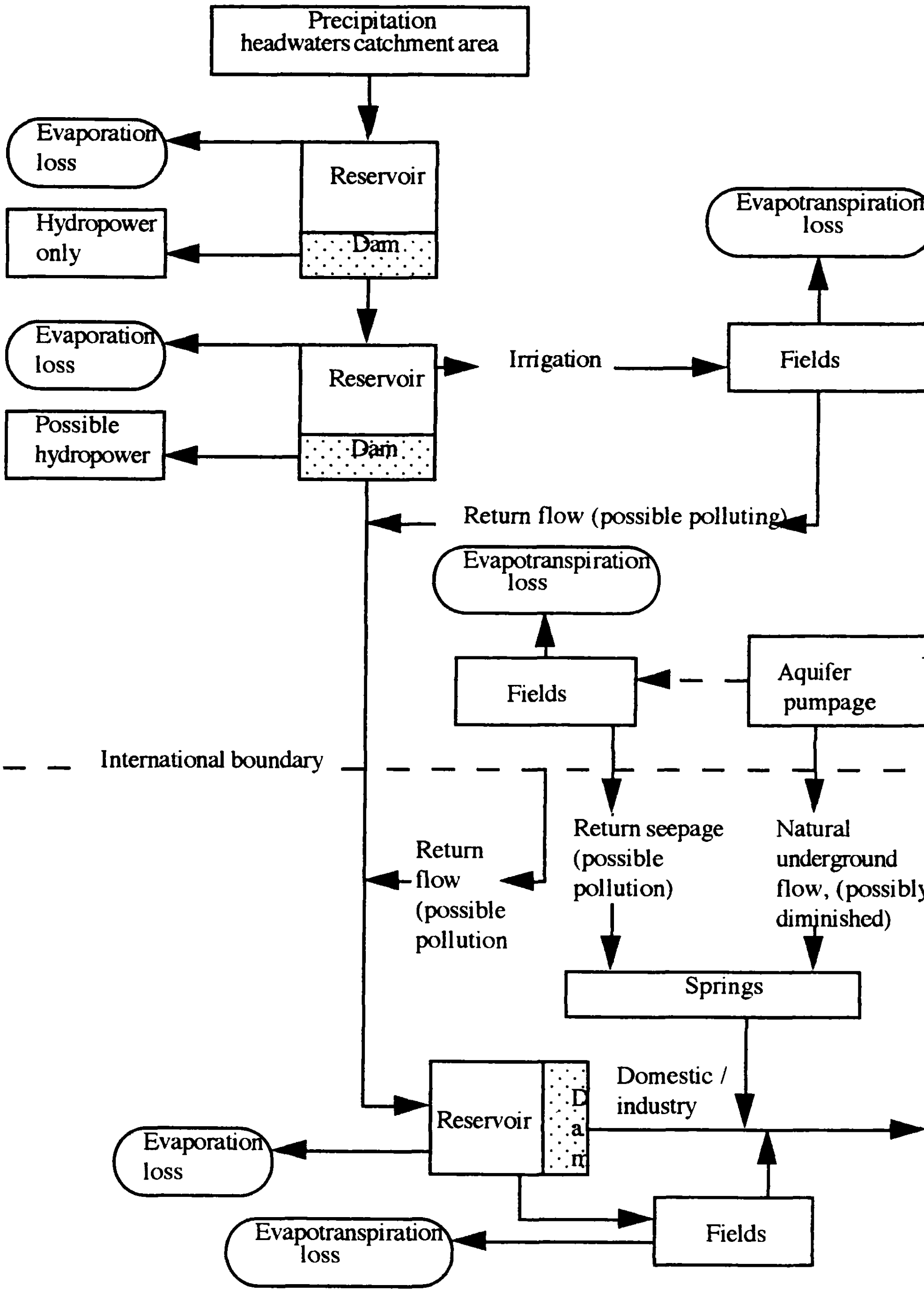
D1. The quantity of water

The Euphrates river is a renewable resource. There are four main uses for the Euphrates river by the riparian countries here presented in approximate diminishing order of importance in terms of volume at the end of 1980'S: irrigation, domestic use, hydropower, and industrial use. However, the pattern of future use of water in these three countries depends on their very different geographical circumstances. What will be the impact of developments (both in place and planned) on the quantity and quality of the river's water in Turkey, Syria in Iraq? In order to assess this we must review the Euphrates river from its source to its mouth in terms of dams, reservoirs, and diversions for irrigation as well as for evaporation, evapotranspiration, crop patterns and their rotation, water loss, return flows, and the domestic and industrial use of water.

Figure D1.1, shows a model developed by Kolars & Mitchell (1991), which illustrates the elements which Middle Eastern rivers have in common. Stream flow begins with natural precipitation at the headwaters of the upstream country; at various points downstream water may be impounded for the generation of hydropower, with some possible loss through evaporation from reservoir surfaces; water then continues downstream to the next reservoir where impounded water may not only be used to generate power but also to irrigate crops. Evaporation losses occur from the surface of the reservoirs but losses also occur from agricultural fields through evapotranspiration and system inefficiencies. Return flows may or may not be unacceptably polluted. Further downstream, pumping from independent aquifers may irrigate additional fields and provide some additional return flow but losses also occur here through local evaporation while excessive pumping may diminish spring flow downstream and even across an international frontier. In a downstream country similar patterns are repeated, all of which can have implications for a country farther downstream. At all points along the river, changes in the amount and quality of water may affect domestic and industrial use *(Kolars & Mitchell, 1991, 82).*

Some researchers have made attempts to evaluate the impact of the riparian states' development projects on the water flow quantities, and it seems that part of the present antagonism over water use between the riparian states can be attributed to the fact that the "acquired rights" calculation have, for some time, been based on the World Bank estimates of irrigated areas in the Euphrates basin made in 1965. According to these estimates, the area amounted to 135,000 ha. in Turkey, 212,500 ha. in Syria and 1,231,000 ha. in Iraq. The World Bank further estimated their water needs for irrigation at that time to be 2.14 billion m^3 for Turkey, 2.98 billion m^3 for Syria and 12.86 billion m^3 for Iraq (see table D1.1).

Figure D1.1:
Elements of a hypothetical international river use system



Source: Kolars & Mitchell, 1991, 79

Table D1.1:

Euphrates "acquired rights" according to the World Bank estimates

	Irrigation area (hectares)	Water needs (billion m^3/yr.)
Turkey	135,000	2.14
Syria	212,500	2.98
Iraq	1,231,000	12.86
Total	1,578,500	17.98

Source: the Arab Economist, May 1975, 16

According to Clawson (1971), the annual diversion of water in Iraq is 18 billion m^3 but both Turkey and Syria reject the estimate of Iraq's current use as up to twice what it actually is, and regard it simply as a position taken to establish the position of major claimant. In Syria the diversion is not quite 3,500 million m^3 and there is little diversion in Turkey at all making a total use of 21,500 million m^3. Current development plans amount to an additional 16,000 million m^3 in Iraq, 11 million m^3 in Syria, and 10,000 million m^3 in Turkey, or a total of 27,000 million m^3. Total future use would thus add up to nearly 48,000 million m^3, compared with an average flow per year of about 34,000 million m^3, which would be reduced by perhaps 10 per cent through evaporation from new reservoirs *(Clawson, 1971, 114).*

Table D1.2:

Total future use of the Euphrates river (million m^3)

	Turkey	Syria	Iraq	Total
Current use	1,500	2,980	12,860	17,340
Planned additions	12,140	4,610	6,040	22,790
Total future use	13,640	7,590	18,900	40,130

Source: Clawson, 1971, 114

As will be seen in table D1.2, the above estimates report a lower current use in Iraq and a lower future use in Syria , but a higher present and future use in Turkey than reported earlier by Clawson.

An attempt to estimate the likely volumes of water to be abstracted from the Euphrates as the result of projects already implemented, currently being implemented, or in the planning stage was made by Beaumont in 1978. According to Beaumont, the evaporation data suggest water losses of about 700 mm/annum from the reservoir behind the Keban Dam, and as high as 900 mm/annum from the lakes in GAP area. The Keban reservoir covers an area of 680 km^2 when full, and this means a maximum water loss of 476 million m^3/annum. With the three lower dams, the total surface area of the associated lakes is expected to be 674 km^2, producing a likely evaporation loss of 607 million m^3/annum. Taken together these potential water losses, of the order of 1,000 million m^3 /annum, represent about 3.4 per cent of the total annual discharge at Hit in Iraq. In the late 1960s Syria's irrigation water use from the Euphrates was about 3,000 million m^3/yr. with the largest dam on the Euphrates in Syria being the Tabqa Dam whose reservoir covers about 630 km2 when full. With such an area of water surface, evaporation losses from the lake behind the Tabqa Dam will be high - about 1,000 mm/yr.- so the water loss will be 630 million m^3/yr., a figure which represents about 2 per cent of the annual flow at Hit. According to Beaumont (1978), an extra one million hectares of irrigated land will be available for cultivation by the end of the twentieth century and, assuming an irrigation water need of between 5,000 and 10,000 m^3/ha, an extra 5,000 to 10,000 million m^3 of water will be abstracted from the river if the planned projects are carried out.

Table D1.3:

Potential water-use along the Euphrates (million m^3 year)

Mean total discharge at Hit	31,820
Turkey	
Evaporation from reservoir above Keban Dam	476 (max.)
Evaporation from reservoir above GAP project	606 (max.)
Potential water withdrawal for irrigation	3,500- 7,000
Syria	
Evaporation from reservoir above Tabqa Dam	630 (max.)
Potential water withdrawal for irrigation	5,000-10,000
Iraq	
Water use (1960-1969)	17,213
Evaporation from reservoir above Haditha Dam	602 (max.)
Total	Min. = 28,028 Max. = 36,538

Source: Beaumont, 1978, 41

For irrigation water use in Iraq, Beaumont (1978) quoted an average figure of 13,300 m^3/hectare/yr. using the figure of water withdrawals of 16,368 million m^3/yr. and this implies that, between Hit and Hindiya, about 1,230,000 hectares were being irrigated. The evaporation losses at Haditha is about 1,450 mm/yr. and this figure suggests a water loss of 1.45 m^3/yr. for every square kilometre of water surface. With a reservoir area when full of 415 km^2, the net evaporation losses is 602 million m^3/yr. Table D1.3 indicates that between 28,028 and 36,538 million m^3/annum of water could be utilized throughout the basin of the Euphrates if all the projects were implemented. The lower figure represents about 88 per cent, and the higher figure about 115 per cent of the average discharge of the Euphrates at Hit *(Beaumont, 1978, 38-41)*.

In a de-briefing report made by Al-Kabs (a Kuwaiti newspaper) in 1990 about Euphrates water utilization, it was claimed that the river's annual average quantity is about 33 billion m^3. Until 1974, about 90 per cent of the water streamed towards Iraq, 7 per cent was used by Syria, and the rest, about 3 per cent, was used by Turkey.

Table D1.4:

Water quantity used by the riparian countries - 1990

	Irrigated area (in hectares)	Quantity of water use (billion m^3)
Turkey	54,000	1,5
Syria	136,000	4,79
Iraq	492,720	12,86
Total	682,720	19,15

Source: Al-Kabs, 12 March 1990

Of the total irrigated area estimated to be 628,720 ha. in the Euphrates basin, 54,000 ha. lies within Turkey, 136,000 ha. within Syria and 492,720 ha. in Iraq. The water quantity used by these countries is shown in table D1.4.

Table D1.5:

The Euphrates basin: possible irrigable land

	Possible irrigable area (in hectares)	Water needs (billion m^3)
Turkey	503,200	13,64
Syria	231,400	7,95
Iraq	734,200	18,90
Total	1,468,800	40,49

Source: Al-Kabs, 12 March 1990

Of the 1,468,800 ha. of total possible cultivated area in the Euphrates basin (table D1.5), 503,200 ha. exists in Turkey, 231,400 ha. in Syria and 734,200 ha. in Iraq. The water needs of the three countries relative to the potential cultivated lands are shown in table D1.5 and the future water consumption of the Euphrates River based on this data, reaches 40.49 billion m^3/yr about 125 per cent of the average discharge of the Euphrates at Hit *(Al-Kabs, 12 March, 1990)*. According to table D1.4 it seems that the author of the article in the Kuwaiti newspaper Al-Kabs has provided a low estimate for the amount of irrigated land in Iraq in comparision to other sources of information. The future estimates concerning Iraq's agricultural potential along the Euphrates river (shown in table D1.5), however, are also low. On the other hand, the estimates of the amount of water needed to irrigate a hectare of agricultural land (2,700 m^3 in Turkey, 3,400 m^3 in Syria and 2,500 m^3 in Iraq) are significantly higher than any calculation so far made by other experts whose estimates generally range between 1,200 - 1,600 m^3 per hectare. The article, it must be noted, does not give any source for the data or the basis for estimating the need for such quantities of water. One should not ignore the possibility that the low quantitative values for Iraq are connected to the Kuwaiti nationality of the author.

Turning to another source, Waterbury (1990) quoted an estimate of Syria's demand for the Euphrates water which ranges from 4.5 to 7.5 billion m^3. Assuming that Turkey will irrigate no more than 1.1 million hectares in the Euphrates basin it might draw between 7.5 to 8.5 billion m^3 per annum from natural flow of the Euphrates (bout 7,500 m^3 per hectare). It should be noted that this amount of water is very low in relation to the data on the high rate of evaporation in the region, and the Turks themselves provided data at least 20 per cent higher than Watebury's calculation. Evaporation at reservoir sites, seepage and transmission losses could account for an additional loss of 2 billion m^3 which would bring the total abstraction to 10 billion m^3 or more. Combining the potential demands of the two countries, we arrive at totals ranging from 13 to 18 billion m^3, or from a little less than half to nearly two thirds of the average annual natural yield of the Euphrates *(Waterbury, 1990, 14)*. As a whole these figures are also low but one should remember that the amount of water for irrigation is dependent, to a considerable degree, upon the type of agricultural crops, the growing season and the irrigation methods used in each of the states. Apart from the irrigation methods (mostly flood irrigation) and the high level of evaporation in the region the consumption of water for agriculture can be relatively rapidly changed by changing the growing season or the type of agricultural crop.

In a recent article Waterbury (1992) claims that the total demand of the three riparians in 1970 left a surplus of 8.5 billion m^3 which drained into the marshes of lower Iraq and the Persian Gulf; but the potential deficit in the year 2005 could be 21 billion m^3 - or more than two thirds of the average annual natural flow of the river as shown in table D1.6 *(Waterbury, 1992, 15)*. Here also, in Waterbury's 1992 article, it is not clear why Syria's estimated water needs reach as high as 13 billion m^3 despite the estimate of up to 7.5 billion m^3 presented in the 1990 article. This, likewise, does not explain why Iraq, which has an irrigated land potential equal to that of Turkey's needs a quantity of water almost twice that of Turkey's. It seems that Waterbury's 1992 article has been influenced by data presented in Kolars & Mitchell book which Waterbury has found useful for presenting a picture of such a serious lack of water that it would produce an inevitable conflict between the states.

Table D1.6:

Actual and potential water demand in the Euphrates for 1970 and 2005 (billion m^3)

	1970	2005	Euphrates natural yield
Iraq	18.0	26.0	32.0
Syria	4.0	13.0	
Turkey	1.5	14.0	
Total	23.5	53.0	32.0

Source: Waterbury, 1992, 15

The most problematic figures regarding the water balance in the river are presented in Nomas' doctoral thesis (1988). where he calculates that the amount of water in the river is already insufficient to supply the water needs of states and will certainly not be able to do so in the future since the amount of water the states need today is 38.4 billion m^3 - 12 billion m^3 more than his estimation of the average perennial flow. In the future the deficit will reach 31-34 billion m^3 (see table D1.7-D1.8) - an amount of water double the annual flow *(Nomas, 1988, 337).* Note that in his calculation Nomas shows that Iraq will need 41-45 billion m^3 in the future - an amount which is 25 per cent higher than the total amount of the annual water natural flow of the river. It appears that Nomas as an Iraqi researcher has made a great effort to present calculations which show the biggest possible deficit of water, and these clearly politically motivated calculations do not reflect the true needs of Iraq for Euphrates water.

Table D1.7:

Present and future annual water balance of the Euphrates in Iraq regarding the total water requirements and losses (billion m^3)

Euphrates average discharge at Hit (1956-80)	26.00
Present water requirement and losses	38.40
Present water balance	-12.40
Future water requirement	41.74
Future water balance	-15.74

Source: Nomas, 1988, 338

Table D1.8:

Future water balance of the whole Euphrates basin, regarding the average long term river discharge (billion m^3)

Potential river discharge	+35.4
Future irrigation water requirements and evaporation losses in Turkey	-17.4
Outflow to Syria	+18
Future irrigation water requirements and evaporation losses in Syria	-7.33
Outflow from Syria to Iraq	+10.7
Future water requirements of Iraq	-41.74 / -45.5
Future water deficits in Iraq	- 31.04 / -34.8

Source: Nomas, 1988, 340

A more complete picture has emerged from reports issued by the Turkish and Syrian governments regarding their respective plans for the Euphrates river. The most up to date and comprehensive study carried out by 1991 - "The Euphrates River and the Southeast Anatolia Development Project" (1991), was completed by Kolars & Mitchell for the Associates for Middle Eastern Research Institute (AMER) of the University of Pennsylvania. Their research includes the collection of existing literature, scientific material and its analysis, but these official publications do not rely on the GAP Master Plan, one of the most important sources for this subject. Professor Bagis from the Faculty of Economic and Administrative Sciences at Hacettepe university at Ankara, published a book about the GAP project in 1989 which is based on the GAP Master Plan (for which he acted as an advisor and consultant) and the DSI reports. The GAP Final Master Plan in its four volumes (1991) contributes much information about Turkey's development plan but ignores its influence on the lower riparian states. In a similar way it seems that the Turks have made a very selective use of the data so that they cannot be used by the downstream states in their claims against the development plans in Southeast Anatolia. Thus the Turks did not publish the figures for evaporation from the reservoirs, the crop rotation for the region and estimates regarding the loss of water from the irrigation canal system. Data from these resources, however, make a more detailed evaluation off the different countries' development plans possible.

Measuring supply and demand lies at the very heart of any co-operative solution to problems of water utilization in international river basins. If and when tripartite negotiations take place concerning the use of Euphrates river waters, much will depend upon reaching a clear understanding about quantity available at any given time to be shared among the riparian users. The first such measure concerns the average annual discharge of the river but this is no simple matter to determine, for it seems that every report and evaluation quotes a different set of figures. According to Waterbury (1990), riparians tend not to agree over how much water there is, or when it is available, and how much each riparian needs or is likely to need. The upstream state may be in a good position to say: "This is how much water is in the river, and this is the amount you need". Future demand estimates are far more problematic because they must include making choices over use, and the relative efficiency with which the water is used (drip irrigation, surface irrigation, lined canal, etc.) *(Waterbury, 1990, 11)*.

Watebury's theoretical approach is useful in illustrating the situation of the Euphrates river. According to the GAP Master Plan, the annual "natural flow" data of the Euphrates at Belkiskoy gauging station on the Syrian border between 1940 and 1980 was 30.33 billion m^3/yr. *(GAP, 1990, Vol. 4, E-6)*. This figure is higher than the values given by Clawson - of 26,990 million m^3/yr. at Birecik *(Clawson, 1971, 217)*. Clawson's figures for Birecik are without the additional water which can enter the Euphrates main system in Turkey, 25 km downstream from Birecik, and do not include the flow of the Nizip, Araban, Goksu tributaries and several smaller streams. Clawson, used reports of the International Bank, in which estimates of irrigation diversion in Turkey, Syria, and Iraq were made, and estimated the total "natural" amount of the Euphrates river at Hit Iraq for the period 1937-1964 at 33.69 billion m^3/yr. *(Clawson, 1971, 205)*. This is the highest value given by any of the different sources. Another source, the Haigh Commission Report (1951), quoted the lowest amount for the average annual "natural" water surplus of the Euphrates river in Hit Iraq, based on 22 years of measurements (1925-1946), - 26.4 billion m^3 *(Haigh, 1951, 39)*. This figure is lower than the values given by Clawson by about 7.3 billion m^3/yr., or between 22 to 28 per cent of the Euphrates "natural" flow. For Iraq, the difference between the high and low estimates represents enough water to irrigate perhaps 600,000 hectares. This figure is based upon quite reasonable calculation of 1,200 m^3/hectare. Haigh's figure is very similar to the figure given by Nomas: 26.00 billion m^3 based on 25 years of measurements from 1956 to 1980 *(Nomas, 1988, 338)*. One should, however, remember that these figures have already been considerably influenced by the loss of water caused as a result of the development projects being carried out along the length of the river. According to Kolars & Mitchell (1991) the annual "natural flow" at Karkamish is 27.4 billion m^3/yr. - 3 billion m^3 less than that mentioned by the authors of the GAP Master Plan *(Kolars & Mitchell, 1991, 105)*.

From an analysis of the data used by the various experts about the calculation of the natural flow of the river, however, it appears that the estimates were made at different periods of time (table D1.9). The great annual differences in the flow of the river water (this can be seen in Figure B1) lead to different calculations of the average flows for each period of time, and so one cannot detect any clear political motivation in the researchers' findings. Similarly, it appears that the great variance in the data is also linked to the difference in the terms of "natural flow" and "measured flow". Natural flow relates to the amount of water in the river before it was affected by human intervention and thus this figure should be examined as an estimate. We must remember, however, that since Turkey began to build its reservoirs it has had exclusive control of data about the use of the river's flow and, from the beginning of the eighties, it has not published the natural flow data.

By using the comparison between the periods of time which the researches used to estimate the flow of the Euphrates river at Hit as a basis one can see that a number of estimates are atypical. Nomas figures include the higher flows of water in the river in 1963 and 1968-9 and, despite this, the average flow of the river is low. On the other hand one must remember that his figures are more influenced than the figures of other researchers by the growing use of water by the riparian states. In fact from 1974 on we can no longer relate to the "natural flow" of the river. It is surprising that, despite the fact that Nomas had the flow figures for the river from the middle of the twenties available, he chose to, inexplicably, ignore more than thirty years of measurements and commenced his calculations only from 1958. Clawson's figures about the amount of natural flow in the river also seem extreme and, despite the fact that his figures do not include the high flow of the river from the end of the sixties the perennial average flow is much higher than of other researchers. It appears that the source of the possible error in Clawson's estimates arises out of an exaggerated estimate of river water usage by the riparian states. Thus, it appears that the estimates of Ubell, Al-Hadithi and Abbas which show an average flow of 29.2-31.8 billion m^3/year are the most reasonable.

Table D1.9:

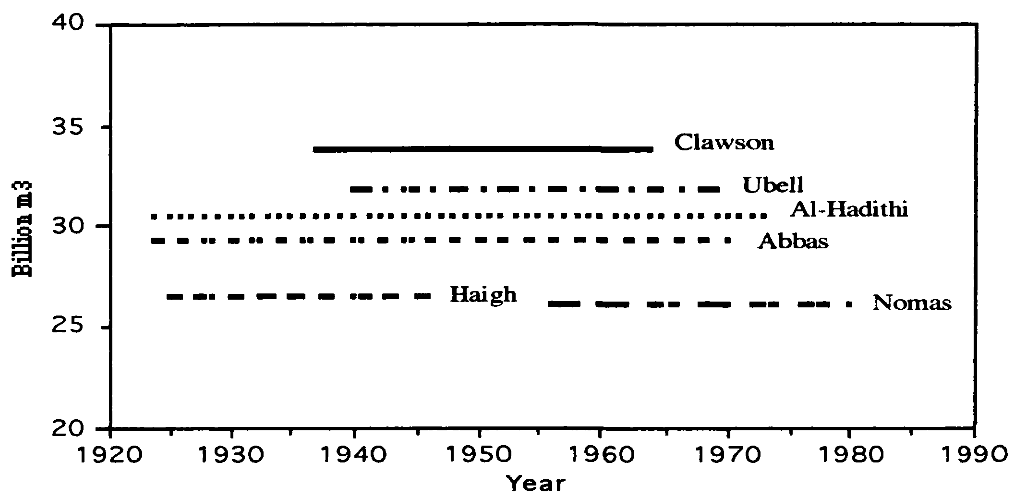
A summary of the experts estimates for the amount of natural water in the Euphrates at Hit (billion m^3)

Source	Period	Average flow
Clawson (1971)	1937-1964	33.69
Ubell (1971)	1940-1969	31.80
Al-Hadithi (1979)	1924-1973	30.60
Abbas (1984)	1924-1970	29.26
Haigh (1951)	1925-1946	26.40
Nomas (1988)	1956-1980	26.00

The use of different flow figures, however, can have political and economic motives. According to Waterbury (1990) Turkey, which will abstract large amounts of water from the upper Euphrates, will want the higher estimates of total supply to be generally accepted while the downstream states will want just the opposite *(Waterbury, 1990, 11)*. A high water estimate would grant Turkey a relatively higher portion as well as the possibility to use a relatively larger amount of water for irrigation. In contrast a low estimate of the average amount of water in the river would leave Iraq with a larger water surplus.

Figure D1.2:

The natural flow of the Euphrates river and the period calculated for, according to various researchers, at Hit in Iraq (billion m^3)



It is necessary to look at the use of the river and its tributaries by the riparian states in greater detail in order to understand the complexities of the river basin's hydrological system. This will set the scene for considering various scenarios relating to the way in which the river may possibly be used in the future. As we shall see the role of the Euphrates river in the economies and lives of the three nations differs markedly:

D1.1 The utilization of the Euphrates river by Turkey

Turkey is petroleum poor but rich in rainfed agriculture and surplus water. It hopes to harness the Euphrates in order to generate electrical energy and to profit from the export of irrigated crops grown with their waters. The total amount of precipitation that Turkey receives is 501 billion m^3 per year, however only 186 billion m^3 (37 per cent) finds its way into the rivers. Of this amount, 95 billion m^3 (51 per cent) is available as a potentially usable resource but currently, 25.6 billion m^3 (27 per cent) of available water is being used. The Euphrates river contributes 17 per cent of Turkey's rivers water potential *(Turan, 1993, 24)*.

Turkey receives 18.5 per cent of its GNP from agriculture and the nation is, for all practical purposes, self-sufficient in food. Nevertheless, its government has undertaken a major regional development project - the GAP, based upon the utilization of the Euphrates and Tigris rivers. The GAP programme is the most ambitious development ever undertaken in Turkey and it has profound implications for south-eastern Anatolia which has long been the least developed region within Turkey. In 1985 the region's per capita gross regional product was 47 per cent of the per capita domestic product of Turkey, The population was 8.5 per cent of the national total, and the population growth has remained higher than the national average despite the fact that emigration from the region continues. The area referred to as "south-eastern Anatolia" takes up 9.5 per cent of the total area of Turkey and 70 per cent of the economically active population in the region is employed in the agricultural sector. In view of the country's poor petroleum endowment and its annual import bill of from $ US 2,000 million to over $ US 4,000 million for petrol products for its expanding economy, hydroelectric production is clearly significant *(Kolars, 1991a, 4)*. In addition to growth in agricultural production, 7,561 megawatts of hydroelectric power generation capacity will also be created, of which 5,346 megawatts will be on the Euphrates and 2,215 megawatts on the Tigris. In total, the GAP's hydroelectric generating capacity will increase Turkey's present total generating capacity by 70 per cent *(NewSpot, 28 June 1990, 7)*. Turkey also sees a great opportunity for electricity exports and the Turkish government has been negotiating with four Middle Eastern countries to export electricity *(Parker, 1991, 17)*. Not only does the government of Turkey hope to increase its energy supply but also hopes to improve the local economy significantly since the increase in agricultural production may also start a developmental "chain reaction" in other sectors of the regional economy. About 4.3 million people live in south-eastern Anatolia, so it is not over-populated, but the population could reach 10 million when economic development takes off and livelihoods will have to face the GAP regions rapidly increasing population *(NewSpot, 19 July 1990, 5)*. When GAP is completed, it is estimated that Turkey will produce enough food to feed 80 million people; 3.3 million extra jobs will be created countrywide, urbanization will receive a boost in the region; and rural emigration will slow down considerably. Turkey claims that these new irrigation schemes will transform the country into the breadbasket of the region *(South, August 1991, 14)*.

The Keban Dam and reservoir and the smaller projects upstream from the site were among the first developments to be completed on the Turkish Euphrates. The average annual runoff volume of the Euphrates at Keban is about 20,627 million m^3 *(GAP, 1990, Vol. 4, 30)*. Depletion of water through evaporation, it has been estimated by Kolars, will be about 985 million m^3 per year when the 675 km^2 reservoir is full. The irrigated area was about 35,000 ha. in 1990, with 58,000 ha. scheduled for about the year 2000. At that date, it is estimated that depletion of the river flow, (with return flow taken into account) will be about 1,430 million m^3 *(Kolars, 1991a, 15)*.

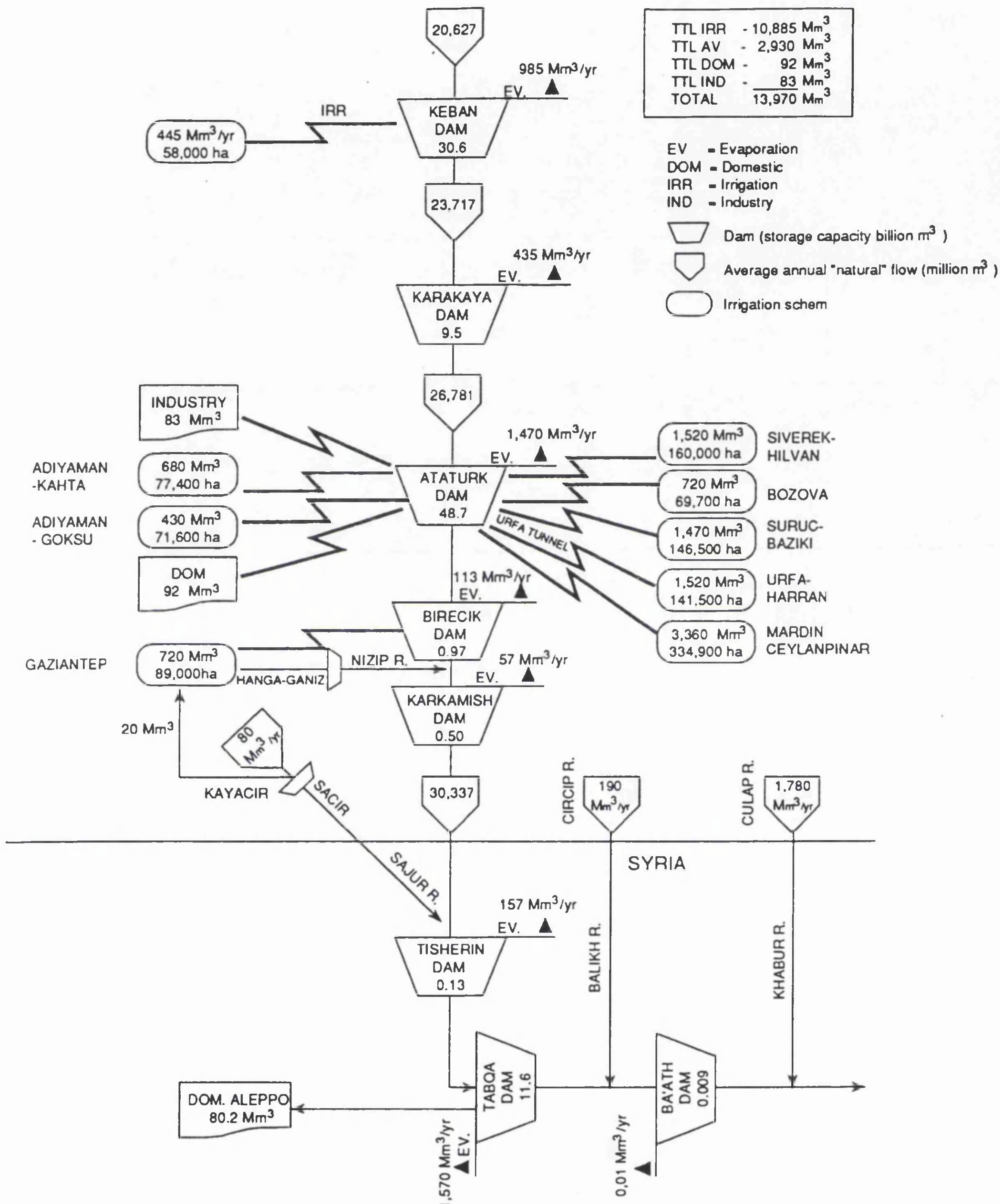
Located 166 km downstream from the Keban is the second section of the development planned by the Turkish authorities: the Karakaya Dam and associated projects; and here the average annual runoff volume of the Euphrates river is about 23.7 billion m^3 *(GAP, 1990, Vol. 4, 30)*. The Karakaya reservoir, now full, was completed in 1987 and being full, the 298 km^2 reservoir, may lose as much as 435 million m^3 of water annually through evaporation *(Kolars, 1991a, 15)*.

The Lower Euphrates Project, which is the core of the GAP, is based upon the Ataturk Dam, 180 km downstream from Karakaya, and its vast reservoir with a volume of 48,700 million m^3, and a surface area of 817 km^2. The average annual runoff volume of the Euphrates at Ataturk is about 26,781 million m^3 *(GAP, 1990, Vol. 4, 30)*. According to Kolars, the Ataturk reservoir when it is full, may lose as much as 1,470 million m^3 annually to evaporation *(Kolars, 1991a, 16)*. Eight different irrigation projects totalling 1,141,500 ha. are projected for completion some time after the year 2000.

Part of the water in the Ataturk Dam reservoir will go to the Sanliurfa-Harran and Mardin-Ceylanpinar plants through the Sanliurfa tunnels (under construction in 1992). The 141,500 ha. Sanliurfa-Harran irrigation area which comprises the 43,000 ha. Sanliurfa and 98,500 ha. Harran irrigation subsystems stretch from the low plains south of the city of Sanliurfa to the Syrian border. The construction of irrigation canals began in 1980 and were planned to be completed in 1992. Irrigation water required in the area is 10,410 m^3/yr. per ha, so about 1,520 million m^3/yr. of irrigation water will be headed (unit water requirement changes are dependent on the crop and irrigation pattern, available moisture capacity of the soil and covering rate). The overall estimate of 10.410 m^3/hectare per annum, however, seems to be a very minimalistic estimate. This figure upon which the Turks based their calculations of water consumption from the river appears to be unreasonable for this hot region so close to the Syrian desert. it is reasonable to assume that in this region the amount of annual water for an agricultural hectare needs to be at least double the figures upon which the Turks based themselves. Thus it appears here that like in a number of other regions (see table D1.10) political considerations are involved in the calculation of the amounts of water in order to try and not cause concern to Syria and Iraq. According to Bagis, these have been taken into consideration in estimating the irrigation envisaged in the GAP master plan *(Bagis, 1989, 52-69)*. The size of the Mardin-Ceylanpinar Irrigation scheme which originates from the Sanliurfa tunnels and Mardin canal, will be 334,900 ha. Studies on this project have already been completed and the first stage, comprising 230,130 ha., should be completed in 1996, while the 104,809 ha. second stage is planned to be completed in the year 2000. The irrigation water requirement in the area is 10,005 m^3/yr. per ha, which implies about 3,360 million m^3/yr. of water for the whole project *(NewSpot, 1 August 1991, 4)*.

Figure D1.3:

Euphrates River : total water utilization by Turkey after the year 2000



Sources: GAP, 1991; Kolars & Mitchell, 1991; U.S. Army Corps of Engineers, 1991; Bagis, 1989.

The Siverek-Hilvan pumping irrigation area which covers a total area of 160,100 ha. will be fed from the Ataturk Dam reservoir and the entire project, now at the preliminary planning stage, is envisaged to be fully implemented by the year 2002; irrigation water required in the area is estimated at 8,980 m^3/yr. per ha, which implies a total water requirement of about 1,520 million m^3/yr.

The Bozova irrigation area will cover a total of 69,700 ha. gross, of hilly terrain between the Hilvan and Bozova districts. Irrigation will be achieved by raising water from the Ataturk reservoir and the irrigation scheme project is expected to be completed in 1995. The irrigation water requirement in the area is 8,920 m^3/yr. per ha, so about 720 million m^3/yr. is estimated to be the annual requirement *(Bagis, 1989, 53).*

The Suruk-Baziki irrigation project is designed to irrigate an area of 146,500 ha. in the Baziki plains within the scope of the project along the Euphrates to the west of the Bozova district near the Ataturk Dam. 44,900 ha. of land will be irrigated from the Ataturk Dam's reservoir, mainly by gravity irrigation and, to some extent, by pumping.

The Suruk irrigation area is to the west of the Sanliurfa-Harran irrigation area, and extends to the Syrian border across the low plains and here, the total irrigated area will be 146,500 ha. with water for irrigation being pumped from the Ataturk reservoir.

In order to give continuity to water flow, especially at times when demand for water is high, three reservoirs, the Tozluca, Aylan, and Tasbasan, are planned to be built on the main waterway with a total active storage capacity of 27 Mm^3. This project will be completed in several stages by the year 2000 when irrigation water required in the area will be 10,410 m^3/yr. per ha, or about 1,470 million m^3/yr. *(NewSpot, 1 August 1991,4).*

The Adiyaman-Kahta project is a multipurpose project aimed at the development of water resources on the right bank of the Ataturk Dam's reservoir in the central and northern parts of the province of Adiyaman. The total irrigated area is planned to be 77,400 ha. with 29,600 ha. being served by the Ataturk Dam, 7,760 ha. by the Gomukan Dam, 6,100 ha. by the Camgazi Dam, 12,300 ha. by the Buyukcay Dam and 21,600 ha. by the Kocali Dam. The Adiyaman-Kahta Project will be completed in several stages by 1994 when irrigation water requirement in the area will be approximately 7,626 m^3/yr. per ha, or about 680 million m^3/yr. *(Bagis, 1989, 55).*

The Adiyaman-Goksu Project will supply water for irrigation to 71,600 ha. gross, and city water to Gaziantep. The Cataltepe Dam on the Goksu river is the key-structure of the project and feasibility studies for this project were completed in 1997. The irrigation water required will be 7,227 m^3/yr. per ha, making a gross requirement of 430 million m^3/yr. *(Bagis, 1989, 55).*

The Gaziantep project is designed to supply irrigation water to an 89,000 ha. area along the Syrian border. Irrigation water will mainly be supplied by pumping from the Birecik Dam but there are plans to take water from the Euphrates at Belkis and send it towards Kilis in a south-westerly direction. In 1997 the project will be completed and the irrigation water required will be 7,227 m^3/yr. per ha., or 720 million m^3/yr. required for the project *(Bagis, 1989, 56)*. According to Kolars & Mitchell (1991), in addition to hydropower, 101,570 ha. are scheduled for irrigation largely from Lake Birecik and the Araban, Hancagis, and Kayacik reservoirs. The Birecik Dam and HPP are planned to be built approximately 92 km downstream from the Ataturk Dam and, with an active storage capacity of 972 million m^3, will supply a significant part of the water for the Gaziantep irrigation project (although the reservoir may lose as much as 113 million m^3 of water annually from evaporation). The Turkish government is currently negotiating with a European consortium to set up a 1,000 $US million to build-operate the Birecik Dam *(MEED, 25 January, 1991, 13)*.

The Karkamish Dam is intended for energy production and the dam will be located on the river 33 km downstream from the Birecik site and 4.5 km upstream from the Syrian border *(Bagis, 1989, 56)*. The reservoir may lose about 57 million m^3 annually through evaporation.

The total proposed irrigation area of the GAP project is 1,083,460 ha. and, according to the GAP master plan, the amount of water required for irrigation is about 10.4 billion m^3/yr. (see table D1.10).

Table D1.10:

Summary of GAP irrigation water requirements from the Euphrates

Irrigation scheme	Irrigation area	Water required m^3/yr./ha.	Water required Mm^3/yr.	Completion date
Urfa-Haran	141,500	10,410	1,530	1992
Mardin-Ceylanpinar	334,900	10,005	3,360	2000
Siverek-Hilvan	160,100	8,920	1,520	2002
Bozova	69,700	8,920	720	1995
Suruk-Baziki	146,500	10,410	1,470	2000
Adiyaman-Kahta	77,400	7,626	680	1994
Adiyaman-Goksu	71,600	7,227	430	1997
Gaziantep Project	81,670	7,227	720	1997
Total	1,083,470		10,430	

Source: Bagis, 1989, 52-70

It would appear that these figures do not include evaporation from the reservoirs, domestic usage and industrial use, meaning that the total water utilization and losses could reach up to 14 billion m^3 (see figure D1.3).

Development plans for the GAP region include the improvement of urban water supplies. Total domestic water use in the Euphrates basin after the year 2000 has been estimated by Kolars & Mitchell at approximately 92.5 million m^3/yr., while 82.5 million m^3/yr. will be used for industrial purposes in the GAP region *(Kolars & Mitchell, 1991, 55).*

D1.2 The utilization of the Euphrates river by Syria

Water poor, if not destitute, Syria has neither the ample rainfall of Turkey nor a second major stream such as the Tigris, nor valuable petroleum deposits as substantial as those of Iraq. Nevertheless, agriculture which employed 25.4 per cent of the labour force in 1984, is very important although declining element in the national economy. Only 30 per cent of the total area is agricultural land and only about 15 per cent of this is irrigated *(MEI, 16 April, 1993, 16).* Traditionally, Syria was a net agricultural exporter of wheat, barley and cotton. In 1963 the value of agricultural imports was only 27 per cent of the agricultural exports but, by 1970, the food trade balance was in deficit and big wheat imports accounted for the bulk of the deficit. From 1970-1971, to 1976-1977 agricultural imports grew by 19 per cent/year and exports by only 14 per cent; so from the early seventies onwards Syria was importing significant quantities of food products and, in 1988, food made up about 71 per cent of the country's overall imports *(Syria & Monde Arabs, No 408, 1988, 1).* More rapid growth in demand seems to have locked Syria into a permanent structural deficit of agricultural products when, being an agricultural country, exports should according to Hinnebusch have been earning the net income to pay for the machinery and finished products which the country's level of development did not allow *(Hinnebusch, 1989, 274).*

The Syrian government has pursued several major goals for the agricultural sector which are framed within the context of much broader national development goals such as sustained economic growth, increased national self-sufficiency, full employment and greater social equity and economic well-being. The expansion of irrigated areas was to be part of the strategy to reduce dependence upon rain-fed cultivation through the development of the waters of the Euphrates. The policies have come to be perceived by many as the panacea for Syria's agricultural problems *(Manners & Nejad, 1985, 257).* Excluding the Euphrates and its tributaries (the Sajur, the Balikh, and the Khabur), approximately 119,000 ha. are irrigated elsewhere in the country in the Orontes (Asi), the

Yarmouk, the Queik and the Barada river valleys and several smaller streams. These sources are limited and, if used to total capacity, might provide another 175,000 ha. of irrigated land *(Kolars, 1991a, 9).*

Prior to 1950, the waters of the Euphrates were little used and traditional lifts (often camel powered), brought what little water reached fields on to the river's banks. Following independence, speculation in cotton by Syrian merchants led to a rapid increase in the number of gasoline pumps drawing water from the river *(Kolars & Mitchell, 1991, 144).*

The first withdrawal of water in Syria downstream from the Turkish border will be on the Syrian portion of the Sajur (Turkish: Sacir) river which rises in Turkey and enters the Euphrates from the right bank. The annual discharge value of the Sajur is about 80 million m^3 but the small Kayacik Dam and reservoir which can store 46 million m^3 in Turkey might further reduce stream flow as a result of the irrigation of about 13,700 ha. at Gaziantep *(Bagis, 1989, 56).* According to Kolars & Mitchell (1991) a total of 20.3 million m^3 could be removed from the Sajur's flow downstream *(Kolars & Mitchell, 1991, 110).*

The Construction of the Tishreen Dam began at the end of 1989 and, according to the Syrian official newspaper "Al-Ba'ath", the storage capacity of the dam is 1,883 million m^3 (1,300 million m^3 according to Kolars), and the reservoir area is 166 km^2 (70 km^2 according to Kolars). The reservoir may lose as much as 157 million m^3 annually to evaporation *("Al-Ba'ath, 7 January, 1990; Kolars, 1991a, 16).*

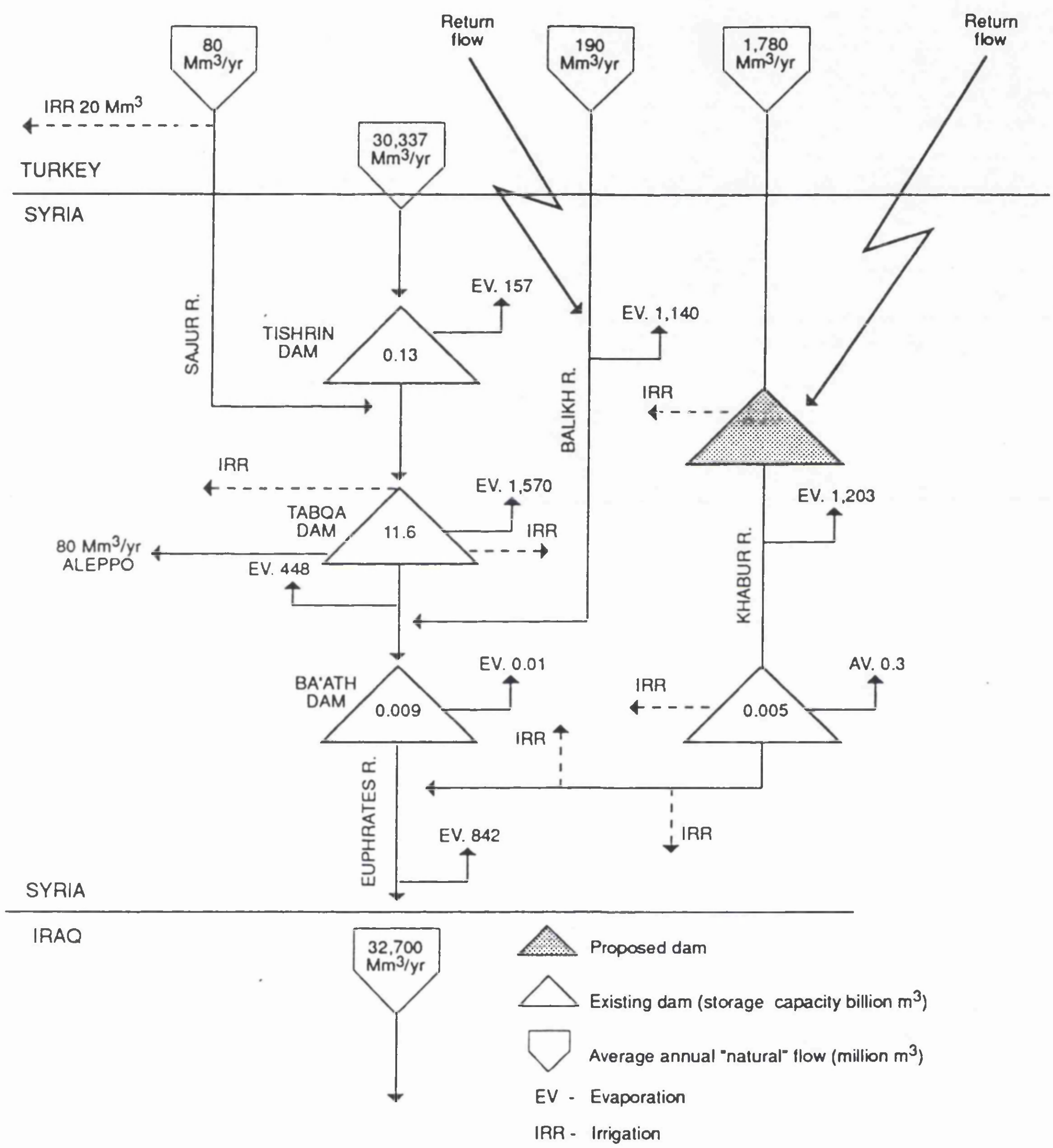
Continuing downstream, the head of Lake Assad formed by the Tabqa Dam is encountered south of Yusuf Pasha at the village of Remis. This reservoir has a storage capacity, when filled to a height of 40 m (300 m above sea level), of 11,600 million m^3, and a surface area of 625 km^2 but the reservoir may lose as much as 1,570 million m^3/yr. (*Kolars, 1991a, 16*). An underground aqueduct leads from a pumping station on Lake Assad to the city of Allepo and carries about 80 million m^3 for domestic demand *(Kolars & Mitchell, 1991, 110).* Lake Assad will also serve five or six proposed irrigation districts and 200,000 ha has recently been proposed for irrigation for areas north and south of Aleppo with water for these fields being taken from Lake Assad as well. Water utilization rates of about 12,500 m^3 per hectare which are anticipated with about 6,750 m^3 per hectare return flow are based on values computed for similar areas nearby. Such removals and returns may start in 1992, and will increase steadily until the year 2010.

The Ba'ath Dam whose construction began in 1982 and was completed in 1986, was built with Soviet assistance, 25 km downstream from Tabqa *(An-Nahar Arab Report &*

MEMO, 19 March, 1984, 20). According to the Syrian official newspaper "Al-Ba'ath", the storage capacity of the dam is 90 million m^3 and the reservoir area 2.7 km^2 *(Al-Ba'ath, 21 June, 1988; Kolars & Mitchell, 1991, 153)* .

Figure D1.4:

The Euphrates river in Syria: major water projects



Sources: Kolars & Mitchell, 1991; "Tishrin", 11 March 1992; U.S. Army Corps of Engineers, 1991.

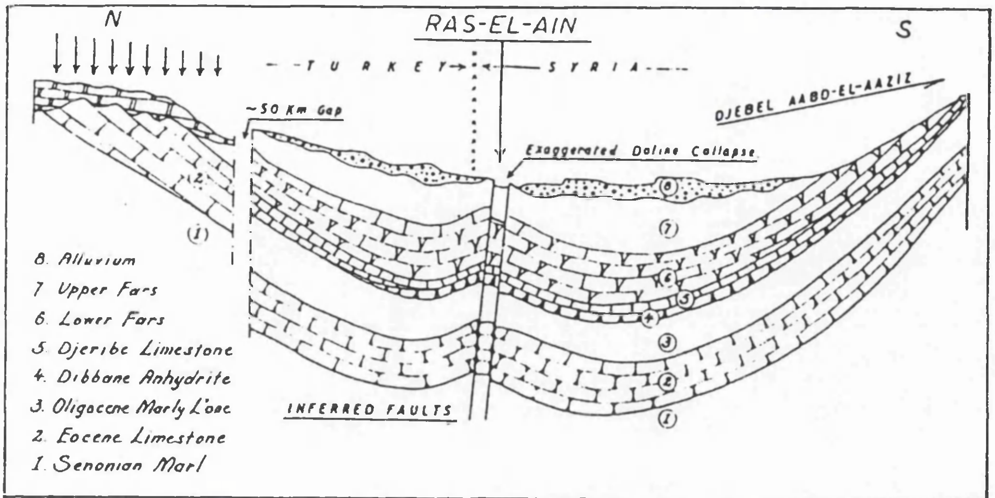
The Balikh (Turkish: Culap) which enters on the left bank and receives the bulk of its water from the Ain Arous spring in Syria near the Turkish border is the next tributary. The catchment area for the water of the Balikh system is about 185,000 ha., of which 140,000 is designated for irrigation *(Al-Ba'ath, 8 March, 1990)*. The 116 km length of the Balikh in Syria is heavily utilized for irrigation and the annual discharge of the river is about 190 million m^3/yr. which is 0.6 per cent of the total flow of the Euphrates river. According to Kolars & Mitchell (1991), the return flow from the irrigation schemes planned in the Urfa-Harran plain, may range between 2,300 and 5,800 m^3/ha. This will increase the annual flow of the river from the underground aquifer by amounts ranging from 368 to 928 million m^3 and this may present new opportunities for irrigation in Syria, but the quality of the water may be poor *(Kolars & Mitchell, 1991, 111)*.

The final contribution to the flow of the Euphrates comes from the Khabur (Turkish: Culap) river system, which joins the mainstream 40 km downstream from Deir ez-Zor. The sources of the Khabur are a giant spring, the Ras el-Ain, and additional seasonal surface flows from Turkey in late winter and early spring. With an average annual discharge of 1,219 million m^3, Ras el-Ain, amongst the largest of the great karst springs of the world lies almost midway between the Tigris and the Euphrates rivers, just south of the Syrian-Turkish frontier, in a region of open rolling plains. The water issues from some thirteen springs which combine to form the effective head of the Khabur river *(Burdon & Safadi, 1962, 58)*. The Turkish aquifer supplying the Ras el-Ain contains a rechargeable supply of 852 million m^3/yr. *(Kolars, 1991a, 17)* ; and the "natural" total flow of the stream is about 1,780 million m^3/yr. which amounts to six per cent of the total flow of the Euphrates river system. According to Kolars, more than 80 per cent of the waters of the Khabur and its tributaries originate in Turkey and will be affected by that country's development plans.

The course of the Khabur river extends for approximately 120 km in Turkey and another 486 km in Syria. Although the catchment area for the waters of the Khabur system lies 45 per cent within Turkey and 55 per cent within Syria, 83 per cent of the total flow originates in Turkey (about 1,500 million m^3) *(Kolars & Mitchell, 1991, 167-191)*. In 1985 Bulgaria agreed to built two dams on the Khabur river in a project which is designed to irrigate eventually 40,000 ha. and includes a canal linking the two dams *(Fisher, 1989, 795)*. Water loss from reservoirs planned along the Khabur will approach 333 million m^3/yr. *(Kolars, 1991a, 17)*. The total irrigation area was originally estimated to be 400,000 ha. but a recent news release by Kolars & Mitchell (1991) gives a total of about 138,000 ha. for the Upper Khabur region *(Kolars & Mitchell, 1991, 152)*. According to the Syrian official newspaper "Tishrin", however, the irrigation area in the upper Khabur region will eventually be 153,700 ha. *(Tishrin, 11 March, 1992, 7)*.

Figure D1.5:

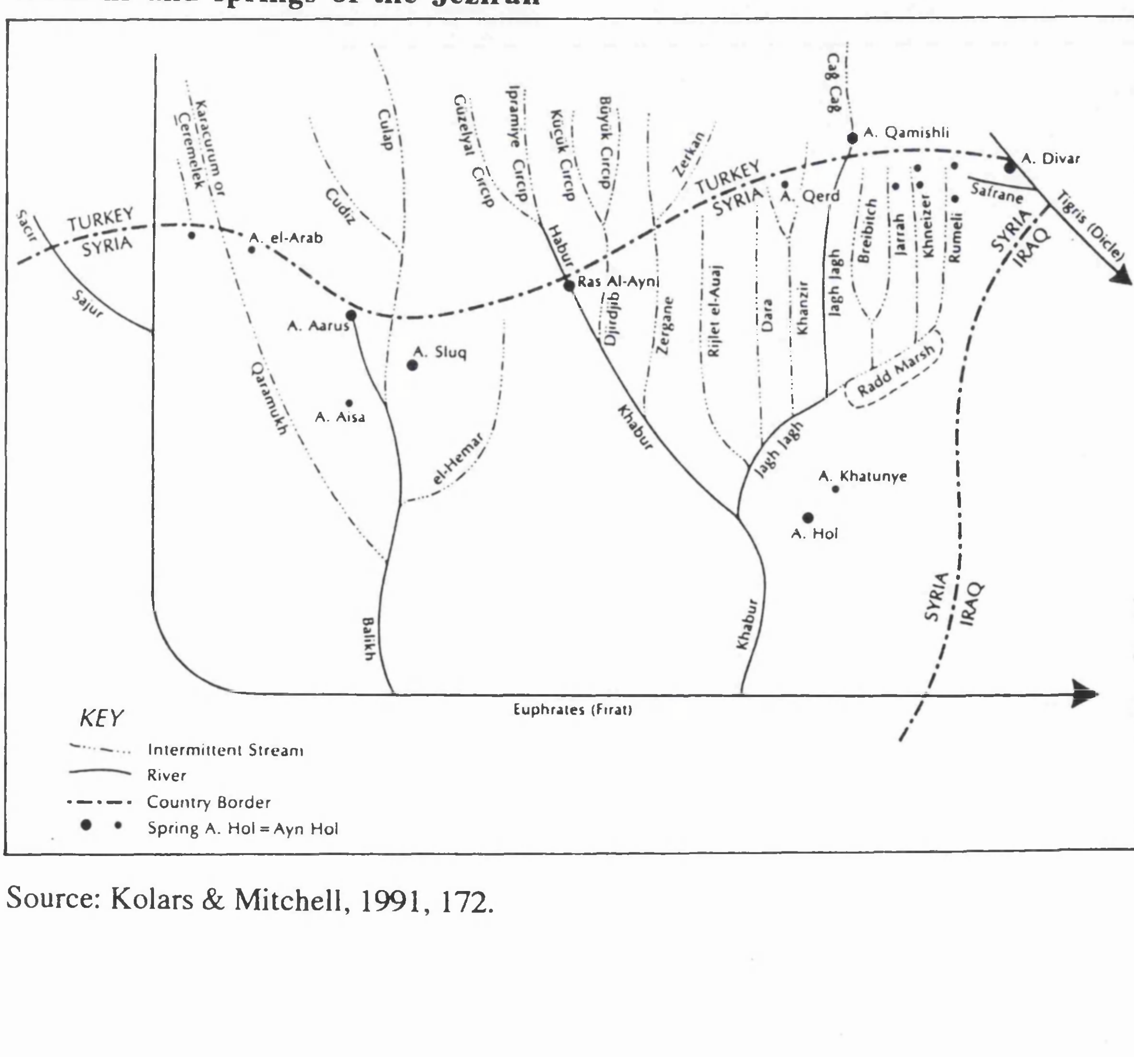
Diagrammatic hydrogeological sections at Ras-el-Ain



Source: Burdon & Safadi, 1962, 68.

Figure D1.6:

Streams and springs of the Jezirah



Source: Kolars & Mitchell, 1991, 172.

The original Syrian plans to irrigate 640,000 ha. of land with water from the Euphrates river have been revised downward drastically. According to Kolars & Mitchell (1991) almost all of these downward revisions have been the result of unexpected problems relating to gypsiferous soils, which dissolve upon contact with water leaking from the new canals, thus disrupting the entire system as it is being put into place. Recent estimates by the Syrian government indicate that between 240,000 and 260,000 ha. of land will be irrigated in the main valley when the projects are completed *(Kolars & Mitchell, 1991, 274)*. If one adds 153,700 ha. of irrigation land planned for the Upper Khabur to this amount, the "best guesstimate" for potential irrigation land from the Euphrates river and its tributaries will be about 411,000 ha. The total Euphrates river water depletion after taking into account the return flow and the evaporation losses will amount to about 6.9 billion m^3/yr. (see table D1.11).

Table D1.11:

Syria: irrigation projects and estimated water depletion

Project name	Irrigation area (hectares)	Return flow (million m^3/yr.)	Water loss (million m^3/yr.)
Tishreen Dam			157
Aleppo diversion			80
Lake Assad			1,570
Maskanah	74,300	591.2	932
Balikh	106,000	613.7	1,140
Middle Euphrates	29,000	273.9	488
Lower Euphrates	50,000	453.3	842
Upper Khabur	153,700	908.0	1,203
Total	411,000	2,840.1	6,896

Sources: Kolars & Mitchell, 1991, 275-279; Tishrin, 11 March 1992, 7

Another source, Briefing (1990), quotes 345,000 ha. as the amount that can reasonably be irrigated from the Euphrates, and about an additional 138,000 ha. in the Khabur basin making the total potential irrigated area from the Euphrates about 483,000 ha. *(Briefing, 15 January, 1990, 7)*. This figure is higher than the data presented by Kolars & Mitchell but, even if we accept this estimate, it implies that the total amount of water that Syria will need annually in the future will reach 7.5 billion m^3 assuming water application of 15,500 m^3/ha/yr., a high level. This figure is similar to the estimates of the future water needs of Syria presented by Waterbury -1990, Clawson -1971 (see table D1.2), the Al-Kabs data -1990 (see table D1.5) and the Nomas figures -1988 (table D1.8) *(Waterbury, 1990,14 ; Clawson, 1971, 114 ; Al-Kabs, 12 March 1990 ; Nomas, 1988, 340)*.

Of these sources Waterbury and Clawson can be regarded as objective. Al-Kabs and Nomas are likely to have taken an Iraqi perspective which could tend to de-emphasis Syria water needs. The most important data are those relating to likely irrigation water needs in Syria. The Kolars and Mitchell data seem realistic in the light of experience in the 1970s and the 1980s and available technology.

The limited irrigation water needs of Syria are an important element in the water balance equation for the Euphrates system. Even assuming a high level of average water use per hectare the water demand for irrigation would only be 7.5 billion m^3 per year which could be regarded as a negotiable share of the water in the Euphrates and its Syrian tributaries.

D1.3 The utilization of the Euphrates river by Iraq

Although in oil-rich Iraq agriculture accounts for less than 10 per cent of the GNP in an economy which is dominated by the petroleum industry elaborate plans and efforts have been made to continue to manage the rivers. Nevertheless, Iraq remains a net importer of food despite the Iraqi government's declared aim to reach self-sufficiency in agriculture. To achieve this, the most probable policies adopted will be expansion of the area under cultivation and improvement in irrigation water supply *(EIU, July 1980, 56).* Iraq's economic potential is enormous. It has the second largest oil reserves in the world, a large area of relatively fertile land in terms of its domestic food needs, extensive cultivable areas available for reclamation and irrigation, an abundant supply of water and vast quantities of phosphates in addition to other raw materials. Nevertheless, the fertility of Iraq's soils is a complicated issue. Its rainfed regions are difficult to manage because of the unreliable rains. Its irrigable lands have generally poor soils which experience similar problems to those of Syria and much more serious salinity. Despite its dependency upon earnings from petroleum exports, almost all of its industry is based upon food processing and textiles.

Observers tend to believe that Iraq's position is somewhat unique with respect to the water issue on account of the importance it attaches to self-sufficiency in every field. With a population of over 19.5 million in 1991 and a high birth rate, Iraq sees agricultural self-sufficiency as vital and, since 1980, about 20 million Iraqi Dinars have been invested by the government in agriculture and related industries including an agricultural reform programme carried out in 1987. According to the "8 Days Report" (1981) the Iraqis became convinced that they would become the food basket of the Gulf once oil ran out, on condition that they continued to develop their agriculture *(8 Days, 24 December 1981, 53).*

In 1980 despite producing 2.22 million tonnes of cereals, Iraq still had to import 2.48 million tonnes to meet its internal consumption needs.

The main systems providing water for irrigation are based on the Euphrates and the Tigris and officials in Baghdad share the belief that, once the waters of the Euphrates and the Tigris are fully utilized through dams and reservoirs, the area of cultivated land in Iraq will be almost doubled (1985 figures show cultivated land at 3.6 million ha). For Baghdad agricultural sufficiency is not seen as an isolated issue, since Iraq considers self-sufficiency in agriculture a matter of national security and political stability or, at least, as a prime component of such security *(Briefing, 15 January, 1990, 7).* Al-Hadithi (1979) calculated that the application of modern techniques to irrigation and agriculture, would allow the irrigated area of Iraq to be multiplied to three times the present with the available water resources alone; and the average net benefit coming from one hectare of cultivated land could be made 3.5 times higher than at present *(Al-Hadithi, 1979, 184).*

Iraq has a relatively small population, but has the largest number of inhabitants of the three riparians living within the Euphrates valley. In 1990 Iraq also contained the greatest area of irrigated land within the basin but faced the most severe agricultural and water-related problems of the three riparians. Iraq's great land and water resources appear to offer the possibility of rich agricultural development, and its hydrocarbon endowment seems to provide the financial resources for investment generally and for rapid industrialization *(EIU, July 1980, 59).* However, Iraq has never enjoyed long periods of stability. In 1990 the agricultural sector produced a bumper cereal crop following favourable rains which, in view of the UN sanctions imposed on 6 August, was critically important. Wheat production was 1.2 million tonnes and barley 1.9 million tonnes figures which were 75 per cent up on 1989, a rather poor year. The normal consumption of wheat was about 3.5 million tonnes per year and the largest share of barley was grown for livestock but, in general, Iraq was producing about one-third of the grain it needed. In the years before the invasion of Kuwait, Iraq imported about 70 per cent of its food measured in calories and 80 per cent measured in value. In 1989 it imported 2 million tonnes of wheat, 500,000 tonnes of rice, 350,000 tonnes of flour, 320,000 tonnes of maize, 600,000 tonnes of sugar, and 280,000 tonnes of palm oil *(The Middle East Review, 1991-92, 69).*

The war with Iran caused Iraq to make a greater effort to improve agricultural self-sufficiency and reduce its food bil- but the results were poor. Throughout the 1970's and 1980's, enormous resources (many billions of dollars) were put into very expensive irrigation and land reclamation schemes which, by 1990, had not had any significant impact on overall crop production. The UN embargo has given Iraq its biggest push yet towards achieving self-sufficiency in food. Meanwhile food production in 1990 was lower than it was thirty years before since neglected irrigated land could not be brought back into cultivation quickly because of the salinity problem. The Kuwait war resulted in the disruption of electric power generation throughout the country which in turn curtailed the pumping of water for both agriculture and domestic purposes. Under these circumstances it is difficult to estimate the effect of the impairment of facilities on the effectiveness of agricultural activity.

By 1990 there had long been a shortage of labour in agriculture (which still employed one-third of the work force) and the need of the army for men competed with the needs of the land. A feature of Iraqi agriculture, and particularly irrigated agriculture in the late 1970s and the 1980s was the contribution of Egyptian farmers to the rural work-force. It is difficult to estimate the numbers of Egyptian working on Iraqi farms and government irrigation schemes out of the 2.5 million or so Egyptians in Iraq during much of this period but it was likely to have been over 500,000. Iraq lost hundreds of thousands of the Egyptian farm labourers who fled the country after the 1990 Kuwait crisis. According to The Middle East Review (1991-92), it seems likely that Iraq and its people could have survived beyond 1991 (and perhaps much longer) on the food front provided their own wheat production held up. Bread was a vital issue and in September 1990, Iraqi farmers were ordered by the government to plant 80 per cent of their land with wheat *(The Middle-East Review, 1991- 92, 69)*. On 3 December 1991, the Iraqi prime minister Mohammed Hamzah, affirmed that the Western coalition countries had used the critical importance of food in people's lives as a weapon through imposing an economic blockade *(SWB, 5 December, 1991, 8)*.

Iraq, being a lower Euphrates riparian country, is in a very vulnerable position vis-a-vis Turkey and Syria. In order to estimate the average "natural" river flow, it is necessary to add the amounts of water diverted from the flow measured at several points below all major tributaries. Clawson (1971), using a report from the International Bank for Reconstruction and Development, in which estimates of irrigation diversions in Turkey, Syria, and Iraq were made, estimated "natural" river flows as follows. The measured river records at Hit Iraq for the period 1937-1964 showed a total average of 29.24 billion m^3/yr., net diversion in Turkey plus the "return flow" from irrigation) was 1.49 billion m^3/yr.; and the net diversion in Syria of 2.96 billion m^3/yr. According to this account, the total "natural" amount of Euphrates river flow at Hit should be 33.69 billion m^3/yr. *(Clawson, 1971, 205)*. According to the GAP master plan, the annual "natural flow" data of the Euphrates at Belkiskoy gauging station on the Syrian border between 1940 and 1980 was 30.34 billion m^3/yr. *(GAP, 1990, Vol. 4, 30)*. The discharge value of the Sajur, Balikh, and the Khabur in Syria was about 2.05 billion m^3/yr., so the average "natural" river flow in Hit Iraq could be estimated to be about 32.4 billion m^3/yr. - a figure 1.2 billion less than calculated by Clawson. Ubell (1971), Beaumont, (1978) and Gischler (1979), use the amount of 31.8 billion m^3/yr. as the annual average volume of flow from

1931 till 1969 *(Ubell, 1971, 3; Beaumont, 1978, 35; Gischler, 1979, 100)*. Kolars & Mitchell (1991) based their research on the 49-year records provided by Al-Hadithi for Hit for an annual average of 28.4 billion m^3. The average difference is 2,460 million m^3, more at Hit than in Birecik Turkey, based on 27 years of measurements (1937-1963) and this figure is lower than Ubell's values by about 3.4 billion m^3/yr. *(Kolars & Mitchell, 1991, 104-113)*. Abbas' figures which are based upon 46 years of measurements show an average flow of 29.26 billion m3 at Hit in Iraq *(Abbas, 1984, 90)*. Another source, the Haigh Commission Report (1951), estimated the average annual water surplus of the Euphrates river in Iraq, based on 22 years of measurements (1925-1946), at only 26.4 billion m^3 *(Haigh, 1951, 39)*. Nomas' figures which are based upon 24 years of measurement from 1956 to 1980 show an average flow of only 26 billion m^3 at Hit in Iraq *(Nomas, 1988, 338)*. As it is analysed in figure D1.2 it appears that the most reliable figures are those of Ubell, Al-Hadithi and Abbas which show the average flow to be 29.3-31.8 billion m^3 and if we take the average of the figures the natural flow of the river is 30.5 billion m^3.

According to Al-Dahiri (1969), the most important areas irrigated by flow through canals from the Euphrates river can be designated as follows: the middle Euphrates area, the Hindiya barrage area, and the lower Euphrates area. The middle Euphrates canals are in the central parts of the country where the Tigris and the Euphrates flow close to each other, taking off water from the bank of the Euphrates river about 160 kilometres below Ramadi. The irrigation canals in these areas are the Saglawiya, Abu-Ghraib, Youssifiya and Latifiya, all which run roughly parallel courses between the two rivers and which actually irrigated about 95,000 ha. of land in 1945. The Hindiya barrage canals are the Hilla and Kifi canals on the left bank of the Euphrates and the Hussainiya and Bani Hassan on the right bank. There are two small canals taking off water from the left bank near the city of Musayab called the Musayab and the Nasiriya canals and, 36 km above the barrage on the left bank, is the Iskandaria branch. The total irrigated area in 1945 was about 186,000 ha. The lower Euphrates canals, mainly the Shamiya and the Kufa start from below the Hindiya barrage and end in the lake of Hore Al-Hammer. According to these figures the total area along the Euphrates river actually irrigated in 1945 was about 281,000 ha. *(Al-Dahiri, 1969, 122)*.

Another source, the Haigh Commission Report, made in 1949 after some three years of field investigation, estimated the total gross area in the Euphrates valley available and suitable for cultivation to be about 2.28 million ha. Only 1.17 million ha. of this total was under cultivation, and only 447,250 ha. were actually planted annually with winter crops, while most of the rest was left fallow. The report states that, with the installation of flood control works, water storage, drainage, land reclamation, new irrigation canals and the improvement of existing canals, one million ha. more could be irrigated, bringing the possible total to about 2.17 million ha. *(Haigh, 1951, 8)*. According to the KTAM report made by a New York engineering firm in 1952, the total arable and irrigable area in the Euphrates valley amounted to 1.92 million ha., of which 1.22 million. ha were cultivated under the fallow system, generating an annual water requirement of 6.1 billion m^3. Furthermore, another 700,000 ha. of arable land could be brought under irrigation *(Quabain, 1960, 61)*. According to Al-Khashab (1958), the gross total irrigation area in the Euphrates valley amounted to 1.2 million ha. of which about one million ha. were cultivated in 1955 with an average annual water consumption of slightly over 9.6 billion m^3. The greater part about 9.57 billion m^3 was consumed by irrigation, 26 million m^3 was consumed for domestic uses, and 7.7 million by municipal industry. The future annual demands for Euphrates water would be 13 billion m^3 according to the same source *(Al -Khashab, 1958, 97)*. Turning to another source, Al-Hadithi (1979) claims that the total area of the Euphrates basin in Iraq that was under irrigation at the end of the 1970s, was about 1.54 million ha. using an average of 16 billion m^3 of water annually *(Al-Hadithi, 1979, 6)*. The estimates of water use by Iraq range, therefore, from 6.1 billion m^3 per year in the 1950s to 16 billion m^3 per year in the 1970s and projections suggested that 17.4 billion m^3 per year would be used in the year 2000 (see table D1.12).

The estimates of irrigated land in Iraq's Euphrates basin, show considerable differences from the figures gathered by researchers from the forties to the seventies. These differences are as large as half a million hectares. Even bigger differences can be found in figures for the agricultural potential of the Euphrates basin which reach as high as one million hectares. It seems that this discrepancy in the figures is principally because of different definition of the agricultural land potential, inaccurate data and different definitions for the area found to be being worked agriculturally which, perhaps, arises out of the large amount of extensive agriculture. Actually in the figures which present the potential for irrigated land in the Euphrates Valley, the figures presented by the Iraqi government are the lowest and it appears that they are the most reliable. According to the Iraqi Ministry of Planning data, the annual irrigated area in the Euphrates basin in the year 2000 will be 1.05 million ha. compared to 926,000 ha. in the 1970s while the annual water required for irrigation will be 15 billion m^3/yr. compared to 12.4 billion m^3/yr. in the 1970s *(Al-Hadithi, 1979, 106)*. This figure is lower than figures calculated by other researchers and this also impresses one as being the most reliable and reasonable figure for Iraq's water needs. This amount, however, is similar to the average amount of water calculated from the maximum to the minimum as presented by Al-Hadithi.

The discharge of the Euphrates varies widely from year to year but, until 1952, very little was done to control the periodic flood menace. The worst recorded flood of the Euphrates, in 1966-67, had a maximum discharge of 63.4 billion m^3 at Hit, and the lowest discharges was 10.7 billion in 1929-30 *(Kolars & Mitchell, 1991, 102)*. As a result the Iraqi Development Board gave first priority in its programme to flood control projects. According to Beaumont (1978) a striking feature of Iraq since the 1940s has been the increasing use of the water resources of the Euphrates, largely for irrigation purposes. Ubell (1971) quoted an average figure for water withdrawals of 16,363 million m^3/yr. between Hit and Hindiya for the 10 year period from 1960 to 1969. Ubell also quotes an average figure of 13,300 m^3 per hectare/yr. Both Ockerman & Samano, (1985), and Al-Hadithi (1979) have claimed that the withdrawals amounted to about 16,000 m^3 per hectare/yr. and this implies that, about 1.23 million hectares were irrigated between Hit and Hindiya. These figures, however, do not give any indication of the amount of water abstracted downstream from the Hindiya barrage or upstream from Hit, where little irrigation was carried out *(Ubell, 1971, 49: Beaumont, 1978 , 37: Al-Hadithi, 1979, 6; Ockerman & Samano, 1985, 193)*. According To Al-Khashab (1958), the potential evapotranspiration is more than 1,200 mm/yr. depth over the estimated area cropped. In addition an allowance of 35 per cent of the diversion requirement may be added for justifiable waste, conveyance and application; and this would increase the water required to irrigate to about 1,700 mm/yr. depth *(Al-Khashab, 1958, 99)*. The figure for the highest amount of evaporation, (and the most detailed), is presented in the doctoral thesis of Nomas (1988). The calculations are based upon the average evaporation at Haditha, Habbaniya, Diwaniya, Nasiriya and Basra. Accordingly the average annual evaporation in the Euphrates basin in Iraq reaches 2.5m a year *(Nomas, 1988, 329)*. By 1970, according to Waterbury (1990), Iraq was already using about 18 billion m^3 of irrigation water per annum, or the equivalent of about 60 per cent of the natural discharge of the Euphrates *(Waterbury, 1990, 8)*. Despite the findings of these experts, in 1973 Syria claimed that Iraq's actual irrigated area was only 835,000 hectares and not the 1.2 million claimed by Iraq making its water needs no more than 12 billion m^3 *(Waterbury, 1990, 17)*.

Here we also see a very great difference in the figures of different experts and it seems that this variance arises out of inaccurate data published from time to time by the Iraqi government and, in addition, considerable differences between agricultural potential, the development plans and their implementation.

Al-Hadithi claims that an improvement of the existing irrigation system and field practice, (assuming both an irrigation efficiency of 60 per cent and an increase of crop yield by 10 per cent over the average in the 1970s) would lead to a considerable drop in irrigation water requirements to 9.36 billion m^3 per year. By adding 5 billion m^3 losses in the irrigation channels, the average satisfactory flow of the Euphrates river in Iraq in the year 2000, would exceed 16.44 billion m^3/yr. If the irrigation system improved, the transit discharge would not be required and 5 billion m^3/yr. would be saved. The domestic and industrial water required in the year 2000 would be about 940 million m^3, so the total demand would reach 10.2 billion m^3 with the improvement of the system, and 17.44

billion m^3 without improvement (see table D1.12) *(Al-Hadithi, 1979, 103-117)*. It should be noted that the efficiency figures presented by Al-Hadithi are very high and apparently take into account the re-use of water. In any case it is difficult to assume that Iraq will be capable of improving its irrigation system up to the level presented by Al-Hadithi.

Table D1.12:

Iraq - the Euphrates river mean monthly water requirement in the year 2000

Month	Irrigation water (Mm^3)	Domestic and industrial (Mm^3)	Total with improved irrigation system (m^3/sec)	Total without improved irrigation system (m^3/sec)
January	561.6	80	240	438
February	522.2	80	249	462
March	1104.5	80	442	707
April	1113.8	80	430	730
May	767.5	80	316	540
June	964.1	80	403	653
July	917.3	80	372	614
August	917.3	80	372	614
September	533.5	80	237	432
October	280.8	80	135	298
November	870.5	80	367	605
December	776.9	80	320	544
Annual (m^3/sec)			324	553
Annual (billion m^3)			10.20	17.44

Source: Al-Hadithi, 1979, 112-117

A detailed account of Iraq's development projects along the Euphrates river shows a very complex structure which includes dams, reservoirs and tens of irrigation canals as well as a clear and very large gap between the development plans and the area actually irrigated. Undoubtedly this difference between the planning and the actual execution contributes to the lack of clarity of the data concerning the amount of land irrigated and Iraq's future water needs.

There are numerous works on the Euphrates River in Iraq including water storage, water diversion and conveyance systems for irrigation.

The Ramadi Barrage: Work on this barrage, which is located across the Euphrates and is 209 meters long and fourteen meters high, began in 1953. The barrage arrests the upstream water of the river and thus reduces the flood danger while the excess flood water is diverted to the lake through the Warier regulator which, together with the Warier Inlet

Canal, was completed in 1952. The canal, which is 8.5 kilometres long, connects the river with the lake, and the 10 kilometre long Dhibban Outlet Canal and Regulator, (completed in 1951) connects the lake with the Euphrates. Its purpose is to feed the river from water stored in Lake Habbaniya during the dry season. The Majjara Escape Canal, (completed in 1945) is 8.2 kilometres long and connects the lake with the Abu Dibbis depression which is a natural depression with no outlet canal and is used only for flood control purposes. The Abu Dibbis depression, which is about 30 metres below the average flood level at Ramadi and extends over an area of about 150 km^2, attains a retaining capacity in the lake of as much as 10 billion m^3 at its higher storage level *(Quabain, 1960, 65)*.

Lake Habbaniya serves the dual purpose of being a flood escape and a storage reservoir. The lake is a large depression 25 kilometres long, and 12 kilometres wide and, until 1956, had a storage capacity of 1.3 billion m^3. In that year, work on raising the dikes from 49.5 to 51 metres above sea level was completed, giving it a storage capacity of 3.25 billion m^3 *(Al-Hadithi, 1979, 9 ; Al-A'ni, 1977, 35; Quabain, 1960, 64)*. The estimated annual evaporation from the lake is 1.08 million m^3 *(Nomas, 1988, 332)*.

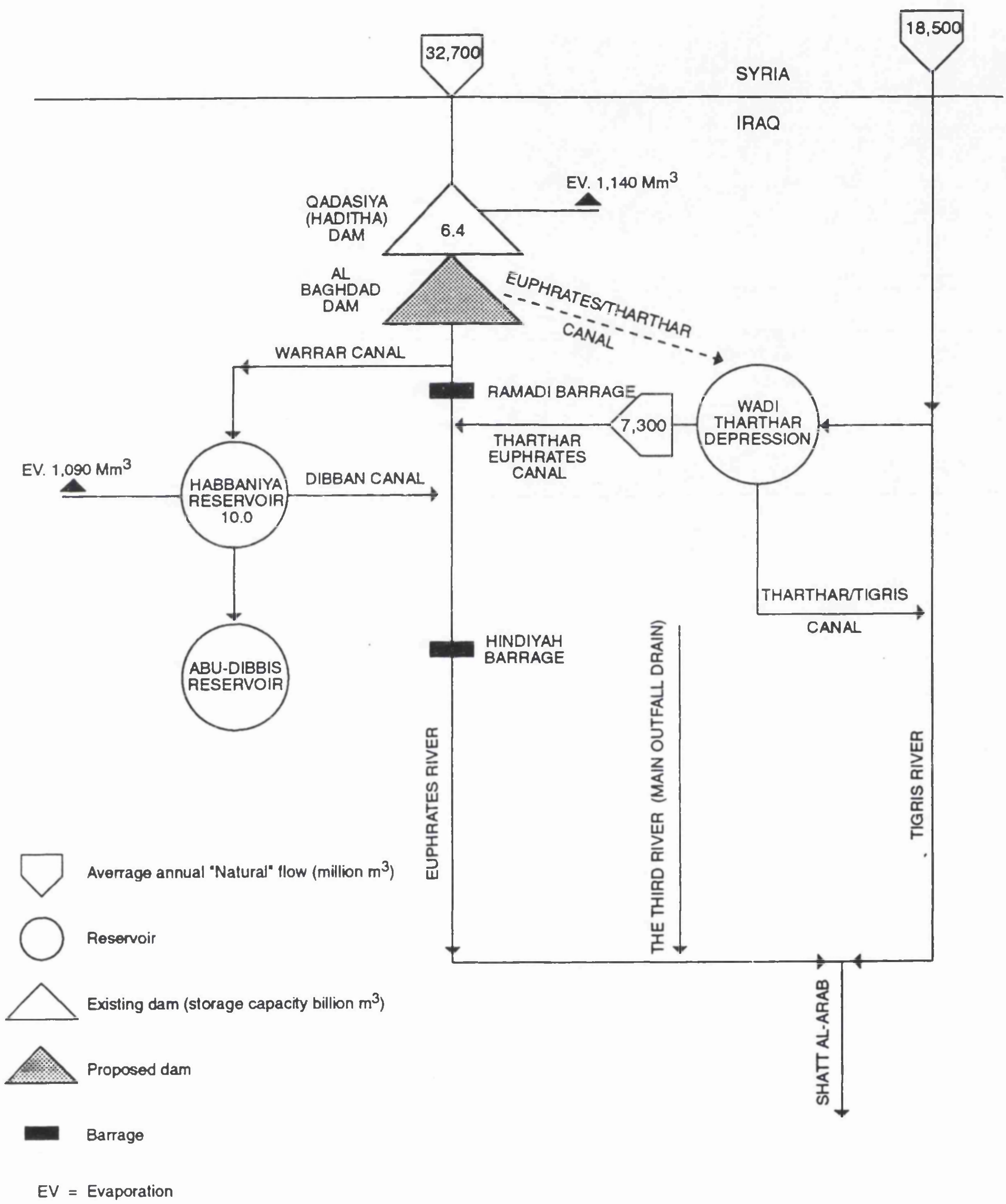
The Hindiya barrage, completed in 1913, is the oldest barrage in Iraq, and diverts water from the Hindiya branch of the Euphrates into a canal that was expected to irrigate 750,000 ha. in the Euphrates Basin, but actually irrigates only half this area *(Al-A'ni, 1977, 35; Quabain, 1960, 71)*. According to McLachlan, no less than 40 per cent of the land is uncultivated as a result of salinity problems *(McLachlan, 1976, 48)*. The Hilla canal system, a network of 13 canals that draws water from the Hindiya branch, is commanded by the Hindiya barrage and is the largest canal in Iraq served by a single intake.

Abu-Ghurib Canal: The First important project started by the Iraqi Irrigation Department was the digging and opening of this canal since the old canal had silted up as a result of neglect. The canal which was designed to irrigate about 66,000 ha. was opened in 1935 to take water from the Euphrates river south of the city of Fallouja to near by Baghdad *(Al-Dahiri, 1969, 116)*.

The Baghdad Canals: These are five canals that draw their water from the Euphrates and flow towards Baghdad along the Tigris because of the natural slope of the land; they cover an area of 211,000 hectares, but actually irrigate 102,000 ha. *(Al-A'ni, 1977, 35)*.

The Greater Musayyib Project: Work on this project in an area 10 kilometres to the north of the Hindiya barrage began in 1953 and was completed in 1956 bringing 33,480 ha under irrigation including 20,000 ha of arable land *(Al-A'ni, 1977, 439)*. The work consisted of two parts: first, enlarging, remodelling, and extending the old canal, (which was 50 km long, had twelve lateral canals, and a 500 kilometre network of small canals) and second, providing full drainage facilities for the areas to be irrigated *(Quabain, 1960, 72)*.

Figure D1.7:
The Euphrates river in Iraq: major water projects



Sources: U.S. Army Corps of Engineers, 1991; Nomas, 1988; Al-Hadithi, 1979

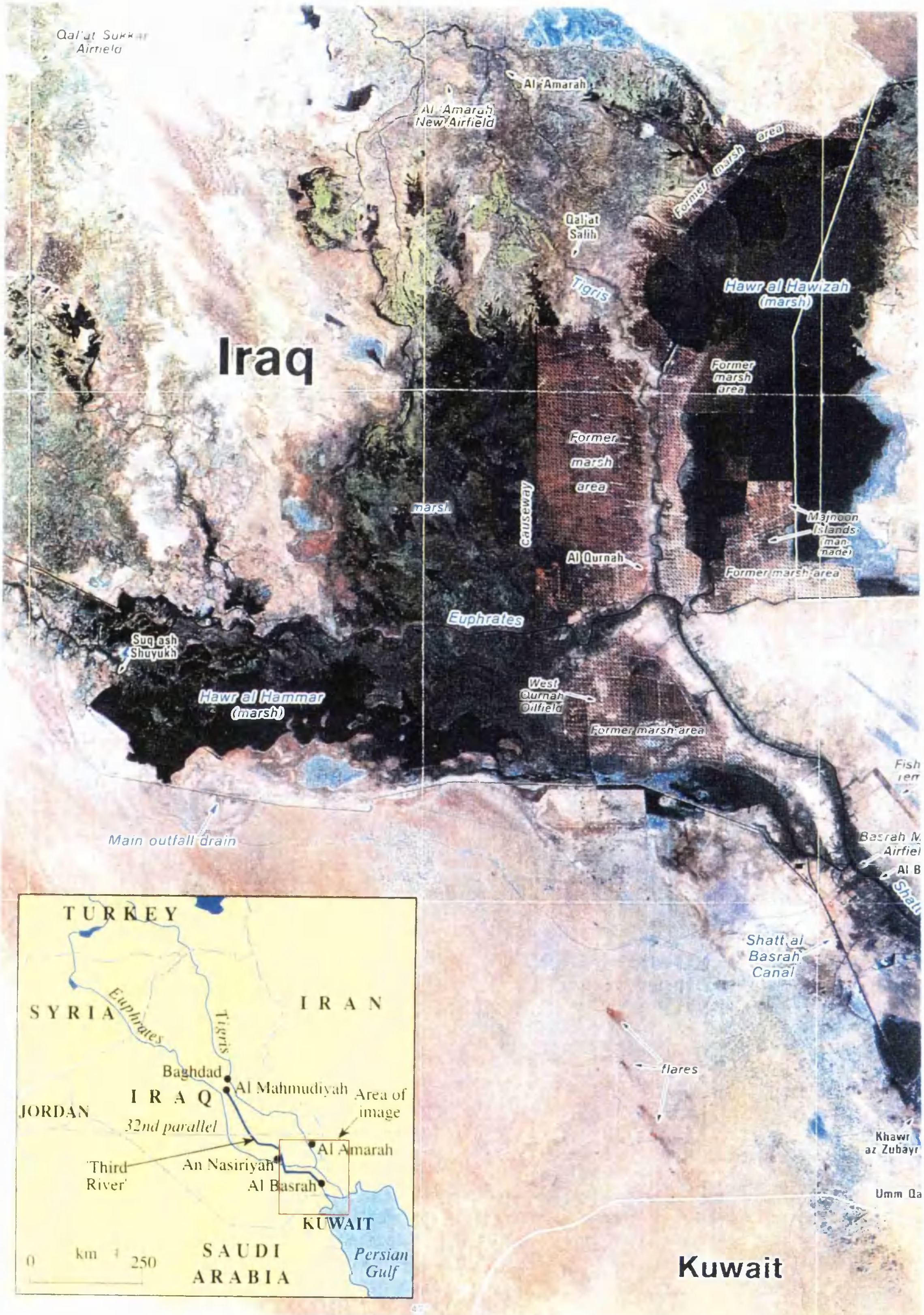
Euphrates Tail Regulators: This rice-growing area above Lake Hammer, suffers from constant erosion which has made the bed of the Euphrates there so low in relation to the silted land that water distribution in the dry season has become almost impossible. To control erosive action, and to raise the water level in the river when needed, five regulators were installed on the tails of the Euphrates before Lake Hammer. The project began in 1954 *(Quabin, 1960, 72).*

Tharthar-Euphrates Canal: This is a canal that stretches between the Tharthar lake, near Sàmara, and the Euphrates river. The storage capacity of the lake is 85 billion m^3, in a reservoir extending over 2,050 km^2, but the Tharthar project also reserves about 22 billion m^3 of water which may be used for irrigation *(Al-Dahiri, 1969, 121).* In 1976, the Iraqi government completed the 37.7 kilometre long Tharthar-Euphrates canal which has a capacity of 1,100 m^3/sec. The project, which is intended to feed the Euphrates from the lake and save Baghdad and the central and southern reaches of the Tigris from floods, was due to be completed in 1976 *(Al-A'ni, 1977, 419).* In 1977 work started on the construction of the Tharthar-Tigris canal to discharge water from the Tharthar- reservoir back to the Tigris river. A canal from the Al- Baghdad Dam (begun in 1990) on the Euphrates to Lake Tharthar will make it possible, in turn, to remove water from the Euphrates to the Tigris *(Kolars, 1991a, 12).* As of the year 1990, the discharge of the Tharthar canal ranges from 150 m^3/sec to 500 m^3/sec, according to the flood in the Tigris river and the irrigation requirements of the south part of the Euphrates. The water quality of the Tharthar lake is improving due to the continues addition of fresh water from the Tigris river, especially during the flood season *(AMER, 1992, 3).*

The Third River Canal Project (the Leader River): According to Radio Baghdad (16 May, 1992) the Third River Canal Project (Marsh al-Am) which stretches from Baghdad to Basra, will be 565 km long and will help irrigate 1.5 million ha of agricultural land in the basins of the Tigris and the Euphrates rivers *(SWB, 26 May 1992, A1/2; North 1993, 11).* This could increase Iraq's crop production by up to 50 per cent *(Pearce, 1993, 12).* Studies for the project were ordered as early as 1952 from American firms and work began a year later but was interrupted because of the 1980-1988 war with Iran. The project also aims to rid agricultural land in the region of high salinity. The Third River is linked to a number of drainage canals near Baghdad and work on the project covers the execution of a large drainage network which stretches from the Ishaqi drainage canal up to Shatt al-Basra to finally flow drain into the Third river basin.

Photo 9:

Iraq - satellite image of the Third River (August 1992)



Source: North, 1993, 13

The main canal will be 8m deep, 90m wide, have a base width of 36m and will pass through Hawr al- Hammer and Hawr al-Likkab lakes. A large pumping station with a capacity of 220 m^3/sec will be built to pump the water from the Euphrates river, and the Third River could be used for river shipping activities, such as the transportation of goods from the Shatt al-Arab to the city of Numaniya *(SWB, 26 May 1992, A 1/2 ; SWB, 16 Jun., 1992, A 1/2 ; MEED, 10 July, 16)*. On 25th August 1992, Iraq announced that it would complete the "Third River" project by the end of August 1992, and thus create another river in addition to the Tigris and Euphrates *(SWB, 28 August 1992, A/9)*. The final result would be to provide Iraq with the urgently needed food that it has been denied under the UN embargo after its invasion of Kuwait in August 1990. The project would drain the southern marshland, where Shi'i opposition groups are active *(SWB, 28 August 1992, A/9; SWB, 16 August 1992, A/7)*. This is the main reason for international reaction to the project being mainly based upon political arguments for building it and less upon the economic needs of Iraq. According to North (1993) they will be completely dry by the end of summer 1993 *(North, 1993, 11)*. An analysis of a recent US satellite image taken in August 1992 clearly shows the course of the Third River marked here as the "Main Outfall Drain" (see photo 9).

The Qudisia (Haditha) Dam: According to the EIU report (1987-88) the strategy of the Iraqi government in recent years has been to compensate for the construction of new dams upstream in Turkey and Syria by providing over year storage inside Iraqi territory *(EIU, 1987-88, 23)*. The dam also releases the Habbaniya reservoir from its flood control function, which will increase its efficiency for irrigation purposes *(Al-Hadithi, 1979, 10)*. The policy of extending more effective control over Iraq's water resources has already brought benefits and, in the summer of 1984, the Iraqi government was able to release stored water to farmers, to offset the low level of the Euphrates *(Fisher, 1991, 480)*.

The construction of a 660 MW hydro-electric power station at the Haditha dam (renamed the Qadisiya dam) on the Euphrates river was started in 1981 by a Yugoslavian construction firms, 70 km from the Syrian-Iraqi border *(The Arab Economist, October 1981, 6 : 8 Days, March 1981, 21)*. The construction of the 6.4 billion m^3 dam was completed in 1985 *(Ockerman & Samano, 1985, 194)*. The estimated annual evaporation from the lake is 1.13 billion m^3 *(Nomas, 1988, 332)*.

According to Al-Hadithi (1979) the engineering-geological-topographical features and problems of the Qadisiya dam are rather complex. Gypsiferous rocks, extensive karst, and a high percentage of clay have all complicated the construction of the project and since the ground surface of the reservoir area is almost flat, it makes the surface of the reservoir very large and the lake shallow, which will cause a tremendous amount of water loss from evaporation. Trapping of the sediments by the Qadisiya reservoir will change the balance of sediment discharge in the Euphrates river downstream from the dam, and this will change the river's width and depth and affect the activities on the river banks. The benefit of Qadisiya reservoir for irrigation is negligible and the only benefit is hydro-power and regulating the river flow *(Al-Hadithi, 1979, 10).*

The Al-Baghdadi Dam: Another hydro - electric power plant was planned in Al-Baghdadi dam on the Euphrates river, 40 km downstream from the Qadisiya dam. The work started in 1990 and stopped one year later due to the economic situation resulting from the Gulf War and the UN sanctions *(AMER, 1992, 32).*

D1.4 Analysis of the current and future overall supplies and demands of water - the Euphrates system

Turkey

As expected, it seems that Turkey, as the upstream state, is the least dependent upon the Euphrates. Even with the development of the GAP project, the great bulk of Turkey's agricultural production will take place outside the Euphrates river system. Politically, however, the GAP is very important to the Turkish government, since, not only is Southeast Anatolia Turkey's poorest region but it also contains the bulk of Turkey's Kurdish population, and has been the object of cross-border terrorist attacks by militant Kurds from Iraq and Syria. Turkey hopes that this difficult political situation can be stabilized by improving the local standard of living and ending the support of the local population for the Kurdish separatist movement. Turkish officials are more and more conscious that psychological propaganda, in the sense of treating the people well and winning their support, may be even more important than overt military threats *(Briefing, 27 January, 1992, 7; Kolars, 1991a, 4; MEED, 13 October, 1989, 5).* According to Waterbury (1990), Turkey hopes to swamp Kurdish national sentiment with regional development and prosperity and it may even hope to dilute the Kurdish population by attracting large numbers of non-Kurdish people to a region that could act as an economic growth pole *(Waterbury, 1990, 9).* The Turks reject this claim completely and argue that the development projects, at best, will slow down the process of migration by the Kurd residents of the area and will certainly not lead the Turkish population to migrate to the South-east of the country.

In line with the criteria of optimality and rationality, Turkey maintains that the three countries have to develop joint projects based on scientific principles, the aim being best usage for all concerned. For example, Turkish officials note that Turkey is introducing modern irrigation techniques, mainly based on sprinkling methods, in conjunction with the

GAP project, whereas Syria and Iraq use open canal techniques stretching back to Sumerian times, (which lead to a wastage of water of up to 50 per cent due to evaporation) *(Briefing, 2-9 July, 1990, 10).* According to the Turkish officials, the technology used in the large, Soviet built Tabqa dam on the Euphrates in Syria, is also a source of serious wastage. This dam was built for "Siberian" conditions, where the melting of the snows provides a plentiful water supply, but it is not suited to the conditions prevalent in the Euphrates basin because the turbines are built too high, which means that a small drop in the water level puts these turbines out of action. In order to compensate for this, more water has be pumped to keep the turbines going *(Briefing, 26 March, 1990, 18).* It has also been claimed that, in an attempt to meet the electricity needs, Syria has allowed water to flow through the dams in an uncoordinated manner, leading to shortages in water for irrigation *(Briefing, 10-17 July, 1989, 6).* In 1980, to alleviate the problem of fresh water shortage and to share its surplus water with southern Arab neighbours, former President Turgut Ozal proposed the building of a "Peace Water Pipeline" to export fresh water from the Ceyhan and Seyhan rivers in Anatolia. The project, however, failed to take off and, in mid-1991, the UAE said it had been abandoned in favour of desalination plants. Analysts say that the Kuwait crisis has increased the Gulf states' reluctance to rely on other regional countries for such an important resource *(MEED, 7 February, 1992, 7).*

The GAP abstraction from the Euphrates might represent from a third to more than one half of the Euphrates "natural flow", but the lowest total amount of water used is estimated at about 10.4 billion m^3 per annum, according to the GAP Master Plan *(Bagis, 1989, 5 2-70).* This also assumes that no more than 1.1 million hectares will be irrigated. It seems that these figures do not include evaporation from the reservoir, domestic usage and industrial use, so the total water utilization plus losses in Turkey could reach up to 14 billion m^3 per annum. The highest amount used by Turkey is that calculated by Kolars & Mitchell (1991) who claim that sometime after the year 2000, the Euphrates irrigated area will be 1,350,243 ha. If all goes according to schedule, by the year 2000, the annual water utilization would be 12.4 billion m^3 and, sometime after that date might even soar to 16.9 billion m^3/yr. *(Kolars & Mitchell, 1991, 221).* Another technique used to attempt to calculate the amount of water demanded by Turkey for its future development plan, is a calculation of the amount of water Turkey has committed itself to giving Syria: 500 m^3/sec. *(Briefing, 2-9 July, 1990, 10).* This amount is equal to 15.8 billion m^3/yr. while the river's "natural" flow, according to GAP, is 30.3 billion m^3/yr., so the total amount of water that Turkey will use, according to this calculation, is about 14.5 billion m^3/yr. This figure is 2.5 billion m^3 lower than the figures shown by Kolars. Despite this it seems that the amount of water needed for irrigation one hectare has been presented in a minimalistic way by Turkey.

Since Kolars & Mitchell studied the GAP project without reference to the overall picture which one gets from the GAP Master Plan one could assume that the figure of 14.5 billion m^3 is better. This amount also corresponds with the water sharing agreement made between Turkey and Syria. Although this figure is 40 per cent higher than Turkey's water data which "forgot" to mention both the evaporation figures and the industrial and domestic needs, it should not create any deviation from the water sharing agreement. Similarly Turkey has various alternatives which can be evaluated in regard to their usefulness as both sources of agricultural produce and the production of hydro-electric power.

The GAP Master Plan, completed in mid-1989, contains several options for irrigation development works such as treating irrigation as an exogenous factor to change the entire structure of the region and uses these data for development projections in the region. Under the first option, the entire area originally planned by DSI would be irrigated by the Euphrates and the Tigris rivers, which implies that part of the energy production would be lost. According to this option the total GAP area to be irrigated from both rivers would be 1,641,282 ha, and the electrical energy production would be 25,018 GWh. The opposite option would aim to maximize energy production and provide irrigation to priority areas only. In another option, the irrigated area would be only 894,460 ha, and the electrical energy production would increase to 29,793 GWh *(Bagis, 1989, 123)*. This option would allow Turkey to increase the amount of water that flows to the downstream states. According to the Turkish Briefing weekly magazine (1990), and Ergil (1991), Turkey plans to irrigate 59 per cent of the GAP area which amounts to some 1,062,725 ha, whereas the additional amount of land that could be irrigated in the region (but which will not benefit from the Euphrates) is said to be 733,843 ha. *(Briefing, 15 January, 1990, 7 ; Ergil, 1991, 55)*.

It is clear that the river development plan is vital to Turkey from many points of view. It, however, appears that the Turks themselves do not yet know what is the total volume of water they will need. The size of the agricultural area which will actually be irrigated as opposed to that plan is not yet known, nor is the required amount of water for each agricultural hectare - which relates to the method used and crop rotation which has not yet been decided upon. It does not appear that Turkey will use more than 14.5 billion m^3 annually by 2025 on the basis of evaluation of a wide range of estimates, based on equally wide ranging assumptions concerning levels of water affected on irrigated land, (see chapter D1.1). These estimates ranges from 10.1 billion m^3 (see table C1.8) to the unrealistic 16.9 billion m^3 (see figure D1.8) of pessimistic Iraqi scientists and journalists.

Syria

By at least one measure, Syria is the most dependent of the three states upon the waters of the Euphrates since it is the only major river with perennial flow crossing Syria's territory. Agricultural development in the hinterland west of Aleppo is contingent upon harnessing this water or leaving cultivation at the mercy of a highly variable rainfall.

In contrast to Turkey, Syria relies substantially on Euphrates water for drinking, irrigation and industry because the Euphrates accounts for about 85 per cent of the nation's surface water resources. According to The Economist report (1989), Syria, with a population growing at 3.7 per cent per year, would be running short of water for agriculture by the end of the century even if the GAP project in Turkey did not exist *(The Economist, 16-22 December, 1989, 56)*. This statement by the Economist is a very unsound analysis as Syria will suffer a water shortage, in terms of its capacity to utilise water. This does not mean that Syria will be able to irrigate sufficient land to be agriculturally self-sufficient. However, it is not water availability which is the constraint. Syria will, undoubtedly be increasingly dependent upon the Euphrates river in the future.

The Euphrates once seemed to offer an answer to Syria's search for new farm land, additional sources of domestic water, and increased supplies of energy. There is simply too much good water in the Euphrates for Syria to ignore it or to turn to inferior alternatives. Syria still remains heavily dependent any available agricultural resources limited as it is by the aridity of the country's interior but ambitious plans for irrigated agriculture which are dependent upon the waters of Lake Assad have been severely curtailed.

While the Euphrates is by far the largest perennial source of water in Syria, its use for both irrigation and power generation has failed to meet that country's expectations although access to its water remains a prime concern of the government and people of Syria.

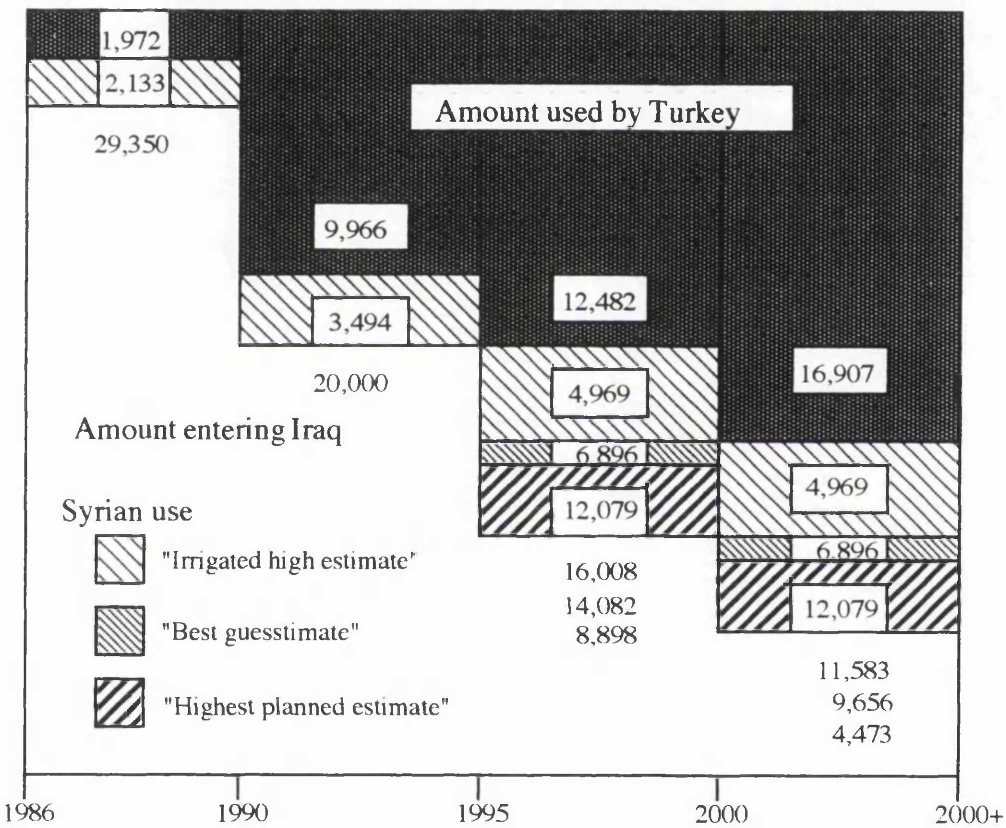
According to Syrian officials, 640,000 ha. of land is planned to be irrigated from the Euphrates, but as we have seen the agricultural area which Syria is capable of irrigating is actually much smaller; and a reasonable estimate is 411-483 thousand ha.. The amount of water needed by Syria to irrigate this area, including the loss of water through evaporation, would reach 6.9 - 7.5 billion m^3 annually. Syria has also failed to reach its targets for the production of electricity from the Tabqa Dam and, in 1990, the dam only produced ten per cent of its potential.

The question one must ask is how much of the natural flow will be available for Iraq in the future and under what circumstances. In April 1990, according to the MEED report (1991), Baghdad and Damascus signed an accord whereby Syria would take 42 per cent of the Euphrates flow once it had left Turkey *(MEED, 25 January, 1991)*. Turkey, under a protocol signed with Syria in 1987, committed itself to giving 500 m^3/sec to Syria

(Briefing, 2-9 July, 1990, 10). This amount is equal to 15.8 billion m^3/yr., but according to the Syrian-Iraqi agreement, Syria's share of this water is about 6.6 billion m^3/yr. and this amount is only 300 million m^3/yr., a figure less than the amount quoted by Kolars & Mitchell best guesstimate (6.89 billion m^3 see figure D1.8) as the total water needs for Syrian agriculture. This calculation does not take into account the Euphrates tributaries, (the Sajur, Balikh and the Khabur), which have a total additional discharge of about 2 billion m^3/yr. According to this calculation, the annual amount of water that Syria will have available from the Euphrates river and its tributaries will reach 8.6 billion m^3 and so Syria's gross water budget will not be in deficit for the foreseeable future.

Figure D1.8:

Water subtraction from the Euphrates river (million m3/yr.)



Source: Kolars & Mitchell, 1991, 212

According to Kolars & Mitchell's questionable "Highest planned estimate" calculations only about 4.5 billion m^3 will remain for Iraq sometime after the year 2000 *(Kolars & Mitchell, 1991, 212)*. According to the calculations made in this section, however, combining Turkey's potential demands of 14-14.5 billion m^3/yr., and Syria's demand of 6.9 -7.5 billion m^3/yr., we arrive at totals ranging from 21 to 22 billion m^3/yr. or nearly two thirds of the average annual "natural" yield of the Euphrates (30.8 billion

m^3). This will allow an annual amount of about 11 billion m^3 to flow into Iraqi territory from the combined Euphrates, Balikh, Khabhur flows.

Iraq

Iraq claims it needs 13 billion m^3 per year from the Euphrates for its agriculture. As we have seen, however, the estimates of water consumption range between 10.2 billion m^3 per year (the amount of water Iraq will need if irrigation improvement methods are proposed) and 17.4 billion m3 per year (without improvement in irrigation methods used today).

Iraq's big advantages over Syria are that it can add better quality Tigris water to the depleted Euphrates and the river's headwaters have not been subject to major impoundment by dams in the same way as the Euphrates. A scheme completed in 1988, allows water from Lake Tharthar, north of Baghdad, to flow by canal to the Euphrates *(The Economist, 16-22 December, 1989, 56).* However, Abdul Satar Salman, the Iraqi Deputy Minister of Agriculture and Irrigation, declared in an interview for the Kuwaiti paper Al-Kabs (1990), that the water in the Tharthar basin was saline and that irrigation from it would cause an increase in salinity levels, which would impair soil fertility and possibly cause a decrease in agricultural cultivation in the Euphrates basin *(Al-Kabs, 27 February 1990, 18).* In 1990 the Iraqi Oil Minister Issam Abdul Rahim, declared that, if the saline water of the Iraq's Tharthar Dam were used for irrigating the Euphrates basin land, a total area of 325,000 ha. of land would be made unsuitable for agriculture *(Baghdad Observer, 15 January 1990, 8).* On the other hand the longer the flow of water in the canal continues the quality of the water increasingly improves because of the cleansing of the salt.

Iraq controls the downstream and estuary areas of the Euphrates river so it feels particularly concerned about any projects undertaken in Turkey and Syria which might affect the final water flow. It seems that Iraq is mainly concerned about the years of drought in the Euphrates basin when the water volume in the river is less than the average. In such a case Iraq will be the first country to be affected by such shortages. Furthermore, any long-range Iraqi planing must consider the drought that periodically affects the river system, approximately every four years, and must be prepared for a serious reduction in available water resources. As opposed to this the enormous amount of water stored by Turkey today cancels the effect of the individual years of drought, and only a series of drought years are likely to affect the amount of water available to Iraq. The amount of water in the Euphrates varies considerably from year to year, with discharges at Hit ranging from 63.4 billion m^3 per year (1966-67) to 10.7 billion m^3 (in 1929-30). There were two severe droughts in the Euphrates area between 1937-1980, the first being in 1958-1962, when the annual flow was as low as 14,883 million m^3 (1961 being the most severe year). The second critical period began in 1970 and ended in 1975, with the lowest flow being in 1973 when the annual flow fell to 62 per cent of the annual average flow *(Bagis, 1989, 42)*. The years 1984 and 1989 were also years of severe drought. In an extended drought the upstream dams might permit only a minimal flow of water into Iraq, but this is unlikely since most of the upstream dams are power-generating rather than reservoir dams.

As we have seen the amount of water Turkey will use in the future will reach as high as 14-14.5 billion m^3 per year and the annual amount of water utilized by Syria will reach 6.9-7.5 billion m^3. Combining the potential demands of Turkey and Syria we arrive at totals ranging from 21 to 22 billion m^3/yr. This amount will allow an annual amount of about 11 billion m^3 of water to flow into Iraqi territory, an amount almost matching the Iraqi demand for Euphrates water. Eventually, this quantity of water will reach Iraq only in the years when the water volume in the river goes beyond 32.5 billion m^3. The amount of water Iraq is capable of transferring from the Tigris to the Euphrates through the Tharthar canal reaches 7.3 billion m^3 per year, therefore Iraq's water potential along the Euphrates river reaches 18 billion m^3- a quantity of water which all would agree is enough to supply the water needs of Iraq in the river basin. However, it seems that Iraq feels confident about future water availability since it reached an agreement in 1980 with Jordan to construct a system to divert 160 million m^3/yr. of the Euphrates waters to northern Jordan in order to aid Jordan to overcome its increasingly grave water deficit *(EIU, 4th Quarter, 1980, 16)*. This project has not been implemented and the developing international circumstances are not propritions for the project. The Iraqi Ministry of Agriculture and Irrigation assumes that the Turkish authorities will not keep their promise to allow the 500 m^3/sec agreed with Syria to flow. Following the water distribution accord between Iraq and Syria, Iraq should have received 58 per cent of the water and, according to the Baghdad Observer (1990), a total of seven provincial centres, 83 towns, and 4,000 villages with a total population of some 5.5 million, would be directly harmed by any decrease in the Euphrates water *(Baghdad Observer, 15 January 1990, 8)*. Iraq's deputy Minister of Agriculture and Irrigation - Abdul Satar Salman has declared that each deduction of one billion m^3, will decrease the area irrigated by the Euphrates water by about 65,000 ha.; therefore, the Ministry is of the opinion that a tripartite accord will enable Iraq, Syria and Turkey to share the water of the Euphrates in a fair and just manner *(Al-Kabs, 27 February 1990, 18)*.

D2. The quality of water

A river basin is an ecological unit (ecosystem) in which the living and non-living environment function together. Water quality is affected primarily by domestic and industrial effluents, human activities like deforestation and land use practices, leaching of agricultural chemicals and natural causes *(Biswas, 1992, 75)*. Just as agricultural activities have an enormous impact on water quality, water quality considerations have important implications for agricultural activities. With our present state of knowledge, it is simply not possible to give a reasonable picture of the status of the water quality of the Euphrates river as a whole. Water quality measurement involves complex and difficult instrumentation which is both sophisticated and expensive, as well as difficult to maintain and operate. Water quality data for the Euphrates river are less reliable than water quantity data. However, it is agreed that the quality of the water is good in Turkey, Syria and in the western part of Iraq up to the city of Ramadi, where the salinity is 250-500 ppm.

The main reasons, however, for this are that Turkey still does not use the river water for irrigation purposes and the irrigation developments in Syria have not yet been completed. The use of river water for the purposes of development throughout the world, does, teach us, however, that development has a serious effect upon the quality of the water and often for states which share river water. The relationship between the USA and Mexico was affected by the consequences of surface water development in the USA of the Colorado River which affected the amount and quality of the water *(Beaumont, 1989, 272-276)*. This river is very similar to the Euphrates from the point of view of the size of the drainage basin, the quantity of water in the river and the climate of the region. The reason for the high quality of the Euphrates flow in Turkey, Syria and in Iraq as far as Ramadi is that only a very small proportion of the water has as yet infiltrated the soil profiles of irrigation schemes. The Turkish schemes have not come on stream and the ambitions of Syria to irrigate extensive areas of the Euphrates and Khabur lowlands have encountered severe management and environmental constraints. If the Syrian and especially the Turkish schemes were to be fully implemented the quality of the water in the Euphrates will be significantly worsened unless agreements to ameliorate the impacts of drainage water flowing back into the Euphrates from irrigation schemes are put in place.

The experience in some United States schemes is of relevance and provides analogies with respect to environmental impacts as well as political adjustments. Water withdrawals in part of the Colorado River basin which is similar climaticaly to that of the proposed irrigated tracts in the GAP scheme of Turkey are much higher than those planned in Turkey involving withdrawals of about 24 billion m^3 per year compared with a figure of between 10 and 13 billion m^3 per year for south-east Turkey. The impact of the Welton-Mohawk scheme on water quality indicates the levels of deterioration in water quality which can be experienced. The Welton-Mohawk scheme is only part of the southern Colorado basin irrigation command area but it has been shown to have been responsible for a deterioration of water quality in the Colorado. The scheme was completed in 1952 and quickly became waterlogged so that a drainage project was constructed in 1961. The waste waters from the scheme were discharged into the Colorado, including salinized groundwater. The water had salinity levels as high as 6000 parts per million and since the Colorado was experiencing low flows the saline waste water increased the salinity level in the river flowing into Mexico from 800 ppm to 1500 ppm in 1962 *(Beaumont, 1989, 273-274).* Water at this level of salinity is unusable for the cultivation of most crops.

It is not possible to transfer the experience from the Colorado to the Euphrates except to infer that there will be an indeterminate deterioration in the water quality of the Euphrates through drainage from irrigation schemes. The water in the upper Euphrates is of higher quality than in the lower Colorado, but it is likely that the water quality will decline from the past low levels of unmanaged flows, at less than 500 ppm, to levels approaching 1000 ppm by the time the waters reach the irrigated tracts of Syria and Iraq.

The political and economic consequences of surface water pollution proved to be expensive for the United States. After lengthy discussions the US Congress approved in 1973 an agreement referred to as Minute 242 of the International Boundary and Water Commission. The United States agreed to ensure the quality of Colorado water and Congress authorised a budget in 1974 to construct desalinisation units to treat the waste water of the Arizona irrigation schemes. Such a precedent could be important in future relations between riparians.

Water quality has now become as immediate a problem as water quantity in the Euphrates river basin since the salinity of wells (due to over pumping, and the salination of land from increased irrigation) is a common problem and salinated acreage must be allowed to lie fallow in order to allow a period to leech the salts. This reduces the chances of increasing production by increasing irrigation as do the urban and industrial effluents which are turning the Euphrates waterway into a virtual sewer *(Naff & Matson, 1984, 7).* Pollution, while not itself a use of water but the result of a use, can interfere, (and, indeed does) with the water use by both upper and lower co-basin states. Although there is general recognition of the seriousness of pollution, there is little agreement over what action needs to be taken to control or eliminate it.

The headwaters of the Euphrates River provide water which is of reputedly high quality but data are not available to quantify this, although van Aart states that irrigation water used in the lower part of the Euphrates averages 300-500 ppm salinity, and may reach 600 ppm in the south. Cressey reports that the salinity of the Euphrates averages about 250 to 445 ppm however, the use of the water for irrigation purposes upstream attests to its quality. In the estuary region located south of Basra, the salinity levels are naturally much higher and this is especially true at high tide in the autumn when the flow is lowest and the salinity is typically over 5,000 ppm. Talling presents groundwater data for the basin at stations located at Musayyib on the Euphrates and at El-Zubeir on the Shatt-al-Arab and these data indicate very high concentrations of dissolved ions, especially sodium, magnesium, chloride and sulphate, but they also show that the salinity of the river has increased from 160 to 525 ppm over the seasonal cycle as measured at Samara in South Iraq.

Table D2.1
Salinity at different locations on the Euphrates (micro mhos/m^3)

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Tabqa	550	530	475	420	420	430	480	505	525	565	615	450	497
Deir ez-Zor	660	610	600	560	560	480	625	725	735	760	700	480	616

Source: Kolars & Mitchell, 1991, 246

Other data presented by Talling show electro-conductivity increasing from 575 micro mho/cm at Qaim to over 900 micro mho/cm at and below Samara. Edaphic factors in the lower basin contribute to a natural reduction in water quality as the river moves downstream. In this regard, it is important to note that the flooding of the Abu Dibis depression by the Iraqis in the 1950s degraded the water because of the rapid evaporation rate and the high salt content in the soils of the depression.

The lower part of the Euphrates, including the Shatt al Arab, is naturally prone to the problems of salinity which results from a combination of poor drainage, centuries of irrigation, and natural soil factors. The salt content of the upper groundwater ranges from 7,000 ppm in the central part of the Lower Mesopotamian Plain to 30,000 ppm in the south *(Naff & Matson, 1984, 87)*. After the confluence of the Tharthar canal near the town of Faluja, the salinity of the Euphrates increases suddenly due to the high salinity of the Tharthar canal which is 2,000 ppm

In the past, the farmers of Iraq used to irrigate their crops by spreading water over the soil. An ignorance of irrigation principles led them to continue this without drainage, until they could grow no more crops and simply moved on to another area. This practice was viable when the population was small, but it is not a sustainable method and has resulted in immense areas of valuable alluvial soil becoming saline and useless. The Iraqi Haigh Commission Report estimated that some 60 per cent of the irrigation area has been affected by salinity, and that about 20-30 per cent of the cultivated land in the irrigation zone has been abandoned in recent decades because it is no longer suitable for cultivation (*Qudain, 1960, 58; Haigh, 1951, 15*). The high concentration of salt in the soil, especially in the flow irrigated areas, is caused by continuous irrigation and flooding combined with the high rate of evaporation that obtains in these climatic conditions. Irrigation keeps the sub-soil water high, (just below the ground surface) and, exposed to the hot summer sun. When evaporation takes place, it leaves salt deposits in the plant root zone and, as the years go by, the salt accumulation becomes toxic in quantity, gradually causing a decline in crop yield, and finally making further cultivation impossible *(Qudain, 1960, 59)*.

Additional, as yet minor pollution occurs in Syria and Iraq through the discharge of untreated sewage into the river. Most settlements are located on the river bank, and sewage is discharged into the river without any treatment *(AMER, 1992, 4)*.

Technological means are now at hand to prevent most known forms of pollution but the financial cost of pollution control or elimination is often staggering and some states, having used the waters of international rivers as open sewers for decades and sometimes for centuries, have been unable to reconcile themselves to the need to pay for the use of water for this purpose. Certain upper riparian states go so far as to express fears that any pollution clean-up requirements imposed upon them will make their products non-competitive in international markets *(Garretson at all, 1967, 11)*. Nevertheless, the water quality will be further dramatically influenced by development programmes which are now being carried out by Syria and Turkey.

D2.1: Future pollution scenarios

The foregoing discussion has been based on not very comprehensive nor definitive data but it indicates that the water quality of the Euphrates water is not yet a serious problem except in parts of the system in Iraq where drainage water has become toxic through contact with saline soil profiles and involvement in the cycling of soil water with saline groundwater. Iraq's geomorphological and soil endowment have made it difficult throughout its long recorded history to create sustainable irrigated farming in the manner achieved by those who for millennia have managed other irrigated lowlands such as those of the Nile in Egypt.

Ameliorating the poor natural soil and water circumstances of Iraq and reversing the degradation caused by ineffective soil and water management are unlikely to be economic options as long as world food prices remain low. Iraq's land reclamation policies have not, however, been inspired by economic considerations so much as by the strategic intent of creating a more self-sufficient agricultural economy. An oil rich Iraq showed itself to be unable to make a significant impact on the reclamation of waste and degraded land in the 1970s and the 1980s, despite loudly articulated reclamation policies. Little additional crop production was generated by the investments of the 1980s, and none of the production was cost-effective.

That land reclamation has proved to be extremely difficult and uneconomic in both Syria and Iraq with the good quality lower Euphrates water indicates that future land reclamation with the inevitably poorer water of the early twentieth century will be even more difficult and expensive. Experience in the Welton-Mohawk scheme in Arizona, to which reference has been made, suggests that water could deteriorate after passing through Turkish soil profiles to worse than 1000 ppm and possibly to 1500 ppm. Another example, that of Egypt, confirms the tendency of water to deteriorate after use for irrigation. Even in Egypt's favourable alluvial soil conditions in the Nile lowlands, water which flows into the country at about 300 ppm at Aswan falls in quality after multiple re-use in irrigation to more than 1500 ppm in the drains in the north of the delta.

It behoves Iraqi and Syrian officials and politicians to establish a negotiating framework noting the precedents set by the United Sates and Mexico in dealing with the export of water polluted by use in irrigation. The issue of water quality will be just as important as that of water volume and it could be argued that quality will prove to be the more important issue especially as elsewhere in the thesis it is shown that water quantity will not be a significant constraint on economic development in either Syria or Iraq for the foreseeable future.

E. Disputes and Agreements Over the Euphrates Water

E1. Geopolitical History

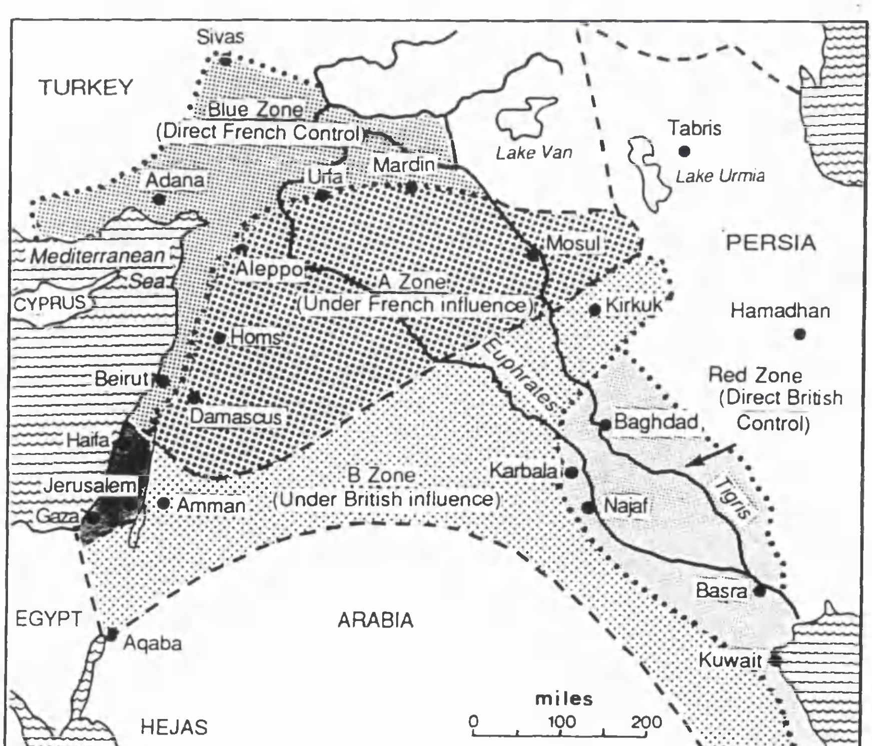
E1.1. The "division" of the Ottoman Empire

Both Iraq and Syria were under Turkish Rule from 1534 till 1917.

On May 16, 1916 the secret accord known as the Sykes-Picot Agreement was concluded between the British, French, and Russian governments, and provided for the division of the Ottoman Empire into a number of zones. Great Britain and France agreed to recognise an independent Arab State or a confederation of such states, headed by an Arab chief. In some regions, including Transjordan and a strip of territory in the south of the vilayet of Mosul, Great Britain was to have a right of priority. In coastal Syria, from a point between Acre and Sur up to and including Cilicia, France was to be allowed direct or indirect administration or control as she might deem fit to establish after agreement with the Arab state or confederation. In the vilayets of Baghdad and Basra Great Britain was to be in a similar position. This framework agreement, and the changes that were further inserted, formed the infrastructure for the geopolitical development and establishment of independent countries in the region.

Map E.1:

The Sykes-Picot agreement, 1916



Source: Bacharach, 1984, 11

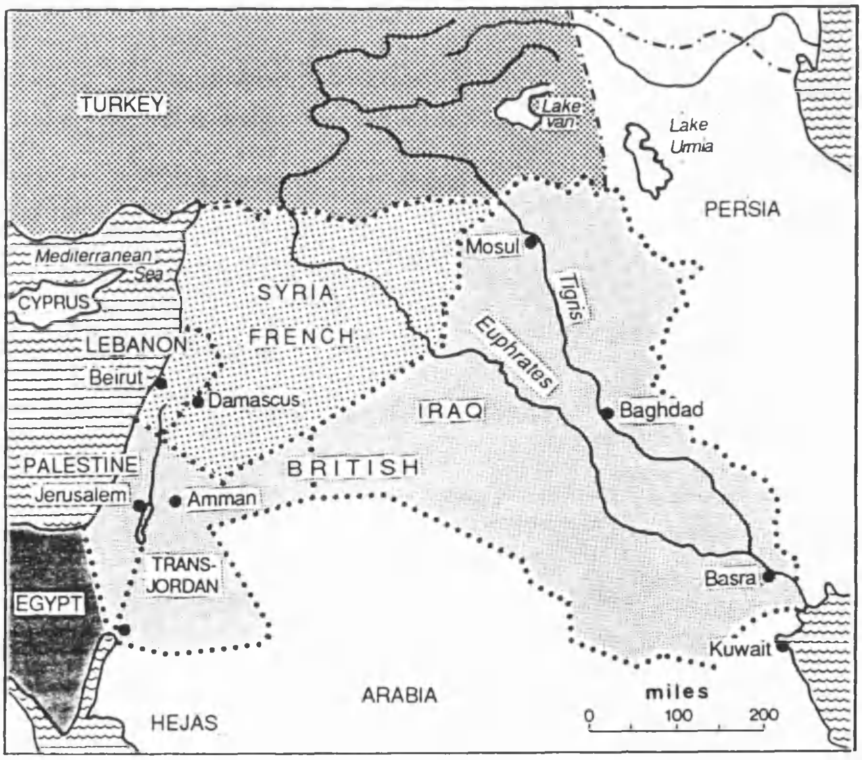
In January 1919 the Peace Conference decided that the newly conceived mandate systems should be applied to the Arab provinces. At the suggestion of President Wilson, an American commission (known as the Crane Commission) toured the area, and recommended the establishment of mandates for "Iraq and for geographical Syria" which should be treated as a single unit and should have a constitutional monarch. At Versailles the Peace Conference came to an end without having proposed a definite arrangement for the Arab lands *(The Middle East, 1948, 155).*

The Conference at San Remo, in April 1920, granted a mandate for the northern half of the disputed area to France and the southern half to Great Britain (see Map E.2). As a result of these international agreements the Euphrates River, for the first time, became an international river with three riparian states: Turkey, Iraq (which achieved its independence in 1932) and Syria (which obtained its independence in 1946).

Until the post-World War I period, water diversion from the Euphrates river did not constitute on international problem because the river was entirely within the jurisdiction of one national entity, the Ottoman Empire.

Map E.2:

The San Remo agreement, 1920



Source: Bacharach, 1984, 13

Even after the creation of the modern states, the diversion of water did not create any conflict as the amounts of water taken from the river in relation to the total flow were minimal. Ample water was available to satisfy the needs of the riparians at that time *(Abbas, 1984, 178).*

E2. Relations among the riparians concerning Euphrates water use (until 1974)

Rivers of common interest to two or more countries have, in modern times in the Middle East as elsewhere, generated political tensions and stimulated debate which has sought legal principles for the regulation of the use of waters by the riparian states. Such regulations are applied to both "boundary" rivers and "successive" rivers.

It seems that even while negotiating the secret Sykes-Picot agreement over dividing the Ottoman Empire by the Great Powers in 1916, the British realized that dividing the river waters between the mandate countries, could affect their use. That is the reason for their inserting a sub-section into the agreement that would guarantee the continual supply of river water to Iraq.

According to the tripartite (Sykes - Picot) agreement for the partition of the Ottoman Empire, (16 May, 1916) "a guarantee of a given supply of water from the Tigris and the Euphrates in area A (France) for area B (Great Britain)" was pledged *(Hurewitz, 1972, 19).*

At the Peace Conference in 1919, President Wilson was aware that the international division of river waters would cause further conflicts between the countries according to the tentative recommendations submitted to him by the intelligence section of the American Delegation to the Peace Conference (21 January, 1919) :-

> "It is essential to the development of the great irrigation projects, below Baghdad, that the headwaters of the Tigris River, and as much of the Euphrates as possible, should be under a single administration...To separate the headwater area of the Tigris and Euphrates drainage from the irrigated valley floors and lowlands further down-stream would be to create sources of dispute and render doubly difficult the task of establishing a suitable government" *(Hurewitz, 1972, 42).*

There is no agreement between Syria and Iraq concerning river control and the allocation of water (supply) although a convention was signed in Paris on December 23, 1920, between France and Britain, as mandatory powers for Syria and Iraq respectively. This convention established the principle that the water interests of the downstream areas were to be protected *(Hirsch, 1956, 87).* The mandatory powers called for the formation of a commission which would examine all proposed irrigation schemes in Syria which might seriously diminish "the waters of the Tigris and the Euphrates at the points where they enter the area of the British mandate in Mesopotamia". No such commission was set up but, in any case, the convention is probably no longer binding. The 1923 Treaty of Lausanne, which formalized the independence of the Turkish Republic, stipulated that Turkey inform and seek agreement from Iraq (but apparently not Syria) before undertaking anything that might alter the flow of the Euphrates *(Waterbury, 1990, 15)*. Iraq, upon the termination of the British mandate in 1932, declared itself bound by all the agreements made on its behalf by the mandatory administration. No such declaration was made by Syria when the French mandate was terminated in 1945 *(Qubain, 1960, 56)*.

Since 1919 there have been numerous attempts to arrive at bi- or multi-lateral accords, but no comprehensive instrument has been established. According to Waterbury (1990), from the theoretical point of view, the expected behaviour on the part of the three riparians will develop along the following lines. Turkey, as an upstream state, will prefer non-binding understandings since any obligations or commitments will necessarily involve concessions to the downstream states and any compensation for the concession can only come through reciprocation not related to the river. It also seems that Turkey will be unwilling to sign a trilateral agreement before the conclusion of the GAP project is fully underway.

The optimal arrangement for Turkey, thus, will be to insist on sovereign control of the headwaters of the Euphrates and assure its neighbours that, in developing those waters , it will always keep their interests in mind although Turkey will make no binding commitments. Iraq, in contrast, as a downstream state, will be the most eager to arrive at binding commitments, because such commitments can only bind the two upstream states so Iraq might offer compensation for concessions made by its upstream neighbours. Syria, as a mid-stream state, will want binding understandings with Turkey and loose understandings with Iraq. In fact, Syria cannot be expected to commit itself to allowing an agreed amount of water to flow into Iraq, while it remains at the mercy of Turkey's actions without knowing how much the Turks are going to withhold for their own purposes. From all this one can understand that bi-lateral accords are more likely than tri-lateral ones and the linking of the latter to side issues and side payments *(Waterbury, 1990, 15)*.

The three riparian states had not reached any formal agreement by the time the Keban dam in Turkey and the Tabqa dam in Syria had begun to fill in the middle 70s. Turkey and Syria had started new construction in the Euphrates valley without seeking the agreement of all three countries *(An-Nahar Arab Report and MEMO, 19 March, 1984, 20)*.

The principle of cooperation (even though limited) between Iraq and Turkey over river control was laid down in the Treaty of Friendship and Neighbourly Relations signed by the two governments on March 29, 1946, and this is the only extant agreement relevant to the Euphrates waters. While regulating the use of the Tigris and Euphrates Rivers certain rights were assigned to downstream Iraq but Syria, whose territory straddles more than 400 miles of the Euphrates and includes a section of the Tigris to the "*thalweg*" was ignored *(Hirsch, 1956, 84)*. In Protocol I of the treaty, Turkey allowed Iraq to establish meteorological stations in its territory (on the Tigris and Euphrates), to conduct geological surveys for possible flood-control dam sites and consented in principle, (subject to confirmation in each case), to the construction by Iraq, in Turkey, of water works found to be necessary. Turkey also obligated itself to inform Iraq of any contemplated projects on the two rivers, (of interest to both states). This principle exemplified above, shows the limitations imposed by the principle of territorial sovereignty and allowed works which might benefit the downstream state to be constructed in the territory of the upstream state *(Berber, 1955, 101)*. Under the treaty, Iraq established three meteorological stations in Turkish territory but no river works were constructed there (until 1960) *(Qubain, 1960, 56)*.

A 1952 agreement between Syria and Turkey was not ratified by the latter's Grand National Assembly because the Turks wanted the agreement to cover all of the rivers of common interest (including those flowing from Syria into Turkey) and not just the Jaghjagh and Balikh rivers (which flow into Syria) which were the subjects of the agreement. This feeling is connected with Syrian plans for the Orontes and the current Syrian use of the Afrine river which is important to the Hatay province, still a sensitive spot for both countries. Before Syria was able to reach agreement with Turkey on the Orontes, it would have had to reach agreement over this river with upstream Lebanon *(Hirsch, 1956a, 215)*.

More recently, closer cooperation between Turkey, Iraq, and Iran over river control was effected through the "Baghdad Pact", and a Joint Irrigation Projects Committee has been established as a subdivision of the Pact's Economic Committee. There is also a subcommittee on cooperation in agricultural planning.

At a meeting of the Joint Irrigation Projects Committee held at Ankara in July, 1956, the Iranian and Turkish Governments undertook to establish meteorological and hydrological stations at the headwaters of the Euphrates, the Tigris, and the tributaries in their territories. The Committee also undertook to make a survey of joint irrigation projects which had been recommended by the Economic Committee at its meeting in Teheran earlier in that summer" *(Qubain, 1960, 56; Naff & Matson, 1984, 92)*.

In 1962, Iraq and Syria agreed to exchange information on discharge and river levels, and a joint technical commission was established to gather the information. Iraq raised the issue of its "acquired rights" to a fixed share of the river, but it is not clear that Syria recognized them *(Waterbury, 1990, 15)*. During the 1960s, as the three riparian states' plans for the use of the Euphrates developed, Turkey, Syria and Iraq held a number of conferences concerning the allocation of the river's waters. As of the early 1960s, the riparians had only gone into bi-lateral understandings that did not specify rights to shares, quality of the water or seasonal flows. In that sense they were non-binding. Little is known of the content of these discussions since, except for one occasion in 1965, all three countries seem to have taken pains to keep their talks off the public record. It was only in the middle of the 1960s, when both Turkey and Syria began to draw up plans for large-scale surface irrigation schemes, that a basin wide accord was put on the diplomatic agenda. It appears that Turkey tried to link an agreement with Syria over the use of the Euphrates waters to a Turkish-Syrian accord over the Orontes river. Syria rejected this attempt since the Orontes flows only through Turkey in Alexandretta, a province detached from Syria in 1939, which Syria still refuses to recognize as Turkish territory. During the first tripartite meeting in Baghdad in September 1965 each country, for bargaining purposes, put forth maximum demands. Iraq is said to have demanded 18 billion m^3/yr. of Euphrates water, Syria 13 billion m^3/yr. and Turkey 14 billion m^3/yr. This is a total of 45 billion m^3/yr., or 1.4 times the Euphrates mean annual discharge of 32 billion m^3/yr. at Hit, Iraq *(Waterbury, 1990, 15; Naff & Matson, 1984, 93)*. Beginning in 1966, Syria and Iraq began a series of bilateral negotiations, in which Iraq re-iterated its claim to acquired rights for a fixed share of the Euphrates discharge. This notion lies at the heart of what any downstream state will try to establish as a binding commitment. Syria has argued that potential needs must be weighed against acquired rights and, in the 1967 talks, rejected the Iraqi claim to acquired rights. In 1967, Syria accepted that Iraq was entitled to 59 per cent of the flow of the river at the Syria-Iraqi border and a variant of this apportionment was discussed in 1967 and 1968 whereby Iraq would receive two thirds of the flow during normal years, but that the proportions would be reversed in favour of Syria in apportioning excess flow. However, by 1968, no accord had been formalized and Iraq protested to both Syria and Turkey about their pursuit of major hydraulic projects (Keban and Tabqa) in the absence of a basin-wide accord *(Waterbury, 1990, 17)*. In early 1967 Iraq and Syria were still reported to be far apart on questions of water allocation, with Iraq demanding 16 billion m^3/yr. from Syria which insisted that Iraq needed no more than 9 billion m^3/yr. *(Naff & Matson, 1984, 93)*.

A World Bank report in 1965 attempted to assess the relative needs of the three states and each one of the three states has utilized partial information said to be derived from the reports, but the studies themselves have not been made public. Syria and Iraq went back to it in 1972 when Iraq defined its needs based on cultivated surface, while Syria used the measure of crop-water duties. Nonetheless, an agreement was reached, much like that of 1967 wherein Iraq would receive 76.5 per cent of the normal discharge, while Syria would receive all the surplus of exceptional discharge, and shortfalls would be shared at a ratio of 76.5/23.5 per cent. Syria, in the end, declined to sign the agreement. At this point Iraq sought Soviet mediation and a Soviet study team arrived on the scene in 1972. The Soviet report used the older World Bank estimate and recommended that Tabqa (and Keban) be developed in such a way as to protect Iraq's acquired rights. Syria objected to some of the findings in the report.

1973 saw another round of unproductive negotiations. A slightly modified formula, by which the apportionment of shortfalls was adjusted, met with Iraqi approval but ,at the last moment, Syria declined to sign. Subsequently Syria claimed that the figures on which the Soviet report was based were inaccurate and that Iraq's actual irrigated surface was 835,000 hectares instead of the 1.2 million claimed by Iraq. Therefore its water needs were no more than 12 billion m^3. By this time the reservoirs at both Keban and Tabqa dam sites had begun to fill, threatening to reduce Iraq's flow to unacceptable levels *(Naff & Matson, 1984, 93 ; Waterbury, 1990, 17).*

E3. The Syrian - Iraqi "water crises" of 1974-1975

The first year that the Keban and Tabqa dams became operational passed without serious incident although Iraq experienced a sharp reduction in the discharge reaching its territory. In June 1974 it requested that Syria release an additional 200 million m^3 of water from Tabqa, and Syria acceded to the Baghdad request preventing any possible conflict. Syria agreed to release a minimum of 90 m^3/sec in the month of June, 110 m^3/sec in the first ten days of July, and the entire flow of the river net of agricultural needs in Syria thereafter *(Naff & Matson, 1984, 93)*. According to Al-Rifai, the former Syrian Minister of Industry, President Assad ordered the opening of the Syrian Tabqa Dam and gave Iraq the water contained there for electricity generating purposes causing Syria to have to buy electrical power from Lebanon. But now the situation has changed and Syria wants to irrigate its land and produce electricity from its own resources *(The Arab Economist, June 1975, 25)*. Iraq and Syria held no further talks after November 1974.

This is the main reason why a major crisis developed during the second season when the Turkish and Syrian dams impounded part of the Euphrates spring flood, and brought Syria and Iraq to the brink of war. In March 1975, about one and a half years after the official opening of the Tabqa High Dam in July 1973, Syria and Iraq clashed over the sharing of the Euphrates water. This coincided with the Syrians raising the lake's level to its full capacity (292 metres above sea level while the optimal level for power generating was 275 metres above sea level). Iraq issued a formal protest and took the matter to the Arab League which appointed a technical investigator committee whose findings Syria rejected *(Waterbury, 1990, 18)*. It was not certain whether the flooding of Lake Assad, temporarily deprived Iraq of part of the water it had previously received. Apart from this Iraq also saw its share of water reduced in the long term as Syria planned to use the lake to irrigate vast areas of new agricultural land. Unfortunately, both Iraq's short- and long-term losses are difficult to assess since reliable figures are extremely scarce or, as in the case of Syrian and Iraqi sources, blatantly contradictory. The different sources do not even agree on the "natural" amount of water carried by the river at the Syria-Iraqi border (that is the amount of water that would on average pass into Iraq if there were no diversion of other artificial losses upstream). The only factor actually known is the storage capacity of Lake Tabqa. Maximum output for the generation of electricity and agricultural irrigation is reached at a water-level of 300 metres above sea level, that is eight metres beneath the crest of the dam and this corresponds to a storage capacity of 11,9 billion m^3 water. The effect on Iraq of filling Lake Tabqa is difficult to evaluate precisely, because there is no reliable information about the beginning, end and speed of this process. Nonetheless, Syrian and Iraqi figures on the amount of water carried by the river, though contradictory, indicate that Iraq was probably short of water in the spring of 1975. While there is no doubt that a large part of the water of Lake Tabqa was stored from early 1975 onwards, by 1 May 1974 the lake already contained 4,5 billion m^3. This was the minimum generating level for hydroelectric production which started on that date. But it is difficult to know over what span of time the build-up of the storage of the remaining 7.4 billion m^3 extended. As the average flow of the Euphrates into Iraq prior to the construction of the Tabqa Dam amounted to some 29 to 32 billion m^3/yr., the storage of 7.4 billion m^3 still corresponds to the entire average amount of water carried by the river into Iraq in two or three months. The question, however, seems further complicated by the fact that, in 1975, the snow in the Turkish mountains seems to have melted very slowly and, in consequence, the Euphrates carried less water than usual. In any case, according to Baghdad, the Euphrates in 1975 only carried some 9.4 billion m^3 into Iraq. However, it is important to note that Iraq had received even less water in 1974 (9 billion m^3) and comparatively little in 1973 (15.3 billion m^3).

In reply to Iraq's allegations that Syria was responsible for the shortage of water, the Syrians claimed that during the previous three years, the annual average of Euphrates water entering Syria from Turkey, had been 28 billion m^3 while in 1974 the volume had fallen to 12.8 billion m^3. Moreover, during the period of October 1975, it had dropped to eight billion m^3 as compared to the normal 17 billion m^3 the principal causes being Turkey's storing of water and the rainfall factor. According to Al-Rifai, former Minister of Industry, between 65 and 75 per cent of the water entering Syria was released to flow on to Iraq, therefore, any shortage of water was not caused by Syria *(The Arab*

Economist, June 1975, 25). The Syrian Minister of the Euphrates Dam, Subhi Kahhaleh, claimed that the shortage of water was due to the fact that the Turks were filling the reservoir at the Keban dam which they had finished two years late at the same time as the Syrians were filling theirs *(The Middle East, October 1977, 75)*.

On 7 April 1975 Iraq asked the Arab League Council to discuss the matter. Syria, according to the Iraqi complaint, was storing even more water in the lake than was actually necessary for irrigation and the generation of electricity and thus were endangering the livelihood of three million Iraqi farmers who depended on the river for irrigation water *(Naff & Matson, 1984, 94)*. Iraq also claimed that the rice crop would be as little as one quarter the normal, while wheat and barley would be a mere one third of the average production leading to reported large scale migration from the area of the Euphrates basin *(EIU, No 4, 1975, 3)*. The Iraqi Minister of Irrigation, Mukarran al-Talbani, claimed that Turkey, in the year after the completion of the Keban Dam, held back 10 billion m^3, while Syria retained 4 billion m^3. As a result, Iraq did not get the 13 billion m^3 it needed for its irrigation networks; in fact, he claimed, the Iraqi part of the basin had only received 7 billion m^3 in 1975. This left a shortage of more than 5 billion m^3 according to the Iraqi assessment and 3.5 billion m^3 according to the assessment of the World Bank *(Baghdad Observer, 11 August 1975, 1 ; The Arab Economist, May 1975, 16)*.

In August 1975, the Iraqi Minister of Irrigation, Mukarram al-Talabani, was quoted as saying that "the justification cited by officials and experts of the Euphrates dam in Syria for withholding water from Iraq, based on claims that by the end of August, the water level of Lake al-Assad, would be below the regular level needed for generating power and that a drinking water shortage would exist in Aleppo as a result of accumulating silt in the feeding canal which branched out of the al-Assad reservoir, is no way connected with either of the two above mentioned points. This lying claim is intended to inflict more harm on Iraqi countrymen in the Euphrates basin" *(Baghdad Observer, 11 August 1975, 1)*. Iraq thus clearly expressed that, contrary to Syria's claim, it considered the dispute "political" and not simply economic. According to Iraq, the problem with Syria was not the Euphrates water shortage and consequently could not be tackled on this basis alone, but had to relate to a broader outlook.

When the Iraqi army was engaged in war in the north against the Kurds, the Syrian regime was supplying the Kurds with arms and other military equipment, as well as setting up training camps in-side the Syrian territory. The Iraqi political leadership also reached the conclusion that the Syrian regime wished to provoke Iraq into a military clash in order to achieve full cover for the acceptance of a peaceful settlement plan for the Middle East crisis. In addition while Iraq had been in a difficult financial and economic situation, Syria had demanded an increase in the fees for transit revenues of Iraqi oil across Syrian territory *(Baghdad Observer, 27 June 1975, 5 ; 1 July 1975, 3)*.

Table E1:

Quantities of water flowing at the Turkish-Syrian and Syrian-Iraqi borders (1975)

Date	Turkey-Syria border (m^3/sec)	Syria-Iraq border (m^3/sec)
26/3/75	873	220
27/3	895	227
28/3	864	234
29/3	744	251
30/3	687	243
31/3	626	258
1/4	615	258
2/4	527	241
3/4	738	262
4/4	902	269
5/4	908	270
6/4	883	262
7/4	914	270
8/4	807	257
9/4	632	223
10/4	637	247
11/4	650	235

Source: The Arab Economist, June 1975, 26.

Iraq next engaged in intensive diplomatic activities to convince other Arab regimes of the rightness of its own position while the Arab League set up a mediation committee, composed of representatives from Syria, Iraq and seven other Arab countries to mediate the dispute. On 1 May, however, Syria announced that it would not participate in the committee *(Naff & Matson, 1984, 94).* Over the next two weeks Iraq and Syria traded hostile statements Iraq threatened to take any action necessary to guarantee the Euphrates flow and Syria protested that it was passing 71 per cent of the water it received from Turkey on to Iraq. In May 1975 Saudi Arabia started its own mediation, and in early June even the Soviet Union was involved in a search for a solution. On 13 May Syria closed its airspace to all Iraqi aircraft and suspended Syrian flights to Baghdad. On 17 May, the Syrians regime closed down the Iraqi trade centre in Damascus while on 25 May the Syrian closed the Iraqi Consulate General in Aleppo and ordered its staff member out of Syrian territory *(Baghdad Observer, 25 July 1975, 1).* By the end of the month Syria had reportedly transferred troops from its southern front with Israel to the Iraqi border where the Syrians claimed Iraqi forces were massing. Other reports spoke of Iraq sending MIG planes to bomb the Euphrates dam at Tabqa *(Baghdad Observer, 1 July 1975, 3).* In July relations deteriorated further when Syria expelled an Iraqi military mission from Damascus and recalled its own military attache from Baghdad. Iraq made new complaints to the Arab League charging Syria with violating Iraqi airspace and harassing and attacking Iraqi military and civilian personnel along the northern Iraqi border *(Naff & Matson, 1984, 94)*. As the threat of military engagement between the two countries grew, Saudi Arabia attempted another mediation effort. After a series of visits and meetings and much procrastination Syria, announced on 3 June that it would release "water of its own share, regardless of the Iraqi regime's attitude". Iraq acknowledged that more water had been released by Syria, but added that it had come too late for the Iraqi summer crops, and that some 70 per cent of the country's winter crops had been lost due to the shortage of water *(Kienle, 1990, 100)*. Although Saudi Arabia is credited with successfully mediating the Syrian-Iraqi water issue, it is likely that the Soviet Union also played an important role in defusing the conflict. According to Naff & Matson (1984), the Soviets had tried to work out a solution to riparian problems on the Euphrates in their 1972 study, and it has been suggested that Syria and Iraq agreed to Soviet arbitration over water disputes in the same year. The Soviets had considerable prestige invested in water projects in both countries and were not likely to have wanted to see their work turned into a cause for conflict *(Naff & Matson, 1984, 94)*. On 12 August Syria announced that it had accepted the Saudi proposal under which the Euphrates water was to be distributed between Syria and Iraq on a "proportional basis", according to the amount of water reaching Syria from Turkey. However, no agreement was signed, and the Euphrates issue remained unresolved *(Kienle, 1990, 100; Hinnebusch, 1989, 241)*.

According to Naff & Matson (1984), it is doubtful that the 1975 Syrian-Iraqi "water crisis" was a conflict over water at all; at least, it was not primarily a conflict over water resources. They note both the lack of a crisis in the winter of 1973-74, and the failure of the water agreement to improve Syrian-Iraqi relations *(Naff & Matson, 1984, 95)*. It seems that the conflict between Baghdad and Damascus is much more complicated than only the "water crisis".

In 1980 all three riparians agreed to establish a technical commission for the exchange of information, but it only began meeting in 1982. According to Mackenzie (1990), because of Turkey's determination to go ahead with its projects, this committee has not yet produced a report. The first crisis was defused once the Keban and Tabqa reservoirs were full and because progress in extending the surface irrigation schemes in both Syria and Turkey was slow *(Waterbury, 1990, 18)*.

Because of the low rainfall in the Euphrates basin in 1984, the annual flow of the river was only 20 billion m^3. This amount was not enough to satisfy Syria's industrial, domestic and agriculture requirements and regular electricity output was insufficient to meet demand. Although this amount of water should, apparently, satisfy Syria's needs the dam and irrigation system in Syria is planned for an amount of water which is at least 30 per cent greater. The Syrian deputy Minister of Irrigation, Mahmoud Tajar, claimed that, at that time, Turkey was taking water off at the Keban Dam which further reduced the flow to Syria. He suggested that the establishment of a Euphrates valley authority would go a long way to defining and reacting agreements over the "rights to water on the river". He favoured an agreement that would require any country that planned to build any construction along the river, or which took water out of the river, to take into account the needs of other riparian states. He complained that Turkey had started new construction in the valley without seeking the agreement of her neighbouring countries *(An-Nahar Arab Report & MEMO, 19 March, 1984, 20)*. However, since contracts had already been awarded for Turkey's Ataturk dam in 1983, Syria began pressing Saudi Arabia and the Arab Gulf states not to make financial aid available to Turkey for the project unless a water sharing agreement was reached *(Naff & Matson, 1984, 100)*. In 1980 the World Bank, a major agency in making the development of large river basins possible, sent a letter to the riparians of the Euphrates saying that further financial support for irrigation and agricultural development schemes was dependent on a definite agreement being made between them on the partition of the Euphrates waters *(Kienle, 1990, 167)*. The bank had provided loans to Turkey for both the Keban and the Karakaya dams.

Turkey took the lead in trying to head off another confrontation in July 1987 when Prime Minister Ozal made a visit to Damascus and reached an agreement with President Assad by which Turkey would maintain the Euphrates flow into Syria of at least 500 m^3/sec after the Ataturk dam was completed. This was less than had originally been asked for, but was apparently acceptable to Syria. In return, Syria agreed to suppress "groups engaged in destructive activities" in Turkey. At the beginning of October 1987, Ozal reopened the breach by publicly hinting that Turkey might cut off the flow of the Euphrates into Syria if Damascus continued to support Kurdish insurgents. The Syrian response came on October 21 1987, when Syrian military jets shot down a Turkish civilian survey plane over Turkish territory *(EIU, No. 1, 1990, 10; MEED, 13 October, 1989, 4;)*.

E4. The water crisis of 1989-1990

Iraq and Syria have often complained that Turkey is opposed to a trilateral accord which would partition the Euphrates water among the three countries. During the 15 meetings held between representatives of the three countries between 1980-1990, Turkey quite frankly stated that it was against such an agreement, but would be very careful about responding to the water needs of Iraq and Syria. The fears of Syria and Iraq seemed justified when on 29 November 1989, Turkey shocked its downstream neighbours, by announcing (through the Turkish Public Works Ministry) that it would hold back the flow of the Euphrates for one month from 13 January - 13 February, 1990 for essential hydraulic works at the reservoir behind its newly built Ataturk Dam, (part of the GAP project on the Euphrates) *(The Economist, 16-22 December, 1989, 55; Briefing, 15 January, 1990, 4)*. Turkey restored the flow some 36 hours ahead of schedule, on the night of 12-13 February but the damage that this stoppage described as an act of international piracy would inflict on Syria and Iraq was only the beginning, for the complete filling of the Ataturk reservoir would still take four to five additional years *(MEI, 16 February, 1990, 12)*.

Syria and Iraq had made diplomatic attempts to get Turkey to review its decision and reduce the period of one month, which they considered too long. Syrian technicians believed that a period of ten days would be enough for the Ataturk Dam to carrying out the essential hydraulic works and Iraqi technicians also thought that ten days to two weeks would be sufficient. Almost all the Gulf newspapers launched a simultaneous campaign to attract attention to the water-cut, calling for Turkey to reconsider its "requirement", while some went to the extent of associating this act with Turkey's hostility towards Syria over that country's support for separatist terrorism. Observers at the Turkish Foreign Ministry, at the beginning, stated that the campaign was a result of pressure exerted by Damascus and Baghdad on other Arab capitals but, later, according to Briefing (1990) they changed this observation, claiming that both Iraq and Syria "understood the technical requirements of Turkey" *(Briefing, 15 January, 1990, 5)*. Officials in Ankara claimed that Turkey had tried to do all it could to minimise the hardship to its southern neighbours *(Briefing, 25 December, 1989, 9)*. January and February were the months chosen by Turkey to hold back the flow of the Euphrates because water needed for irrigation in Syria and Iraq and evaporation losses are minimal during these months *(Utlcan, 1990,* 12). They declared that Turkey had released 3.43 billion m^3 of water, or an average of 780 m^3/sec from the Keban and Karakaya Dam systems, over 52 days starting from 23 November 1989 to 13 January 1990, in order to compensate for the losses that might accrue to these two countries during the following month. If we take into account the total make-up and low-flow periods of 82 days starting from 23 November 1989 till 13 February 1990, we can see that an average quantity of water passing through the Turkish-Syrian border was 531 m^3/sec, or 3.76 billion m^3 (see table E2). However, according to Turkey, Syria and Iraq got more water during the 82 days and there was actually an increase in the amount of water, instead of a decrease. During the 31 days of closure, the Euphrates river was fed by the downstream tributaries like Goksu, Araban, and Nizip and the long term average of these tributaries is about 120 m^3/sec *(Utlcan, 1990, 13).*

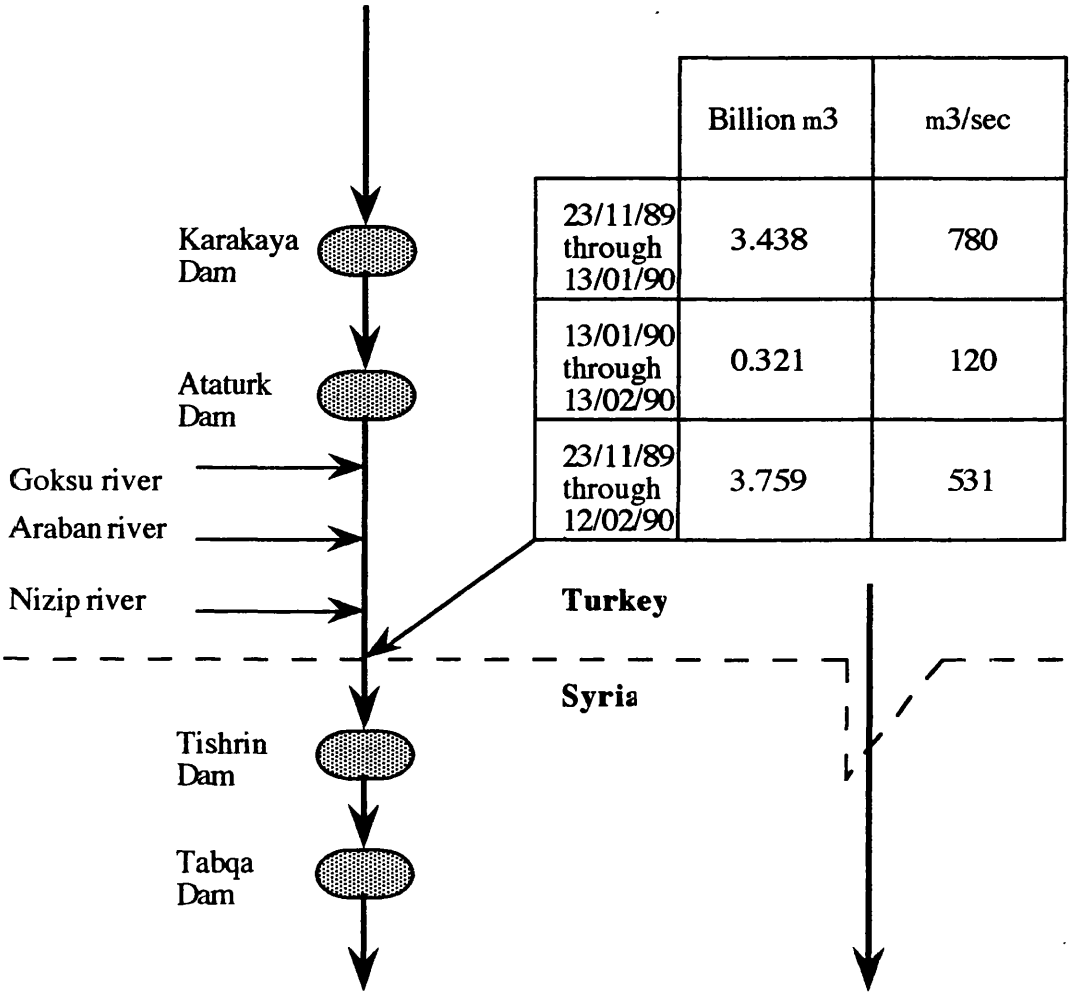
This, officials in Ankara claimed, amounted to 500 m^3/sec running across the border which, if used cautiously, could be stored for thrifty use in order to overcome any discomfort. They declared, however, that this should not be judged on a daily or weekly basis, but as a monthly average *(Briefing, 25 March, 1991, 10).* They also noted that Turkey had displayed goodwill towards its neighbours by providing an average of 500 m^3/sec a month during the 1989 summer months, when Turkey itself had suffered one of the worst droughts for the past fifty years *(Briefing, 25 December, 1989, 9).* The total amount of water that passed through the Turkish-Syrian border was 25.7 billion m^3, whereas the natural flow for the same period was calculated at 20.8 billion m^3. The difference between these figures, (4.9 billion m^3) was made up by releasing water from Keban and Karakaya reservoirs, to maintain the level of flow *(Utlcan, 1990, 13).*

These displays of goodwill however, do not appear to have appeased officials in either Damascus or Baghdad. Syria's Minister for Information, Mohammed Salman, was quoted in the press as saying that the most important problem between his country and Turkey concerned the sharing of the waters of the Euphrates. He was also quoted as saying that he hoped this question would be resolved through "peaceful means" ,and it was sufficient for Ankara to detect an "unfriendly tone" *(Briefing, 25 December, 1989, 10).* The Syrians and Iraqis had a real grievance. They thought the Turks had no more right to use Euphrates water than they had and were simply seizing what they wanted: that is the lion's share *(The Economist, 16-22 December, 1989, 55).* By reducing the water flowing in the Euphrates river, Ankara would be directly showing Baghdad and Damascus that it controlled things in the region. According to the MEI report (1990), Turkey, in complete defiance of international law, was doing as it pleased simply because it was the strongest country involved *(MEI, 16 February, 1990, 13).*

In a rare show of unanimity, both Damascus and Baghdad unequivocally rejected Ankara's claims. Syrian officials argued that water rationing had to be instituted in northern Syria and that power supplies had been disrupted as a direct result of the Turkish action while Iraq complained that 7 million of its citizens had been affected by subsequent shortages.

Table E2:

Euphrates river discharges at Turkish-Syrian border, 23 November 1989 - 12 February 1990



	Billion m3	m3/sec
23/11/89 through 13/01/90	3.438	780
13/01/90 through 13/02/90	0.321	120
23/11/89 through 12/02/90	3.759	531

Source: Utlcan, 1990, 14

The Iraqis also claimed that the reduction in the Euphrates level would affect 1.3 million hectares of rich farmland, (40 per cent of Iraq's arable land), and would force Iraq to shut down four power plants which produced 40 per cent of the country's electricity *(MEI, 16 February, 1990, 12; MEED, 25 January, 1991, 10).* Shaker Bazaoua, the director-general of Syria's Al-Thawara Dam, believes the Ataturk Dam will eventually cut the Euphrates's flow by two-thirds. "There is no longer a river; the Euphrates is dead... In the future, people will visit the Euphrates valley and say, 'There used to be a river there" *(Tekeli, 1990, 221).* Olcay Unver, who is the GAP regional project director in Sanliurfa, stated that Turkey was not required by law to send 500 m^3/sec into Syria but claimed that this was done as an act of goodwill. "Syria was pleased at first but now both Syria and Iraq are demanding 700 m^3/sec from Turkey, which more or less amounts to demanding the entire supply as the total, "natural flow" is something over 900 m^3/sec". In an interview with Cumhuriyet, Inan he underlined the Turkish position by comparing Turkey's military situation with that of its neighbours. Putting it bluntly, he said: "We have the water and they have the missiles" *(Briefing, 15 January, 1990 , 6).*

The ruling Ba'ath Socialist Party's newspaper "Al-Thawara" warned that Turkey's action of blocking the river for a month would seriously harm Iraq and could cause "a real agricultural disaster" in the long term, adding that Ankara-Baghdad relations could suffer. Al-Thawara reported that seven provinces with 5,000 villages inhabited by about 5.5 million people, would be threatened by the severe water shortage caused by the Turkish action. Iraqi officials believed that the Euphrates flow could eventually be reduced from its current 32 billion m^3/yr. to 11 billion m^3/yr. - or two billion m^3/yr. less than Iraq claimed was its minimum requirement. Although Ankara had increased the flow of the Euphrates by 100 per cent over the normal flow of 500 m^3/sec into Syria to compensate for the loss of water during the cut-off period, it made little difference because Iraq had already filled its Al-Qaddissiya dam to capacity to make up for shortages during the summer growing season. Claiming that villages and towns in the area north of Al-Qaddissiya dam would not be able to make use of that water *(Turkish Daily News, 15 January, 1991, A1 ; Baghdad Observer, 15 January 1990, 1).*

The Iraqi Deputy Foreign Minister Nizar Hamdoun, complained that the 1987 Turkey-Syrian accord excluded Baghdad making a trilateral agreement necessary and that the diversion would leave Iraq with little water. He said: "Really I cannot talk about minimum. We need to keep industrial projects going. Our population should get at least enough." Hamdoun's complaint was probably justified because Turkish officials claimed that Turkey had given Syria 3.4 billion m^3 since November, but Syria had released only 860 million m^3 to Iraq during the same period *(Bolukbasi, 1990, 53).*

Iraq's concern, however, led it to seek help from its partners in the Arab Cooperation Council, in the form of exerting pressure on Turkey. Both Baghdad and Damascus tried to find supporters among other members of the Arab League and the secretariat of the League actually made an announcement in late January 1990 calling for a just partition of the Euphrates waters and requesting Turkey to reconsider its decision to divert the river for a month. The Turkish Foreign Minister, Mesut Yilmaz, reacted to these diplomatic moves by asking the Iraqi and Syrian ambassadors in Ankara to get their government to stop trying to internationalize the issue and turning other Arab states against Turkey. In addition, Ankara sent delegations to Arab capitals to explain why Turkey had diverted the Euphrates *(Bolukbasi, 1990, 55; MEED, 26 January 1990, 13).*

According to Briefing (1989), officials in Ankara believed that what was actually disturbing Syrian and Iraqi officials was the effect on their public when they observed

Turkey's ability to cut water off at will. They felt that this would be interpreted in Syrian and Iraqi public opinion as a show of strength by Turkey and a sign of weakness by the regimes of Hafez Assad and Saddam Hussein *(Briefing, 25 December, 1989, 10)*. But, even if the cut-off were due to technical requirements, and had no political motivation who could guarantee that this would be the case in the coming years or in the case of a serious regional crisis?

In April 1990, according to the MEED (1991) Baghdad and Damascus signed an accord by which Syria would take 42 per cent of the river's flow once it had left Turkey. However, as in all fifteen meetings of the Syrian-Iraqi-Turkish joint commission on the Euphrates held over the past ten years, finding a solution has remained elusive. Here, the talks reportedly broke down over the volume of water to be discharged by Turkey and the decision to carry on with the negotiations. The Turkish side presented a three-phase plan at the 1990 meeting of the Technical Committee, outlining the course that had to be followed to resolve the question. According to this plan, Turkey, Syria and Iraq were to conduct joint studies about their Euphrates water resources and the data collected was to be evaluated by engineers with a view to reducing wastage to a minimum. In addition, current projects were to be reviewed in order to conform with the principle of optimal usage. This plan was rejected by both Syria and Iraq who insisted that there was no need for such intricate measures and that supplying water on the basis of unilateral declarations of requirement would be sufficient. Baghdad demanded the release of 700 m^3/sec instead of the 500 m^3/sec offered by Ankara and Iraq indirectly, but clearly, stated that they could have sorted out their problems with Syria had Turkey not spoiled things by not giving enough water *(MEED, 25 January, 1991; Briefing, 26 March, 1990, 18 & 2-9 July, 1990, 10)*. The fact that Turkey has embarked on the grand-scale GAP project, involving a network of dams in the Euphrates and the Tigris basins, has led both Syria and Iraq to believe that, in the long run, they are going to be deprived of water since the Euphrates is one of the main rivers in the GAP region. Both countries are critically dependent on the Euphrates, and therefore wish to conclude some form of binding arrangement with Turkey which would involve quotas for the amounts of water from this river for each of the three countries.

On 26-27 of June 1990, Turkey, Syria and Iraq held two days of ministerial level talks in Ankara in order to try and reduce the differences over the question of the sharing of regional water which had been clouding Ankara's relations with both Baghdad and Damascus. According to a Dateline report (1990) the Turkish officials pointed out that there was more than just the Euphrates river in the region. There was also the Tigris, and the river Asi which flowed from Syria into Turkey and was used to irrigate the Amik Valley, not to mention a host of smaller rivers and streams which had to be taken into account. Turkey claimed that when all water resources were taken into account, a more effective, rational and equitable system could be implemented for sharing the water between the three nations. In view of all this, Turkey argued that the whole area had to be accepted as a single geographical unit, and that the water resources in this basin, rather than being shared, had to be made subject to a joint use agreement based on the criteria of optimality, fairness and rationality. Turkey also offered technical help to minimize wastage of water *(Dateline, 30 June 1990, 9).* According to Briefing (1990), however, Syria and Iraq did not want to get involved in any technicalities with Turkey but preferred a simple mathematical solution to a problem which in reality, is very complex *(Briefing, 2-9 July, 1990, 10 ; Dateline, 30 June, 1990, 9).* In addition to the protocol signed with Syria in 1987, which committed Turkey to giving 500 m^3/sec., Turkey also offered to increase the flow from the system of dams in the region to Syria, and subsequently Iraq, by 100-200 m^3/sec, according to the availability of water during certain periods of the year especially when these countries were in dire need of water for agricultural purposes.

Before further negotiations could take place, Iraq's invasion of Kuwait took place and the Euphrates water issue was eclipsed by other pressing concerns. According to the MEED report (1991), Turkey was under pressure to cut the flow of the Euphrates and Tigris rivers in an attempt to drive Saddam Hussain out of Kuwait. Water could be viewed as Iraq's Achilles heel and the denial of water was a possible means of ensuring a swift and bloodless end to the Kuwait crisis *(MEED, 25 January, 1991, 10).* There were, however, clear threats made by Saddam's son (who was the Minister of Energy) that if Turkey stopped giving Iraq its required water, they would know what to do *(Frankel, 1991, 261).* The Turkish authorities have repeatedly said that they do not intend to use the river as a political or military tool against their neighbours to the south and their behaviour during the Gulf Crisis and War of 1990-1991 appears to confirm that Turkey is pursuing a long-term policy which does not introduce any unnecessary increments of tension and resentment to relations with its downstream riparians. The Turkish press claimed during the Gulf war that the Ataturk Dam represented a prime military target *(Dateline, 18 August, 1990, 1).*

E5. Relations between Turkey, Syria and Iraq

A deep study of the conflict between the states concerning the sharing of Euphrates river water teaches us that the subject of water cannot be isolated from broader geographical, historical, political and economic issues. Thus is needed to understand the true importance of hydro-politics on the background of the complex of relations between states.

The examination of the relations among the riparian states shows the importance of four factors. These factors include the respective policies of the three states toward the amount of water to be drawn from the Euphrates and Tigris rivers, the Kurdish question, the rivalry between the Iraqi and Syrian branches of the Ba'ath party, and Syria's history of animosity towards Turkey.

E5.1 Relations between Turkey and Syria

The source of the difficulties in achieving a real improvement in relations between Turkey and Syria up to 1991 undoubtedly lies in the dichotomy of Turkey's membership of NATO and Syria's reliance on support from the former Soviet union. In other words, the confrontation between East and West is reflected in the Middle East in general and in Turkish-Syrian relations in particular. Even though this tension has been reduced by the world-wide softening of the Cold War, it has not completely disappeared.

Relations between the two countries have not been cordial since 1939, when France, then the mandatory power in Syria, handed the area around Alexandretta (Iskanderun in Turkish, Hatay in Arabic) over to Turkey as a bribe to enter World War II on the side of the allies. Turkey accepted, but then stayed neutral. Syria has never accepted this territorial loss and Syrian maps still show the territory as part of Syria. Damascus has never been able to hide the fact that it considers Turkish sovereignty over the Hatay as illegitimate. Ali Mustafa, the Syrian consul general in Istanbul, argued, in 1985, that Syrian maps still included Hatay region within Syrian borders because "Syria does not accept the present frontiers which were drawn up in Hatay through a referendum, because that referendum was conducted following an agreement between Turkey and France. In those days there was no independent Syrian state". In addition to this, the consul declared that Syria's hostility was at least partly due to Turkey's GAP project, and the construction of the giant Ataturk Dam that would harm Syrian interests. He added that the controversy concerning the sharing of the Euphrates waters should be solved according to the rules of international law governing the joint use of rivers and other waterways *(Bolukbasi, 1990, 27).* Until the late 1970s diplomatic relations remained "correct", yet both sides knew that the state of affairs could best be described as "peaceful coexistence". Perhaps because of this background, Syria has been willing to permit anti-Ankara Kurds and leftist opposition groups to use its territory as a base for operations, and Ankara has sometimes angrily admonished Damascus on the issue *(MEI, 16 February, 1990, 13; Bolukbasi, 1990, 3)*. The subject of Syria's helping Turkish opposition groups during the 1970s by arming them and sending them back secretly into Turkey has aroused the most severe displeasure in the Turkish administration. Evidence has also been put forward suggesting that Syria had helped Armenian terrorists, and during the 1980s had similarly provided arms for Kurdish terrorists. In particular, Syria was held responsible for the fact that Abdullah Ocalan (APO), the leader of the Marxist-oriented Kurdistan Workers' Party (PKK) which was founded in Turkey in 1978, had moved his headquarters to Damascus and, from 1984 on, had sent Kurdish terrorists, trained in the Bekka valley of Lebanon, (under Syrian control), into Southeast Anatolia. Syria has refused to admit training and arming members of the PKK, or providing facilities for them.

In December 1986, Turkish police claimed that they had discovered Syrian-backed terrorists operating to blow up the Ataturk dam *(The Middle East, October 1987, 27)*. The Turks reported that there were three training camps in northern Syria housing militants belonging to the "Armenian Secret Army for the Liberation of Armenia" (ASALA) and the PKK, and that Syrian agents, disguised as diplomats, had delivered arms to ASALA militants in various European countries. On 17 September 1986 the PKK Central Committee held a meeting in Damascus where it decided on more increasing its operations, especially its crossings of the Turko-Syrian border into Turkey *(Bolukbasi, 1990, 24;41)*. The Syrian Prime Minister Abed al-Rauf al-Kasm stated in 1986, that Damascus was unable to prevent PKK incursions into Turkey because Syria, with a long frontier, had no army in the north, since it was needed to watch the enemy in the south. Thus, although Syria was doing its best to avoid friction with Turkey, they could not keep the border under strict control*(Bolukbasi, 1990, 34)*.

In July 1987 the Turkish Prime Minister Ozal went to Damascus and two months later Kadurra, the Vice-Prime Minister of Syria, went to Turkey. At these meetings, a protocol for "Cooperation on Security Problems" was signed, bringing up a number of bilateral matters dealing with the prevention of the smuggling of goods across the common border, the cross-border trade in counterfeit money and the return of fugitives to the country from which they were escaping *(Lewis, 1991, 73)*.. In addition discussions were held on the prevention of terrorism (from Turkey's point of view- the PKK, and from Syria's, certain elements of the Syrian Moslem Brotherhood). Particular attention was given to the important problem of regulating the water of the Euphrates. As a result of his visit Ozal proposed Turkish help in the prospecting for gas and oil in Syria, presented a project to supply electricity to Syria if Damascus needed it, and suggested that increased trade and economic cooperation would benefit both countries. His major proposal was, however, the installation of the Peace Pipelines *(Bolukbasi, 1990, 43)*. According to Briefing (1989), the result of this protocol was that the Syrian government moved the PKK camp out of Syria into the Bekka valley in Lebanon. Turkish officials felt that such a move was not sufficient in itself because there was evidence of Syrian territory still being used for many of the PKK attacks. They did not accept the Syrian excuse that the PKK camps were in sovereign Lebanese territory and therefore beyond their reach for, in fact, the Bekka Valley was under Syrian control *(Briefing, 10-17 July, 1989, 5)*. Many questions were left unanswered such as the fate of the PKK terrorists in the Bekka Valley, and Syria's attitude towards the extradition of the PKK leader, Abdullah Ocland, about whose presence in Syria Turkey had documentary proof but about whom Damascus claimed complete ignorance *(Briefing, 20 July, 1987, 15)*.

On 21 October, 1989, two Syrian MIG-21 fighter planes entered Turkey's airspace near Samandag, Hatay, and shot down a Turkish plane killing two pilots and three technicians. Syria argued that its pilots had disobeyed orders and Ankara accepted Damascus' explanation, but many suspected that Damascus was in fact trying to scare Ankara so that Ozal would not dare to use the "water weapon". In November 1989, Jamil al-Assad, the Syrian president's brother, made a statement that a Kurdish state should be established in the region and should also encompass Southeast Anatolia, adding that the Syrian government was providing every kind of political and logistical support to the PKK. Later on in December 1989 the Syrian Minister of Information, Mohammad Salman, claimed that his country did not recognize the Hatay region as part of Turkey. All these were perceived by Ankara as a Syrian attempt to build up tension between the two countries in order to force Ankara to revise its "water policy", and agree to Damascus' demand to sign a treaty to formally share the water of the Euphrates *(Bolukbasi, 1990, 50)*.

In a sense Turkey was taking a "wait-and-see" stance towards Syria to see if Syria would, in fact, take serious steps to broaden the scope of its relationship with Turkey, especially its economic and commercial relations. However, there was a certain reticence on the part of Syrian officials about the prospect of coming too close and thus becoming more dependent on Turkey, as had already happened in the matter of water *(Briefing, 10-17 July, 1989, 6)*. Turkish exports to Syria in 1989 (first 8 months) reached 110 million US dollars, of which nearly half were agricultural products *(Erengul, 1990, 15)*. According to Ozal, Syria was a very important "key country" in the Arab world and relations with it would further increase its importance in the region. Ankara's close ties with Arab and Islamic countries also had a great importance for Turkey's relations with the west *(Briefing, 20 July, 1987, 15)*.

The visit of Syrian Foreign Minister, Farouq Al Shara, to Ankara in March 1991, marked a new phase in the relations between the two countries. These relations, often strained in the past because of the issues of the water of the Euphrates and cross-border security, have vastly improved since the two countries found themselves on the same side of the fence during the Gulf crisis; but according to The Sunday Times (1991), Hafez al-Assad, the Syrian president, ordered his soldiers in Lebanon to leave the PKK base alone because he wanted the camp as a bargaining chip against Turkey which he feared could use the Euphrates dams to cut off Syria's water *(The Sunday times, 13 October 1991, 24).*

According to The Guardian (1992), the Turkish Interior Minister, Ismet Sezgin, visited Damascus on 17 April 1992 and, as a result, Turkey and Syria have drawn up two protocols aimed at improving joint border security and removing the PKK from the Bekka *(The Guardian, 18 April 1992, 12).* According to Briefing (1991), there was a visible desire on both sides to overcome the traditional problems which had beset bilateral relations in the past *(Briefing, 25 March, 1991, 9).* When it came to discussing bilateral issues, the Syrian's again brought up the topic of the water of the Euphrates. Neither side harbours the illusion that the water issue will not be a focus of discussion again and again in future contacts between the two capitals, but there appears to be a recognition, that water could become the cause of fresh tensions in the region as it seeks to recover from the Gulf crisis; and therefore, cooperation is needed to prevent this *(Briefing, 25 March, 1991, 10).*

E5.2 Relations between Turkey and Iraq

The Turkey-Iraq situation is rather different since Iraq and Turkey are more than just a neighbours but major trading partners with Turkey buying a substantial part of its oil from Iraq, some of which acts as rent for pipeline and port facilities in Turkey through which Iraq ships oil to international markets (till the embargo resolution of the UN in 1990).

According to the Turkish National Pact adopted by the last Ottoman Parliament on 28 January 1920, the Mosul area (the towns of Mosul, Kirkuk, Suleymaniye and their surroundings), had to remain within the Turkish border. On 1 May 1920, Mustafa Kemal (Ataturk) declared that this would be the case in 1925, however Britain, bearing in mind the oil fields in the Mosul area and the strategic importance of Iraq, decided that the whole of the Mosul area was to remain in Iraq. Turkey did not participate in the Council of the League of Nations at which this decision was taken unanimously and was not in a position at that time to consider changing the *fait accompli,* which would have meant going against Britain, so, instead, she re-opened talks with Britain in 1926. In exchange for certain concessions, Turkey accepted the decision of the League of Nations, and signed the "Treaty between Turkey, the United Kingdom and Iraq concerning the establishment of the border between Turkey and Iraq", thus putting an end to the dispute over this border *(Lewis, 1991, 29)*. Since then, the two countries have been on fairly good terms although the Turks still say that the oil producing area of Mosul should have been allotted to them after World War I rather than being incorporated into the new Arab state of Iraq, then under British mandatory rule. Since the 1926 agreement, however, there has not been a single territorial dispute between these two states.

Indeed, Iraq and Turkey have another common interest: the suppression of Kurdish dissidents in their frontier areas, and this is the major factor which has led to cooperation between the two countries. Both states have been generally careful not to harbour or support the other side's opposition groups and when the Iraqi army was preoccupied with fighting Iran in the Gulf War, Iraq even granted the Turkish army the right of "hot pursuit" of Kurds across the border. After the closure of the port of Basra during the Gulf War, road and rail links across Anatolia and from Iskanderun, became Iraq's back door for supplies. What is more, new and enlarged pipelines carried Iraqi oil to the export terminal in Yumurtalik near Mersin and, in normal circumstances 60 per cent of Iraq's total oil output would flow across Turkey. Thus Iraq, heavily dependent on Turkey's good will, cannot strongly protest about that country's unilateral usurpation of the Euphrates water *(MEI, 16 February, 1990, 13)*.

Turkish-Iraqi relations made very rapid progress from the mid 1970s until the end of the 1980's on both the economic and political fronts and, after April 1982, Turkey became the major outlet for Iraqi oil. In 1977 a first pipeline was laid from Kirkuk in Iraq to Yumurtalik in Turkey and, by the end of 1984, the Kirkuk-Yumurtalik pipeline's capacity had been extended from 700,00 barrels per day to 1 million barrels per day. In 1985 Iraq and Turkey began building a second pipeline through Turkey which was completed by June 1987 increasing oil exports via Turkey from 1 million to 1.5 million barrels per day. Thus nearly half of Turkey's annual 20 million tonnes of oil imports comes from Iraq as well as 280 million dollars in royalties per year for the oil transported via these pipelines. Without the Turkish outlet, Iraqi oil exports would have come to a virtual standstill long ago *(Inan, 1989, 51; Bolukbasi, 1990, 22)*.

Turkish-Iraqi cooperation reached its climax when both sides signed the security protocol in October 1984 whereby Iraq granted Turkey the right of "hot pursuit". The protocol allowed forces from either country to pursue "subversive groups in the territory of the other" up to a distance of five kilometres, thus Turkey could continue pursuing members of the PKK into Iraq and, in August 1986, Turkish planes first bombed camps set up by the terrorist organization on the Iraqi side of the border *(Lewis, 1991, 70; Bolukbasi, 1990, 21)*.

Turkey and Iraq have, however, faced several major problems over the last few years particularly Baghdad's increasing concern over Turkey's GAP project and the feeling that it was left out of the Damascus-Ankara agreement of July 1987 over the sharing of the Euphrates water during the building phase of the Ataturk Dam. During his Baghdad visit in April 1988, Ozal declared that the Turkish-Syrian agreement was a temporary one and that the real treaty would be reached through tripartite talks to be held by the three countries *(Bolukbasi, 1990, 39).*

The failure of the respective governments to reach an agreement over oil prices has led to a drastic decline in trade between Iraq and Turkey. In 1989, Turkish exports to Iraq were reduced to one quarter of what they had been in 1987, and imports from Iraq (95 per cent of which were oil), were halved. Turkish exports to Iraq in 1988, when the trade volume was at its peak (986 million US dollars), had consisted mainly of live animals, poultry and eggs, cereals, chemicals, and iron and steel products *(Erengul, 1990, 15).*

Following Iraq's invasion of Kuwait on 2 August 1990 and Turkey's compliance with the subsequent embargo resolution of the UN, the pipelines were closed, but the Kirkuk oil installations and the Iraq-Turkey pipeline survived the Gulf War undamaged *(Lewis, 1991, 69).* The closing of the pipeline, introduced a problem of distrust in the mutual relationship which will not be easy to overcome since, until recently, Turkey had conveyed the impression to Iraq that it viewed the pipeline as a commercial enterprise, protected from the uncertainties of politics. Turkey's closing of the pipeline has left the Iraqi government suspicious that the pipeline might be turned off whenever it suits Turkish economic or political interests.

The political cost of the Turkish action may be no less serious than the economic cost. It should be remembered that of all Turkey' s neighbours, Iraq - along with the former Soviet Union - is the country with which Turkey has the fewest problems. The Iraqi regime not only does not try to base its legitimacy on religion (being more secular than many other Middle Eastern countries) but, unlike the Islamic revolutionaries of Iran and the fundamentalist conservatives of Saudi Arabia, Iraq has no ideology to export to Turkey which might cause strains and stresses in the basically secular Turkish society. In addition Iraq and Turkey have no territorial claims against each other.

E5.3 Relations between Syria and Iraq

Relations between Iraq and Syria in the 1940s and 1950s were characterized by asymmetry. Iraq, the stronger of the two, with significant economic resources, a stable leadership, and ambitions for the dominance of Syria, was capable of intervening and affecting Syrian politics. Syria was relatively unable to affect Iraqi politics and its politicians were pleased to receive financial and political assistance from Iraq. Between 1955 and 1958, relations between the states took on an ideological dimension and the main motive for Iraqi activity in Syria during those years became more and more defensive: to prevent Syria from joining the anti-Iraqi, pro-Egyptian camp. The rise to power of the Ba'ath parties in both Syria and Iraq intensified the rivalry between the two countries by adding the dispute over the legitimacy of their respective regimes *(Eppel, 1991, 3)*.

The Ba'ath regimes of Syria and Iraq have been in conflict since the very beginning of their coexistence in July 1968. According to Kienle (1990), this conflict, until 1972, chiefly arose from the desire of the Syrian rulers to monopolize Ba'ath legitimacy and prevent certain categories of their Ba'ath supporters from shifting their political allegiance to the regime in Baghdad. Although the Syrian rulers partly overestimated the danger, such tendencies did exist among certain members of the Syrian establishment, mainly those who occupied key positions in the army and the party and who threatened to erode the regime in Damascus from within. Reviling and attacking the more attractive Ba'ath neighbour seemed to be the most adequate from of self-defence. With the increasing consolidation of the structure of the Syrian regime bilateral relations in 1972 entered a calmer period that, nonetheless, was marked by serious and narrow conflicts of interest *(Kienle, 1990, 170)*. Given the lack of democracy and, the inability to maintain legitimate opposition activity, the forces and personages opposing the regime in each state found asylum within the rival country. Syria persistently encouraged and assisted Iraqi groups which opposed Saddam Hussain and his regime, including the Kurdish opposition operating from Damascus. Assad's opponents and Syria's enemies likewise received assistance from Baghdad and, since the early 1970s, Iraq has been granting assistance to anti-Syrian groups *(Eppel, 1991, 6)*.

In 1975, relations between the two countries reached a crisis level over economic interests, involving such questions as the pipeline from Iraq to the Mediterranean and the division of the water from the Euphrates, and this led to the massing of military forces on the Iraqi-Syrian border. In April 1976, after the breakdown in negotiations over fees for the transit of Iraqi oil across Syria and the price for supply of Iraqi crude, Iraq cancelled the transit agreements and cut off oil supplies until February 1979 when a new agreement was reached and supplies resumed *(Drysdale, 1990, 351; EIU, Syria, 1991-92, 34)*. According to Waterbury (1990), it is in this respect that side issues and side payments became especially important. One of these already manifested itself in the mid-1970s, and that was the deal made between Iraq and Turkey to construct an oil pipeline from northern Iraq to the Mediterranean in Turkey. This was seen by Syria as a hostile act, which threatened the existing, economically vital pipeline through Syria and part of Syria's intransigence towards Iraq over the Euphrates must have stemmed from this affront *(Waterbury, 1990, 18)* . During the 1970s and the 1980s, Iraq frequently accused Syria of withholding up to 60 per cent of Iraq's share of the Euphrates water but Damascus denied this.

Even after the loss of its Gulf ports at the outset of the Iran-Iraq war Iraq was able to use both the Turkish and Syrian pipelines. Although the Syrian pipeline was damaged at the beginning of the war it became operational again by December 1980 and, in 1981, Baghdad was exporting 500,000 barrels per day through the Syrian pipeline. Syrian-Iraqi relations which had already started to deteriorate after the aborted unity attempts of 1978 and 1979, however, reached their lowest point during the beginning of 1982 and, by early 1982, the Iraqis felt that Syria was not only supporting Iran in the Gulf war, but was trying to bring down Saddam Hussain as well. In July 1982, when Iran had recaptured most of the Iranian territory and carried the war into Iraq, Syria also pressured Iraq by shutting down the Iraqi oil pipeline which carried oil to Banyas and Tripoli in Lebanon as well as closing the Syrian-Iraqi border. With the loss of the Syrian pipeline the only remaining outlet for Iraqi oil exports was the Turkish pipeline, but the closure of the Iraqi-Syrian border also forced the shut down of the Turco-Iraqi railway, which passed through Syria, and was used by Iraq to import European goods *(Bolukbasi, 1990, 18)*.

Saddam Hussain, who replaced Ahmad Hasan al-Bakr as president of Iraq in July 1979, started a large scale purge within the Ba'ath in February 1980, and there were abortive coups and assassination attempts made against him during 1980. Saddam held Syria responsible for these attempts which contributed to a drastic deterioration in relations. Saddam's ambitions for regional power and Iraq's growing military strength were among the factors which led Assad to approach Iran in a spirit of cooperation during the war against Iraq. The end of the Iraq-Iran war in 1988 increased Syrian fears of Saddam Hussein's ambitions and of the Iraqi military machine, which was now unhampered by war. After the August 1988 Gulf cease-fire, already poor Iraqi-Syrian relations were further strained by Baghdad's active military and material support of General Aoun, the head of the Christian military government in East Beirut, who during

1989 and 1990 had waged a "war of liberation" against the "Syrian occupation force" in Lebanon *(EIU, Iraq, 1991-92, 6)*.

Before Iraq invaded Kuwait on August 2, 1990 and annexed the Emirate, there had been signs of a possible rapprochement between the two Ba'athist rivals, Syria and Iraq. The two sides found common ground on issues such as the sharing of the Euphrates water, and the Israeli problem. Iraq was important to Syria as its strategic depth against Israel and as an Arab partner in its relations with Turkey in the dispute over the Euphrates water. Paradoxically, Syria needed an Iraq which was militarily and economically strong but, at the same time, one which both refrained from regional ambitions, (to avoid endangering Syria and its leadership), and adapted itself to the considerations and priorities of the Syrian leadership. The Iraqi invasion of the Arab state of Kuwait was, for the Syrians, clear proof that their previous suspicion regarding the nature and tendencies of Saddam Hussain and his regime were correct. The immediate Syrian response to Iraq' s invasion of Kuwait on 2 August 1990 was a call for the urgent convocation of the Arab summit conference. Shortly after the Gulf crisis erupted, Syria adopted a pro-western approach, joining the US led international coalition to protect the Saudi Kingdom. Together with Egypt and Morocco, it was one of the three Arab countries to dispatch troops and armoured tanks to the Gulf to join the US led multinational military force. Syria's long land border with Iraq has made it a crucial factor in the enforcement of UN trade and military sanctions imposed against Iraq as a result of the latter's aggression *(EIU, Syria, 1991-92, 8)*. Syria's insistent and uncompromising attitude resulted from fear of Iraqi expansionism and of Saddam Hussain's increased strength, should his move into Kuwait prove successful. An Iraqi success in Kuwait would have tipped the balance of forces even further to Syria's disadvantage, endangering the status and survival of Assad's regime and, perhaps, that of Syria in general. The attempt to forge a united opposition front against the Ba'athist government in Iraq, (which fell apart in the shambles of the failed Kurdish and Shia uprising of March 1991), was finally resurrected in December 1991 *(EIU, Iraq, 1992, No. 1, 8)*.

E6. Conclusion

The diplomatic relations between Turkey and Iraq are fashioned by three principal factors.

a) The sharing of Euphrates river water.

b) Security issues - problems with the Kurdish minority in Northern Iraq and South-Eastern Turkey.

c) Close commercial links including a safe, continental conduit for Iraqi oil.

The national aspiration of the Kurdish minority obliges Turkey and Iraq to co-operate in order to safeguard their common interest in maintaining stability in South-East Anatolia and Northern Iraq especially in the area of Kirkuk and Mosul where half of Iraq's oil is also produced. The Iraqi pipeline to the Mediterranean also traverses Turkey through an area mostly settled by the Kurdish population and this also requires the states to co-operate. Thus, particularly since the eighties, Iraq and Turkey have co-operated against the Kurdish population and principally against the PKK. One must remember that the establishment of a Kurdish state in Northern Iraq would probably have far reaching implications for the national aspirations of the Iraqi Kurdish minority in South East Anatolia.

The close commercial links between Turkey and Iraq up to the Gulf War relate to the logistical importance of Turkey as a safe passage-way for the transportation of goods to and from Iraq, including its being a reliable continental conduit for Iraqi oil. 60 per cent of Iraq's oil at the end of the eighties was exported through Turkey as well as a significant amount of other commercial products.

Iraq's has become Turkey's preferred source of oil supply but Turkey has benefited from transfer payments and Iraq's political and economic dependence something which has enabled Turkey to develop its exports to Iraq.

Iraq's invasion of Kuwait in August 1990, had far-reaching ramifications for the web of diplomatic relations between the states. Without Turkey's co-operation it would have been impossible to carry out any efficient economic embargo against Iraq. Despite this Iraq's economic and political dependence upon Turkey can be seen in the fact that Turkey was the first state with whom Iraq tried to rehabilitate its relations after the end of the war. Thus it is reasonable to assume that after the economic sanctions against Iraq are cancelled the previous relations between the two states will be restored to what they were.

Of all its Muslim neighbours Syria is the one with which Turkey has the coldest and tensest diplomatic relations. The main area of contention between the two states for several decades was the fate of the Alexandretta territory which was annexed to Turkey in 1931 with France's consent. Since the seventies, however, the issues of sharing the water of the Euphrates and the Syrian assistance to the radical anti-Turkish movements (mainly Kurdish and Armenian) have dominated the relationship between the two states. During the middle of the eighties it was already possible to talk about a network of relations based upon water for security. Syria's support for Greek-Cyprus, from 1974 on, did not make matters easier for the relations between the states.

Although Syria and Turkey co-operates against Iraq during the Gulf War and it appears that this co-operation reduced the mutual distrust between the states, one cannot yet identify any significant change in their relations. On the other hand a future forecast suggests Syria will need to come out of its political and economic isolation and therefore will improve its network relations.

Examining Syria and Iraq's complicated relations we can observe that although the issue of sharing the water of the Euphrates brought the two states to the brink of war in 1975 it appears that since then both states have avoided conflict over the water. Syria did not exploit its position as an upstream state to harm Iraq and, even more, the same subject caused Syria and Iraq to co-operate in 1990 against Turkey's development plans.

There are no two regimes more similar to each other, both structurally and ideologically than Syria and Iraq in the Arab World that severe disagreements over political, diplomatic, economic and strategic relations as well as personal rivalry between the leaders (which has worsened over the years) are what shapes the relations between the states.

From an economic point of view Syria harmed Iraq by stopping the flow of oil in the pipeline from Kirkuk in Northern Iraq to the ports of Baniyas and Tripoli on the Mediterranean Sea for the first time in December 1966 and then in March 1967. In 1972 Syria nationalized the Syrian section of the pipeline and in 1973 forced Iraq to double its transit payments. From 1976 to 1979 Iraq stopped the flow of oil in the pipeline in protest over the intervention of Syria in Lebanon and, in 1982, Syria stopped the flow of oil in order to damage Iraq's war effort against Iran. Since then the pipeline has been closed.

Syria militarily supported Iran in its war with Iraq in 1982 and then again, in 1990 it supported the Alliance in its war to remove the Iraqi forces from Kuwait. This support by Syria in the war against Iraq did not only arise out of the severe rivalry between the leaders and the different ideological points of view of the Ba'ath parties but that this military intervention helped Syria to overcome a crisis connected with the end of the Cold War, the collapse of the communist regime in the Eastern Bloc and so allowed it to begin to develop economic and political ties with the western world.

F. Models from International Law

F1. The nature of international law

The utilization of the waters of an international drainage basin raises many problems with respect to both international relations and international law. Water rights have been the subject of state concern ever since the earliest appearance of any form of state organization. In the light of the most recent research it may not even be going too far to say that the organization of the state as it has been known over the last six thousand years had its origins in water rights. The history of water legislation in the Middle East goes back to antiquity and appears in extant ancient Talmudic, Muslim, and Ottoman law as well as in modern water laws *(Hirsch, 1957, 2)*. It is only in the last century since the increased development of systematic irrigation planning, domestic and industrial consumption, and hydro-electric power that water relations between states have become a complex legal problem. This problem still contains many uncertainties and unsolved questions and is, in view of the ever increasing shortage of water throughout the world, one of the most important fields of research in international law at the present time.

In the area of management of international water bodies, the geopolitical considerations and hydropolitical implications for the co-basin countries cannot be divorced from the technical, legal, economic and environmental issues. When water becomes scarce and is considered to be a strategic national resource, hydropolitics needs to be taken into account for the national management of international water bodies *(Biswas, 1993, 179)*.

Law, an instrument which can be used to smooth out conflicts of interest in the sharing of water resources, provides guidelines for ordering future conduct. Law can be determined by a court action which may set a precedent that becomes a "guideline" for future cases but may also come from legislation by an administrative body, for example a government, which passes a statute when it sees a need. According to Barrow (1987), in many countries the state constitution affects water rights and water management because it binds legislation and common law or its equivalent *(Barrow, 1987, 68)*.

International rivers are of two general categories: those that flow between the land territories of two or more states (contiguous or boundary rivers), and those that flow from the territory of one state into the territory of another state (successive rivers). In the case of a successive river one state is in complete physical control of the river as it passes through its territory, while in the case of contiguous rivers, there is dual physical control of the waters. The sources of both successive and contiguous rivers bring them into physical contact with the land territory of two or more states and one type of river is no more a separate physical unit than the other. Even the geographic distinction between the two kinds of rivers can, in some cases, be more apparent than real, for a river may be both successive and contiguous. For example, it may flow through the territories of two states and, at some point, between their territories as well *(Garretson & Haydon, 1967, 17).* The Helsinki rules define an international drainage basin as "a geographical area extending over two or more states determined by the watershed limits of the system of water, including surface and underground waters, flowing into a common terminus. A basin state is a state or territory which includes a portion of an international drainage basin" *(United Nation, 1977, 78).* The International Law Commission (ILC), has provided a different definition of an international river. "International watercourse means a watercourse, parts of which are situated in a different state. Watercourse means a system of surface and underground waters constituting, by virtue of their physical relationship, a unitary whole and flowing into a common terminus" *(Environment Policy and Law 21 May 1991, 249).* The difference between a river, tributary, watercourse or stream is largely one of degree measured by the size, length and breadth of the watercourse; but, in the legal sense, there is no particular difference between them.

The state located uppermost in the drainage basin of an international river is normally in a position to exercise its control over the waters first. Generally, there can be only one such "upper basin state" since all other states within the drainage basin are "lower basin states" with respect to that state, although, in turn, some may be "upper basin states" with respect to others. In the case of an international drainage basin composed of a tributary stream in addition to the principal river, there may be more than one upper basin state relative to all other co-basin states *(Garretson & Haydon, 1967, 1).*

State territory, which is a principal sphere of "essentially domestic" matters, undoubtedly includes those waters flowing within it, which are so-called "national waters". As a result of its physical qualities, water which is in the territory of one state today and therefore a part of its state territory, will flow, into the territory of another down stream state tomorrow and become part of that state's territory. According to Berber (1955) the fact that one part of state territory (in contrast to the definition of territory), is movable and, even naturally, a fluid element, gives it a characteristic similarity to the most mobile elements of nature such as the clouds and the winds, despite its association with the most stable of all elements, the land. This contradictory character of flowing water raises complicated questions in international law. By definition it belongs to the domestic jurisdiction of the territorial sovereign; but the territorial sovereign acts to the full extent of its powers, and interferes with the legitimate expectations of the lower riparian. Contemporary international law is based on the distinction between internal matters, which are only concerned with the individual state, and matters of international importance, over which no single state has exclusive jurisdiction. The boundary between the two is fluid *(Berber, 1955, 4)*. In general, the rights of any country with respect to a river pertain only to that section that lies within its territory and under its sovereignty. More precisely, the rights of the country pertain to the river bed rather than to the water, since it is limited by international law in what it may do with the water; and what it can do with the water may be done only as long as the water is in that part of the river bed in that particular state's territory. A river that crosses the borders of a country remains under that country's jurisdiction only as far as the border of the next country, where the river becomes part of the territory of a different state *(Hirsch, 1956a, 207)*.

In the Middle East today, five elements of water legislation are discernible and they are based upon:

1) Local customs, based in part on legal principles perhaps dating back to earlier antiquity, which may still dominate the water relationships in many parts of the area.

2) Principles of religious law (or civil-law provisions of religious law codes) often provide a theoretical super- structure which has an independent legal existence overshadowed by ancient customs, on the one hand, and more recent legislation on the other.

3) Ottoman law which has survived in many parts of the Middle East and remains an important factor for water laws.

4) The independent states of the region which have also passed more recent legislation, some of it enacted after these states attained independence *(Hirsch, 1956, 147)*.

5) International law, founded on the concept of the nations that participate in the system.

International law comes from international agreements, international custom, and general principles of law and its principles are based up on equity and natural justice. However, while international law cannot provide all the needed answers, it is, nevertheless, essential if legitimate answers are to be found. There are several aspects of international rivers that are legally relevant and they are: water use; water allocation; water pollution and joint development *(Solanes, 1992, 116)*. Hypothetically, legal principles can be effective devices for settling problems which arise over the competing uses of water. These principles are fairly well developed in legal theory, but the institutional machinery for applying them is still rudimentary, especially in the international arena. International legislation can result from new approaches to settling water conflicts but it cannot, a priori, direct the search for a solution *(Naff & Matson, 1984, 4).*

In pursuing their claims for the water resources of an international river, riparian countries have pressed certain theories into service which have received varying degrees of acceptance over the years. Reviewing the principles which govern the use of waters flowing through more than one state, one finds that there are several similarities in the approach taken by the scholars. Berber (1955), Garretson & Haydon (1967) as well as Rogers (1991) and Solanes (1992) define four basic principles:

1. Absolute territorial sovereignty
2. Absolute territorial integrity
3. Limited territorial sovereignty
4. Community use of the waters.

1. Absolute territorial sovereignty. This principle favours only the upper riparian and is the most controversial of the theories. It derives from the complaint by Mexico about the flow of the Rio Grande on the United States side of the border (Harmon Doctrine) and claims the right to the free disposal of water within a state's territory but without the right to demand free flow from other countries. According to this other riparians do not have any rights to constrain a country's use of a river within its own boundaries. This doctrine, which contradicts international law, was rejected by the U.S.A after it was used only a few times.

2. Absolute territorial integrity. This principle appeals only to lower riparians who are more powerful and, where there are several riparians, only to the lowest. The basic principle of the theory states that sovereign rights are limited by the duty not to injure the interests of other members of the international community. The consideration one state must take will also express itself in relation to the advantage gained by one to the injury caused to the other. Furthermore, no state is allowed to alter the natural conditions of its own territory to the disadvantage of the natural conditions of the territory of a neighbouring state. This theory is no longer accepted.

Neither of these principles provide a solution regarding the personal, chauvinistic and conflicting interests of the upper and lower riparians. However, the absolute territorial sovereignty doctrine and the theory of absolute territorial integrity constitute two extreme positions, between which there are other two more pragmatic concepts.

3. Limited territorial sovereignty. This is a restriction of the free usage of the water and is the most appropriate principle for a fully developed legal community; but there is

still a question about whether such a community exists. There is a distinction made between boundary rivers and successive rivers according to this principle.

a. Boundary rivers. So far, boundary rivers have been treated as successive rivers but the application of this law goes beyond its application to successive streams probably because of the establishment of boundaries between states and due to an awareness of the geographic facts which may deprive either state of a natural advantage over the other in regard to these waters. It is a general rule of international law that boundary water is divided among the states sharing the streams as a boundary, with each being subject to the equal rights of the other.

b. Successive rivers. There is a corresponding duty not to injure the interests of a neighbouring state and the sovereignty of each of the riparians acts to guarantee the reciprocal restriction of the actions of each towards the other. Treaties between states respecting successive rivers have one common element - the recognition of the shared rights of the signatory states to utilize the waters of an international river *(Garretson & Haydon, 1967, 33).* Where many states are involved in resolving a legal dispute, there is a legal basis which they all believe necessitates such conduct.

4. Community of water. This principle appeals for the common cooperation of all the riparians involved in sharing the waters in an acceptable way. This is a modification of the third principle and is applicable to a less advanced level of international integration *(Berber, 1955, 14).* This approach considers that the geography of the river often has little (if any) relationship to the political frontiers which divide it and, in order to make optimum use of the waters, it is often necessary to develop a more integrated program for the entire drainage basin. The ideal location for such an installation as a dam for harnessing basin waters for hydroelectric use, for instance, may be within the territory of a riparian state which is not interested in such a use when a less desirable location might be inside the interested state. There are two approaches to this issue. The first prefers to separate the development programmes of each riparian, but permits the use of the territory of a co-riparian state for varying purposes. The second, more advanced approach, considers that a joint effort made by the riparians might best develop the basin for joint benefit without interference to state borders (joint planning, construction, management and maintenance) *(Garretson & Haydon, 1967, 39).* The best expression of the principle of communal water utilization can be found in the Dubrovnik draft (1956), the Helsinki rules (1966) and the ILC draft (1991), which have become the accepted legal foundation for the utilization of international rivers.

It is an assumption of international law that the allocation of scarce resources requires legal adjudication if conflict is to be avoided. International law recognises the community of property among riparian states as a customary rule of law, that is, each of them is entitled to use a share of the river so long as unreasonable injury to another riparian does not ensue. Although this principle has been upheld in the courts, it contains an inherent weakness and has also been challenged by countervailing legal arguments. The flaw lies in the fact that customary rules tend to be highly unstable unless all involved parties have compatible interests, preferably guaranteed by formal agreement. International law has recognised that a river is the property of the community of all riparian states and this has been followed by a recognition of the existence of certain limitations to territorial sovereignty in favour of the international community in general. However, the first step toward translating legal theory into institutional application is the production of political agreements. Such facts are essential to the creation of a broader array of legal instruments for solving international disputes over shared water resources *(Naff & Matson, 1984, 5).*

One can sum up this section with the two doctrines which propound the absolute authority of the state and they are: a) Absolute Territorial Sovereignty, as opposed to b) Absolute Territorial Integrity. These two doctrines first developed during ancient times and do not reflect concordant international law (i.e. international conventions) but the reality of agreements in which states or the empire took the waters of some river for themselves. When a state was located on the upstream part of the river it propounded the doctrine of Absolute Territorial Sovereignty (e.g.. the USA vis-a-vis Mexico) and, if it was located downstream (such as Iraq and Egypt), it propounded the doctrine of Absolute Territorial Integrity. These doctrines were the dominant rule until the end of the 19th century when the body of international law began to develop.

At the end of the 19th century and principally in the 20th century the concept of sovereignty changed. States banded together into international bodies such as The League of Nations or The United Nations and laid the foundations of the International Court in Hague in order to interpret, clarify and lay down basis for the voluntary sacrificing of part of one's sovereignty for the good of "world peace". In this way the body of concordant international law (such as the Geneva Convention and The Law of the Sea) was created and replaced the doctrines of Limited Territorial Sovereignty and The Community Use of Water, doctrines according to which states recognize the water rights of other states and agree to share a resource this would later express itself in the principles of The Helsinki Rules, the ILC draft and the Dubrovnik draft as we shall see anon.

F2. The law of international water resources

The first attempt to identify international rivers was made by the Centre for National resources, energy and transport (CNRET). In its revised edition of a report which was first published in 1958, it identifies 166 international river basins on a world map. In 1978, CNRET published a register of international rivers which identified 214 international rivers and lake basins. According to the report, nearly 47 per cent of the world's area (excluding Antarctica) falls within international basins *(Biswas, 1993, 170).*

The International Law Association, at its meeting in August 1956 in Dubrovnik, Yugoslavia, unanimously adopted a statement of principles "as a sound basis upon which to study further the development of rules of international law with respect to international rivers". Acceptance of these, or substantially similar principles, by the parties to international water disputes might go far towards advancing adjustment and agreement *(United Nations, 1970, 34).*

From the principles of the Dubrovnik draft, it is quite obvious that there has been no attention paid towards a variety of issues such as topographic structure, hydroelectric potential, and the irrigation components, in addition to political, economic and sociological factors. However, pending the establishment of an accepted international code, the Dubrovnik draft statement of principles potentially affords a sound basic philosophy for planning and executing a project for integrated river development in an international river basin. The fifth principle, in particular, should be useful to furnish a guide to the solution of disputes with respect to the use of such waters, recognising, as it does, the pertinence of all equitable and historical circumstances in the resolution of such disputes.

According to the fifth principle "the states upon an international river should in reaching agreements, and states or tribunals in setting disputes, weigh the benefit to one state against the injury done to another through a particular use of the water. For this purpose, the following factors (among others) should be taken into consideration:

a) The right of each to a reasonable use of the water

b) The extent of the dependence of each state upon the waters of the river

c) The comparative social and economic gains accruing to each and to the entire river community

d) Pre-existent agreements among the states concerned

e) Pre-existent appropriation of water by one state" *(United Nations, 1970, 35).*

The above are the general rules of international law applicable to the use of waters of an international drainage basin, as adopted by the International Law Association at its fifty-second Conference in Helsinki in 1966.

The Helsinki rules introduced the concept of international drainage basins as: "the aggregate of both surface and ground water within a given geographic area flowing into a common terminus". The rights of basin states (those sharing a common basin) are outlined by the Helsinki rules which also attempt to establish an attitude towards a variety of issues that the Dubrovnik draft avoided. The heart of the 37 article Helsinki rules is Article 5, whose recommendations contain the " relevant factors which are to be considered included, but are not limited to:

a) the geography of the basin, including in particular the extent of the drainage area in the territory of each basin state;
b) the hydrology of the basin, including in particular the contribution of water by each basin state;
c) the climate affecting the basin;
d) The past utilization of the water of the basin, including in particular existing utilization;
e) the economic and social needs of each basin state;
f) the population dependent on the waters of the basin in each basin state;
g) the comparative costs of alternative means of satisfying the economic and social needs of each basin state;
h) the availability of other resources;
i) the avoidance of unnecessary water in the utilization of water of the basin;
j) the practicability of compensation to one or more of the co-basin states as a means of adjusting conflicts among users;
k) the degree to which the needs of a basin state may be satisfied without causing substantial injury to a co-basin state (see figure F.1)

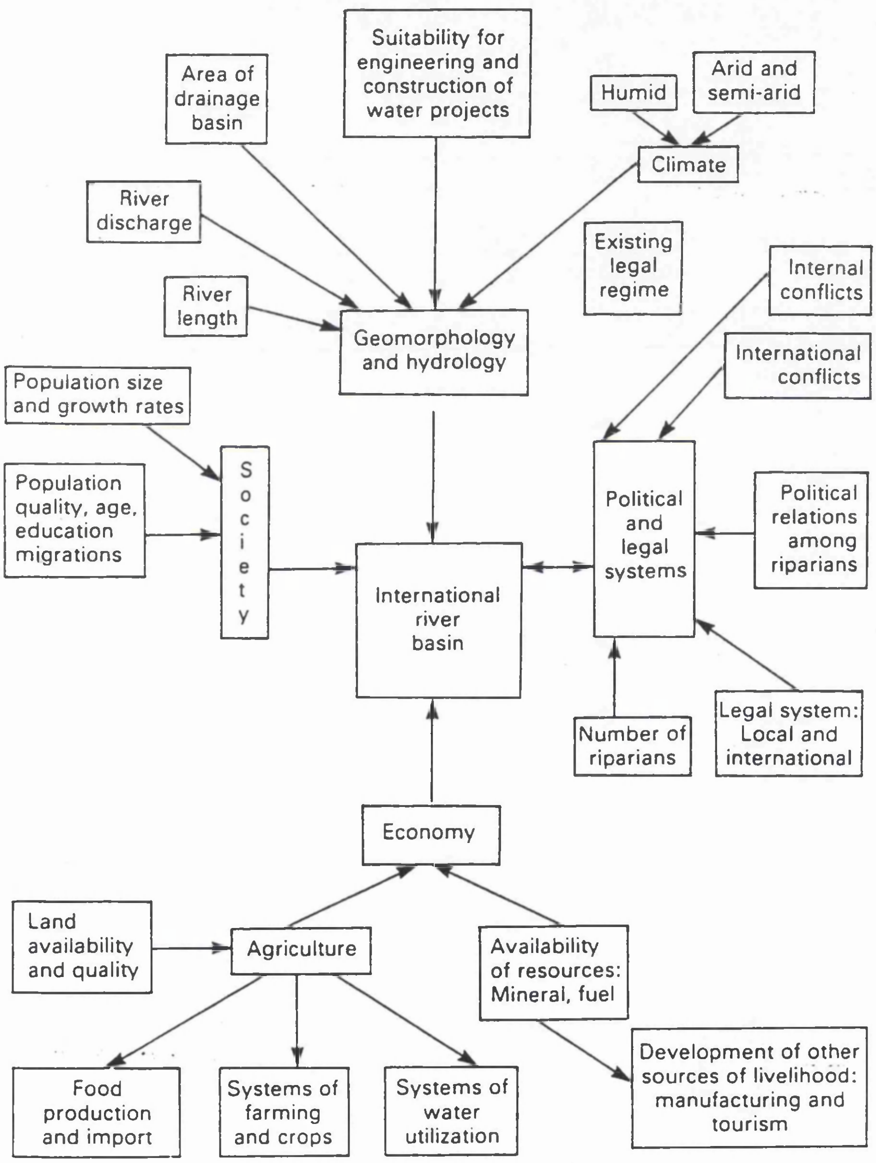
The weight to be given to each factor is to be determined by its importance in comparison with that of other relevant factors. In determining what is a reasonable and equitable share, all relevant factors are to be considered together and conclusions reached on the basis of the whole *(Manner & Metsalampi, 1988, 22).*

Figure F.1, as it is presented by Kliot does not show any difference in the importance between the various factors which appear in the Helsinki rules. Thus, for example, the factor of political and legal systems and the factor of society are far more significant in the system of relations between states than the factor of geomorphology and hydrology. In contrast the factor of economy can, at time, enable a state to find an economic alternative to a shortage of water. As we can see in chapter G there are far more accompanying political issues which influence the system of relations between states, than factors mentioned in the Helsinki rules.

In 1970, Finland introduced a resolution in the UN General Assembly on laws for international watercourses, which proposed that the Helsinki Rules be considered a model. While the UN Committee felt that the subject of international watercourse law was important, three reservations about the Helsinki rules surfaced. First, the rules were formulated by a professional organization which did not represent nation-states. Secondly, some countries such as Ethiopia argued that adoption of these rules as a model could preclude new considerations about this complex issue. The third was expressed in the fact that the Helsinki rules were based on a drainage basin approach, that could be a potential threat to national sovereignty *(Biswas, 1993, 172)*.

Figure F.1:

A framework for the analysis of international rivers based on the Helsinki rules



Source: Kliot, 1994, 13

Since 1970 the United Nations, through its International Law Commission (ILC), has been attempting to establish a set of rules governing to the sharing of international water resources for purposes other than navigation *(Cano, 1989, 168).* The ILC rules contains 32 Articles, offers some simplification of the 37 articles of the Helsinki rules, and develops the mechanisms of regional consultation. The relevant articles from the ILC rules which are compatible with the above Helsinki rules are articles 5 and 6.

Article 5 of the ILC rules states that riparian countries shall, in their respective territories, utilize the water in an equitable, reasonable and optimal manner, avoiding appreciable harm to the other riparian countries. Article 6 specifies the factors relevant to the equitable and reasonable utilization of international rivers and these relevant factors are:

a) geographic, hydrographic, hydrological, climatic and other natural factors;
b) the social and economic needs of the water course states concerned;
c) the effects of the use or uses of an international watercourse (system) caused by one watercourse state to other watercourse states;
d) the existing and potential uses of the international watercourse (system);
e) conservation, protection, development and economy of use of the water resources of the international watercourse (system) and the cost of measures taken to that effect;
f) the availability of alternatives, of corresponding value, for a particular planned or existing use *(Environment Policy and Law, 21 May 1991, 247).*

Rules concerning international aquifers were formulated for the first time at the Seoul meeting of the ILA. The ILA Seoul rules recongnized that ground and surface water resources should be treated similarly and the rules called for the prevention of pollution of international groundwater and, the exchange of relevant information concerning the aquifer and integrated management; but there is no suggestion of how these waters should be divided among the co-riparians *(Kliot, 1994, 8).*

The most significant difference between the Helsinki rules and the ILC draft can be seen in the principle of prior appropriation of the "natural" or historic rights of a state to utilize water, which is stated in the Helsinki rules (Article 4 d). The ILC draft refers to protecting "existing and potential" uses (Article 7 d), rather then "prior" uses of the international watercourse *(Mallat, 1992, 6).* In the context of the Euphrates river, for example, Iraq lost its historical rights to the water, and Syria and Turkey gained priority on the basis of potential uses. In contrast Iraq can try and protect most or part of its rights (dependent upon its bargaining powers) by making claims based upon the ILC draft where Section 5 and 6c state that the equitable allocation of water is desirable as long as considerable damage is not done to one of the co-riparians. A dramatic change in the present allocation of water could, according to Iraq, cause considerable damage. The factor concerning the population that depends on the water in each basin state in the Helsinki rules (Article 4 b), has been deliberately ignored in the ILC draft. This also appears to weaken the legal position of Iraq, where there is a larger population dependent on the Euphrates water. The factor of the "availability of other resources" in the Helsinki rules (Article 4 h), has been replaced in the ILC draft by the "availability of alternative resources" (Article 7 f). in the context of the Euphrates river, and this favours Syria which has fewer alternative resources than Turkey and Iraq (see table F1).

Table F1:

Summary table of significant advantages (+) and disadvantages (-) for the riparian countries of the Euphrates according to the ILC draft and Helsinki rules

		Turkey	Syria	Iraq
1) Helsinki	- past utilization	-	-	+
ILC	- existing and potential uses	+	+	-
2) Helsinki	- population that depends on the water	-	-	+
ILC	- ignored the subject	+	+	-
3) ILC	- equitable allocation has to consider damage	-	-	+
Helsinki	- ignored the subject	+	+	-
4) Helsinki	- the availability of other resources	+	-	+
ILC	- the availability of alternative resources	-	+	-
5) ILC	- obligation to early notice regarding the construction of water project and damage to water flow	-	-	+
Helsinki	- ignored the subject	+	+	-

The ILC draft embraced both the principle of equitable appointment and the obligation not to cause appreciable harm to other states, but without clearly indicating the relationship between the two principles *(Dellapenna, 1993, 19)*.

The Helsinki Rules and, even more so, the ILC draft, reflect the new spirit of international law by laying emphasis upon equitable allocation; and the difference between them also reflects the emphasis upon the new section of "damage protection" which, to quite a degree, contradicts the section on equitable allocation. This is also true for the subject of water quality as it is expressed in Section E of "Conservation and Protection". Another section which refers to the "new spirit" of the ILC is connected to the group of sections which deals with the obligation for consultation between states and the obligation to give prior notice of development plans or intervention into the flow of the river's water. States, through their behaviour in this area, indicate that they recognize the limitations of their sovereignty as well as their obligation to take the co-riparians of their river's drainage basin into consideration.

This may be the place to point out that the ILC draft and, principally the Helsinki Rules, contain many limitations which make their implementation by the co-riparian states difficult. Thus, for example, it is not clear why the Helsinki Rules use the term "Watercourse" - a definition which does not exist in geomorphological terminology and whose meaning is not clear - while they do not use the term: "drainage basin". It seems that the legislation's lack of understanding of geographical terminology has led to this situation. In addition, in the sections of Article 5 which state that geographical factors of the basin have to be considered there is also no explanation of which factors and what weight must be given to each of them and all these features contribute to the lack of clarity.

Another serious problem which would arise in any attempt to apply the articles of the ILC and Helsinki which deal with hydrology is the assumption that there are accurate data about the volume and quality of the water in each drainage basin and, in our case, the Euphrates river basin. A question arises here about how to divide up the river water when the characteristics of the drainage basin are not completely known or when there are no data for a sufficiently long period to show trends of change in the quantity and quality of the water in the river. Trends in hydrology of the basin are affected by climate change and changes in supply over a long period of time. International law is not a sufficiently flexible response to climatic changes which cause changes in flow and does not answer the question about how to apportion the water in the case of several successive years of drought. This is a very significant issue particularly in arid or semi-arid climatic regions, and, in our case, the large perennial differences in the quantity of water in the Euphrates river which makes reference to "average flow", virtually impossible. One must also note here that the articles dealing with different geographical variables do not at all relate to problems such as salinity or pollution of the river water, an area which in our case has very serious implications in the long run for Iraq.

Another problematic area involves the variables which determine the proportion of each state in the drainage basin, of the river bed and of its water contribution. Neither the Helsinki rules nor the ILC offer suggestions about whether or how to give weight to each of the factors involved in the subject. Iraq's share of the Euphrates drainage basin is the greatest, but Turkey contributes 98 per cent of the water and Syria, whose share of water of the basin is the smallest, contributes virtually no water at all.

The whole subject of subterranean water, both within and outside the drainage basin, is completely absent from the Helsinki rules but does receive some attention in the ILC which points out difficulties of two kinds - the problem of measurement and the problem of the flow of subterranean water outside of particular drainage basins. The subject of subterranean water will certainly have to be given additional attention by the legislators.

From the hierarchy of treaties, customs, generally accepted principles and judiciary decisions, it is extremely important to note that neither the Helsinki rules nor the ILC rules are legally binding. The International Court of Justice at the Hague recognises only treaties as binding, but the principle of equitable utilization of international river basins has become the principle most widely advocated by the international legal community *(Kirimani 1990, 204)*. The Helsinki rules and the ILC-endorsed principles can only provide a guiding framework for negotiations.

A major problem with both the Helsinki rules and the ILC draft is that they were devised from the point of view of establishing legal principles rather than from the point of view of the operationalisation of an system of legal, economic and political intercourse. That they were moderated via committee procedures which appear to have included the tendency to compromise and adjust to the political interests of participants has resulted in drafts which lack precision in essential definitions. The most important deficiency, however, is the absence of any understanding of economic principles which might have enabled the value of water to be addressed by those who might use such guidelines and rules. It is understandable that the deliberations should concentrate on the water in river channels and, to the extent which available data allows, to groundwater flows and storage. But such a treatment is a dangerously narrow one and this inadequacy leads to a very partial and generally irrelevant analysis of international water resources in the political economies of riparians. In a national economy surface water flows are only part of the economically relevant water resources of a basin in that precipitation might be an even more important economic resources. Individual riparians have differing endowments of utilisable rainfall which enters their soil profiles and is available for productive cropping. By addressing only the water in surface streams and groundwater flows and storage illogical positions will be taken up by contending riparians.

To be so selective in isolating one factor, water, in the economies associated with productive, or potentially productive, economic activity, is unhelpful in another way because such an approach does not take into account the capacity of real political economies, in which real allocators such as politicians, engineers and farmers operate, to react and develop their economies. These officials and users can, and frequently do, substitute for scarce resources, including water, and otherwise make adjustments to abundance or scarcity.

F3. The riparian approach to international law

From the theoretical point of view, an upper riparian state will initially claim "absolute territorial sovereignty" and this means claiming the right to do whatever it chooses with the water regardless of the effect of the activity upon other riparian states. Lower riparian states begin with a claim to the "absolute integrity" of the watercourse which means claiming that the upper riparian state can do nothing that affects the quantity or quality of water that flows down to the lower riparian states. Eventually, the competing riparian states will reach a "modus vivendi" based on the theory of "restricted sovereignty", meaning that each riparian state recognise the right of all riparian states to use water from a single shared source and the obligation to manage that use so as not to interfere unreasonably with the use of the water in other riparian states *(Dellapenna, 1993, 13)*. The quantity of water to which each state is entitled might be defined according to some more or less objective measure of need such as historic pattern of use, population, area, arable land or the United Nation's clear idea that each state is entitled to an "equitable share" of the river's water.

According to Ergil (1991), Arab countries do not like to be dependent on another power, especially about water which appears to be very important from a socio-psychological point of view. Turkey's southern neighbours both see the Euphrates and the Tigris as the waters of a common basin and, as countries of this basin, they wish to use these waters and share them according to their needs. On the other hand, Turkey sees the Euphrates and the Tigris rivers as single rivers with separate basins. Turkey refuses to accept its southern neighbours' proposals for "common use", "natural" use or "taking water according to their needs" approaches. Turkey does not see these waters as common property but as transboundary water courses. In this respect, international law is also ambiguous. Current international law gives the right of ownership of waters flowing within the borders of a country to that country but, while implementing this, it adds a principle that one should not cause any loss to create a disadvantageous situation for another country. It is neither clear how one determines this "loss", what the "criteria" are nor which authorities are responsible to settle a possible dispute. In this case, the country of origin, Turkey, has certain advantages and international law gives certain rights to the first country in the chain as the owner of the water. The owner has moral and traditional responsibilities to the dependants and the Turkish government is aware of its responsibility *(Ergil, 1991, 52)*; but because of an increased population and the need for food, southern neighbours want to water deserts and infertile lands, activities which can cause the waste of large volumes of water. Both Syria and Iraq, thus, are demanding extra water from Turkey, but are not renovating their irrigation systems, improving watering techniques nor adopting water saving methods. It is therefore not reasonable for Turkey to respond to their southern neighbours' demands which could be interpreted as "we need this much water therefore Turkey ought to share it with us according to our needs alone".

The Turkish government insists that its southern neighbours use available water with minimum waste and then come forth with realistic demands for more water if it is needed *(Ergil, 1991, 55)*.

Turkey does not want a rigid agreement over the Euphrates water since it claims that the river originates in Turkey and is fed on the whole by the rain and snow that falls on its own territory. According to Turkey, there is nothing in international law that says that Turkey must share its water on the basis of a quota system even if there are precedents in this field on an international level *(Briefing, 2-9 July 1990, 10)*. The Turkish former prime minister, Suliman Demirel, gave his opinion on this subject in a recent interview: "If the natural resource is in our country, we have every right to use it the way we see fit. Water is an upstream resource in Turkey and downstream users cannot tell us how to use our resource. By the same token, oil is an upstream resource in many Arab countries and we do not tell them how to use it" *(South, August 1991, 14 ; The Middle East, August 1991, 30)*. Demirel also stated: "The Euphrates and Tigris are not international waters, and nobody foreign has any claims on resources within Turkish boundaries" *(Tekeli, 1990, 211)*. According to Ferruk Amik, the Turkish director general of the State Hydraulic Works (DSI): "Syria and Iraq insist on their right to share the water. We reject this term of 'share'. It is a Turkish river so we are not required to share any of the water" *(Frankel, 1991, 292)*. Actually, in these statements, Demirel and Amik claim absolute Turkish territorial sovereignty over the Euphrates river.

As one can learn from these declarations, even if they have only been made for internal purposes, Turkey supports the principle of Absolute Territorial Sovereignty despite the fact that international law today does not support this point of view. It also must be pointed out that the comparison made between water flowing in an international river and oil deposits found within the territory of some state is not relevant, for when an oil field goes beyond a state's border (Iraq/Kuwait) this factor also causes tension for inter-state relations.

Turkey differentiates between the notions of "international waters" and "transboundary flows" declaring GAP rivers as "transboundary". This Turkish approach is based on two assumptions:

1) Turkey distinguishes between "international" and "transboundary" watercourses in the following way. An international watercourse has its opposing banks under sovereignty

of different countries and such waters are shared by the riparians through the "median line", while a transboundary watercourse crosses common political borders.
2) The Euphrates and the Tigris rivers must be considered as one transboundary watercourse system, since they are linked by the Tharthar Canal before merging as Shatt-el-Arab, allowing the substitution of Tigris waters for demands from the Euphrates *(Tekeli, 1990, 213).*

Iraq and Syria, however, do not accept Turkey's definition of the river as a transboundary river and Turkey will probably have difficulty in basing its claims upon international law. In a statement in 1975, the Syrian Minister of Industry, Mureddin al-Rifai, made his government's position clear on its unequivocal right to development and use of the river; "The Syrian Euphrates project is Syria's future. The Euphrates region is the new Syria and Syria will not be able to stand on its own feet and ensure a stable and prosperous economy in the future unless it is capable of benefiting from its share of Euphrates water. There is no other way" *(Caelleigh, 1983, 127).*

An interview with Professor Yuksel Inan (Gazi University Ankara, 8 July, 1992), gives a broader explanation for the Turkish approach towards international law. Inan claims that Turkey does not insist on "absolute sovereignty", but on the "community of water" principles. He bases his arguments on several examples:

> "According to the 1946 agreement ("the neighbourhood relations agreement") which was made with Iraq, Turkey has accepted the right of Iraq to build dams and reservoirs within Turkish territory. Iraq has also accepted that the best and most suitable place to block the water and regulate the flow of both the Tigris and the Euphrates rivers is be located within the territory of Turkey".
>
> "According to article 3 of the general resolution from December 12, 1974, especially concerning the transplant of the water courses by means of sharing natural resources, every state can use the water resources for its own benefits without interfering with the essential rights of the other states. But prior to any use or utilization, the state concerned has to provide technological knowledge and consult with the other states in order to achieve co-operation in the field. Giving prior knowledge not only means that this is compulsory for technical purposes, but can also aim to diminish the losses that upper riparian states could face. Prior to the construction of the Keban reservoir, Turkey informed both Syria and Iraq of its plans, but Syria and Iraq refused to enter into negotiations at all. On the other hand, in order to achieve the level of investment required, Turkey had to approach several sources and one of them was the ARD (an international investment fund). According to this agreement from August 31, 1966, Turkey promised to give sufficient water to the lower riparian states.

Turkey intended to build new constructions and, new reservoirs but due to the publicity and propaganda of the lower riparians including the Iranians, none of the international finance corporations gave any financial credit to Turkey. When Turkey started to plan the GAP project, it also notified the lower riparian states of Syria and Iraq. The Arab countries got together, but in the end they agreed not to agree. This sort of cause probably led both Syria and Iraq into non agreement. In 1987 Turkey concluded an agreement with Syria and promised to give not less than 500 m^3/sec. This amount was divided between Syria and Iraq with 42 per cent of this flow being used by Syria and 58 per cent by Iraq. This agreement came into force in May 1990 prior to the Gulf crisis" *(Inan, 1992)*.

Another Turkish argument, according to Inan, is based on the length of the Euphrates river in each basin state, the area of the drainage basin and the contribution of water. Turkey contributes 89 per cent of the annual flow of the Euphrates and Syria contributes only 11 per cent of this flow. Since 1987 Turkey has delivered 500 m^3/sec which is more than 50 per cent of the water. In other words, Turkey has agreed to leave more water for the down stream states than they contribute to the system. On the other hand when this whole project came into force, Turkey left two thirds of the annual flow of the Euphrates and Tigris waters which was sufficient for both Syria and Iraq. These two rivers has to be considered as falling from a single basin. Prior to the Gulf crisis Iraq was selling some of this water to Kuwait. By 1992 Turkey consumed only 1.5 per cent of the flow but when the GAP project is completed, Turkey will consume about one third of the whole consumption. Turkey's contribution to both rivers is 19 billion m^3/yr. of water from the Tigris basin and 30 billion m^3/yr. from the Euphrates basin, which amounts to 49 billion m^3/yr. Turkey is going to consume one third of this - 18 billion m^3 per year. 36 billion m^3 of water will be allocated to the lower riparian states, but only if they accept the equitable principles which were requested in the draft articles of the international law commissions (the 1991 ILC draft). These articles, indicate the sorts of principles which should be taken into consideration in order to create equity among the concerned states. In 1976 an additional agreement called "a technical co-operation and economic co-operation" agreement concerning the GAP project, was made between Turkey and Iraq.

"The Turkish principle of equity relates to actual needs. Syria indicates a need of 13 billion m^3/yr. According to European publications its actual need is only 8 billion m^3. Iraq demands 26 billion m^3 of waters and this means that it is claiming more than it needs. Right now Iraq uses only 12 billion m^3 of water from both rivers. Iraq and Syria are still using unsatisfactory techniques for irrigation. If modern techniques are used, Iraqi and Syrian demands for water will decrease. If these two states use modern techniques there will be no disagreement between the consumers. Turkey insists on considering both the Euphrates and Tigris basins as a whole. They both originate from Turkey which makes the greatest contribution to them. The water from the Euphrates and the Tigris should be more than sufficient for Iraq especially after constructing the Tharthar project which links the Tigris and the Euphrates" *(Inan, 1992).*

According to MEI (1990), Turkey in complete defiance of international law, is doing as it pleases, simply because it is the strongest country involved. Neither Iraq nor Syria has even considered taking Turkey to the International Court of Justice. (it would be "ex post facto" now anyway) - where they could present a strong case against Turkey to oblige it to take no more than its fair share of the river's waters *(MEI, 16 February 1990, 13).* The crux of the disagreement may be summarized as follows Syria and Iraq consider the Euphrates river to be international (common) waters and demand their rights to share them accordingly, whereas Turkey, points out the "transboundary" character of the waters, and has come up with a counter-proposal for "rational and optimal utilization". However, it is important to note that neither the Helsinki rules nor the ILC draft recognises the definition of "transboundary river" as Turkey uses the term.

It seems that as long as Turkey continues to base its development programs upon the viewpoint of being an upstream state, Iraq and Syria will continue to make claims based upon the viewpoint of being downstream states. Together with this it is obvious today that Turkey is more concerned than ever about negative international opinion about the way they relate to the apportionment of the river water. This has not led to a change in the development plans but it can be assumed that Turkey's policies today are based upon the principle of - the state can do what it likes provided it appears to be fair from the point of view of international law. It should be noted that the 500 m^3 of water which Turkey has undertaken to transfer to the downstream states annually comes more from the need to produce cheap electricity than any consideration for international law.

It seems that Turkey is also unwilling to sign a trilateral agreement, especially before the conclusion of the GAP as Turkey does not want to place itself under any obligation before the GAP project is fully underway. It seems that the optimal arrangement for Turkey is to insist on its sovereign control of the headwaters of the Euphrates and assure its neighbours that in developing these waters it will always keep their interests in mind, even though it will make no binding commitments.

F4. Conclusion

It has been emphasised in the preceding discussion that a concentration of the legal frameworks devised by the drafters of the Helsinki Rules and the ILC draft on surface water flows places constraints on the scope of any analysis of real water using situations and especially on circumstances where waters are shared. That the Helsinki Rules and the ILC draft have not been the basis of any agreement is a reflection of the lack of fit between what they address and what is important to individual riparians. International law is helpful in disputes over territory, and also in regulating procedures in areas of commerce. The application of international law encounters great problems in other areas, for example in the application of law to environmental issues because there are great problems associated with concepts of environmental evaluation and in valuing the environment generally. Valuing a water resource is easier than valuing the environment, elements of which have intangible and unmeasurable qualities, but attempts to value water are intellectually challenging and therefore easy to discredit in a political arena where simple and familiar ideas are persuasive. That the drafters of the Helsinki and ILC documents failed to take the valuation of water into account reflects partly the predictable unease of one profession, the law, using the tools of another, the economist, partly the recognition that principles of evaluation, even of water, are difficult to establish and operationalise and partly that downstream riparians need to be negotiated out of the idea that water is free. Whenever representatives of downstream countries participate in a drafting session such as the Helsinki and ILC commissions they will insist that free water be the basis of any legal framework and close the option on considering markets in water. That water is being sold by an upstream country, Lesotho, to downstream Republic of South Africa, sets a legal precedent that the legal drafters have yet to accommodate *(Davies, 1992).*

The direct sale of water between countries is for the moment exceptional, but no longer unprecedented. Meanwhile the indirect purchase of water has been an important economic instrument throughout history in that the price of food on the international market includes an actual input of water which is a notional cost to the food importer. If the food importer could gain access to such water for the shadow value of this 'virtual' water it is possible that the transactional costs of producing the equivalent food at home would be less than those associated with food importation. If such water were to be available via pipeline, or ship or 'bag' transporter, it should certainly be seriously considered whether food production would be a viable economic option using such water.

Any review of international law with respect to water is inevitably unsatisfactory which is confirmed by the absence of examples where the Helsinki Rules or the ILC draft have been the framework adopted by negotiators. In addition to the neglect of economics by the drafters another major reason why it is difficult for riparians to use the guidelines for the allocation of water is that water is an element in cultures which attribute to water a high 'emotional' value based on traditions, expectations and practices which did not in the past lead to water deficits. Traditional management of water was also often not irrigation oriented, and since irrigation is by far the most demanding use for water, tensions were avoided. Traditional technologies also tended to be benign in terms of water consumptive use. In addition traditional assumptions that water should be available free were safe for utilisation rates of less than 50 m^3 of water per person per year which is sufficient to service the livelihoods of individuals not involved in irrigated farming. They are, however, very unsafe assumptions when levels of use involving over 1000 m^3 per person per year are expanding in order to support livelihoods on irrigated farms. Inevitably arguments concerning entitlement and rights to water will occur as long as water is assumed to be free irrespective of the returns to be achieved from that water.

Based on past practice water throughout the region is perceived to be free by most users and they do not want to pay even the actual costs of delivery and have no concept of the actual value of water in an economic sense. Water like all elements in a productive cycle has a value which can be estimated, or shadowed, by identifying the cost of obtaining water from an alternative source. In some circumstances such water could come from an expensive desalinisation process or in many cases water would be obtained through the development of new water, either from a groundwater storage catchment or even from another basin involving transport by pipeline.

In these circumstances a constructive approach to valuing water would be best achieved by considering initially the costs of the control works necessary to provide sufficient flow and adequate quality together with the cost of water delivery systems. These costs, at least for the Euphrates surface water flows will be low in terms of cost per cubic metre, say between five and ten US cents per cubic metre. The productive sectors of the respective economies of the Euphrates Basin could support such costs.

The capacity to pay for additional water will be determined by the ability to purchase water in imports. No theory has been developed to determine the value of such 'virtual water', even though for some countries in the region, although not those of the Euphrates Basin, the water imported in, for example, food is already or will become the most important water in their national water budgets. Egypt is such a country, as well as Jordan and Israel and all the oil exporting economies.

Trade in food, rather than the implementation of difficult to agree legal principles of water sharing, is the most readily available means of filling water gaps and is a commonplace solution in the region. Some economies can readily afford to import food. For example a strong oil economy. In the Euphrates Basin, in normal circumstances, Iraq unencumbered by international problems and trade embargoes would be in such a position. Before the 1990 crisis Iraq imported 80-90 per cent of its food and in due course it will resume its role as a major food importer. Meanwhile Turkey does not need to import food except in exceptional years. Only Syria has a significant problem in affording necessary food imports in the long term. In the case of Syria, the only reason that it would need to enter the international market for food in a major way would be if it does not achieve its plans to extend its irrigated area in the Euphrates lowlands. In the 1970s and the 1980s Syria found it more difficult to develop its water than to import food and it appears to be a case of what economist call 'transactional costs' being so high in one set of institutions and practices, in this case the development of water in irrigated farming to produce food, than those available in gaining access to imported food with its implicit content of water required for its production.

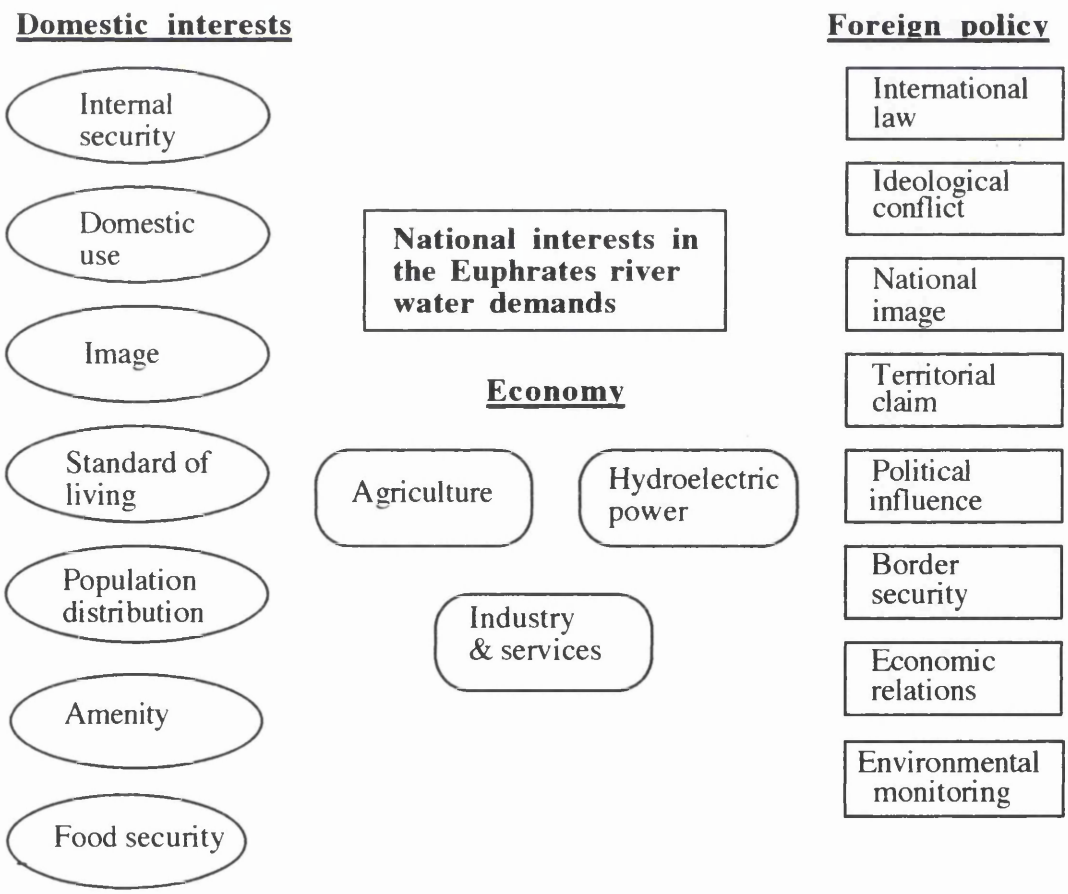
In other words trade in food is a system which can be effectively operationalised. The sharing of water on the other hand according to a legal framework is proving to be an intractable problem because it is impossible to operationalise an agreed procedure of implementation. It is concluded that the sharing of Euphrates waters will become a subordinate issue within the overall political economy of food and water in the Euphrates Basin as it becomes clear, as it has already to some analysts of the Nile water resource where the duplication of demand for water by its riparians is palpable, that the ability to purchase food on the world market is the important capability for arid countries such as Egypt rather than the protection of relatively small volumes of water from upstream sources *(Allan, 1994)*. The Euphrates countries are decades away from the predicament of the countries of the Nile Basin. Meanwhile they are industrialising and will adopt the approach to food provision of industrialised economies, in all probability with much of the paraphernalia of subsidies and support which have been established in such political economies.

G. Factors Which Have an Impact on Domestic Policies and International Relations.

The conflict over the Euphrates water is a good example of a conflict ostensibly over fresh water which, on closer analysis, can be seen to be affected by many factors of which water is just one. The political economy of the catchment area, in which Euphrates water is a significant element, is influenced by the ideological, national and security aspirations of the political entities that occupy the Euphrates basin. In such conflicts one cannot determine which factor is foremost in shaping the approach of an individual riparian at any given time, nor is it possible to determine whether a dispute over the quantity and quality of fresh water resources has led to a political conflict, or vice versa, or whether economic, security interests or ideological factors have, or have not exacerbated the conflict over water.

Figure G1:

Factors where Euphrates water has an impact on domestic policy and international affairs



In order to deal with such complexity it is necessary to address the three major factors that appear to shape the conflict over water use by riparians namely: economic interests, foreign political interests, and domestic policy (see figure G1).

The major ideas and principles which underlie national interests and inspire the policy of national governments are listed and discussed in the following paragraphs.

Economic interests - shaping co-riparian behaviour

Economic factors are of great importance in setting priorities. Although water is nowhere treated as a pure economic good, economic theory does provide some guidelines for policy options regarding efficient water distribution. The three most important economic factors for developing the Euphrates basin are food security, the production of hydroelectric power and the development of industry. A riparian country's perception of future water needs determines whether it will be cooperative or uncooperative in its relations with other riparians concerning the water issue. If a riparian nation foresees a great need for additional water in the future, it will be more defensive in negotiations with other countries; in contrast, if it has little concern about water use, it will more readily agree to the institution of water allocation and management measures *(Abbas, 1984, 208)*.

Economic development, especially in its early stage, is often dependent upon agriculture and agricultural demands for water always dominate water allocation in arid and semi-arid countries (80 per cent in Turkey and about 77 per cent in Iraq). On the other hand, the economic returns for agriculture, and especially returns to water are relatively low compared with those for industry. Industrialization has enjoyed a high priority in the planned government expenditure of all the riparian states, and when industry develops, the amount of water required increases. But food security policies have the most important impact on water resources and are perceived by the governments of the riparian states as a matter of national priority. Food security, in turn, leads to special emphasis on agriculture, which increases the demand for water and for "water security". Stress on water security leads to more tension with riparian neighbours over water, which leads to increased general concern over security, and stiffer defence of agriculture *(Frey, 1993, 63)*. Non agricultural uses of water such as the production of hydroelectric power will also have an impact on the water management of rivers through the evaporative losses from reservoirs. The availability of adequate power generation capacity is considered to be a prerequisite for rapid economic and social development and energy consumption has increased in all the riparian countries very dramatically. However the hydroelectric potential from the Euphrates river is very limited in Syria and

Iraq because of the topographic conditions which do not allow the construction of high dams.

Foreign policy:

Clearly the decisions involved in developing policies for international river development are mainly political and can only be adequately addressed in political terms. It is recognized by international lawyers that international law can only be involved when treaties and mutually acceptable agreements have been signed and ratified. International politics are among the most important features of international river basin development and have to be addressed in any analysis *(Rogers, 1991, 14)*. Several significant factors in international relations influence the degree and intensity of conflict over the Euphrates water. Factors such as national image, international law and linkages with other issues such as territorial claims, border security, ideological conflict and economic relations, can all influence a country's position in matters concerning water resource utilisation (see figure G1): for example, Turkey claims that both Baghdad and Damascus wish to amplify the water issue to deflect attention from their other problems *(Tekeli, 1990, 212)*.

National image:

The concern for a positive national image may be one of the most important factors in deciding how to deal with international water issues. Turkey attaches great importance to the GAP project not only because of its economic and sociological benefits, but also as a matter of national prestige. Syria also has a similar point of view towards the Tabqa Dam project and the economic projects linked to it. On the other hand, the autocratic regimes of Syria and Iraq do not like to be dependent on a non-Arab power, especially for the supply of water which is a very important resource, not only strategically and economically but also from a socio-psychological point of view *(Ergil, 1991, 52)*. Vulnerability to water scarcity contradicts the image of a serious and powerful leadership. The image of political weakness would become evident through palpable water shortages and could be politically destabilizing.

International law:

Another important component in international relations is the riparian attitude towards international law. Nations may either ignore or adhere to the principles of international law. Usually riparians support only those principles of water law that favour their position in a basin, but they may accept widely espoused international principles even when they are to their disadvantage because they do not want to appear to be opposed to international law or to lose their credibility in the world community *(Abbas, 1984, 210)*. The basic principles of international law in the matter of international rivers are based on equity and justice. But as discussed in chapter F, international law does not provide any institutions that automatically establish operational procedures to implement the legal principles. "Equitable" does not mean equal use; rather it means that a large variety of factors, including population, geography, availability of alternative resources and so on, can be considered in the allocation of water rights. The international law for international rivers is not mandatory and cannot compel states to solve international conflicts; however, its principles are widely understood although not publicly accepted by riparian countries. The development of non-binding international legal principles can be an important factor in enabling a country to become involved in negotiations and principles of international law could function as basic guidelines for the management of water equitably in the Euphrates basin states. As discussed in chapter F3, Turkey has drawn attention to the differences between "international" and "transboundary" water courses, and has claimed privileges as a Euphrates upstream state over water sharing. Turkey also claims that, according the international law, the waters of the Euphrates and the Tigris rivers have to be considered as one single basin, and the sharing of the water among the riparian states should be related accordingly. On the other hand, Syria and Iraq consider the Euphrates river as international (common) waters and demand that they be shared according to "common use" or "according to their own needs." Syria's interests will relate to the international law, particularly with reference to articles that deal with the "availability of alternative resources" because Syria is short of water resources compared with Turkey and Iraq. Iraq's claims on Euphrates water relate to the articles dealing with "prior uses" and "historical rights" and the articles dealing with the "population factor". It seems that the Turkish declaration of "absolute territorial integrity" has been made mostly for internal proposes, but as long as Iraq and Syria maintain their demands based on their lower riparian position, Turkey will insist on its advantage as an upper riparian state.

Syria is the only riparian to recognize the ILC principles, being one of only two governments which has. That Syria has agreed the principles is a sign that its position lacks the real power of Turkey to control flows, or of Iraq to enter into compensatory agreements in normal economic circumstances.

Ideological conflict:

The foreign relations of the riparians in the Euphrates basin have fluctuated widely since they came under the influence of western powers following World War I. After World War II, these western powers attempted to bring the riparian countries into their coalition through military alliances such as Turkey's membership in NATO and later the Baghdad Pact. From the 1960s onwards the Soviet Union began to play a more important role in the region and the political differences in the foreign relations of the riparian tended to reflect the conflicting interests of the superpowers in the area *(Abbas, 1984, 225).*

The collapse of communism in Eastern Europe and the break-up of Syria's leading ally, the USSR, at the end of the 1980s, left Syria without the important support of the Soviet Union. On the other hand, the Gulf War provided Damascus with an avenue for shifting its priorities to the western camp. The end of the Cold War and the Gulf crisis, however, have also changed Turkey's priorities and forced it to look further afield than it had in a bi-polar world *(Briefing, 18 January, 1993, 5 ; MEI, 16 April, 1993, 16).*

Linkage with other issues:

Linking conflicts over the water of a river basin with other bilateral or multilateral issues is one way which countries may use to extract concessions from their neighbours. As discussed in section C3, the relations among the Euphrates riparian states are highly influenced by other factors such as territorial claims, border security arrangements, economic interests and ideological conflicts. None of these factors relate directly to the water of the Euphrates river, but they are on the agenda of many bi-lateral meetings and figure in other communications between political leaders; in fact they play a most important role in bi-or trilateral negotiations among the riparian nations. For example, in 1990 President Saddam of Iraq demanded a formal sharing of the Euphrates water, through a trilateral agreement before any economic agreement could be reached with Turkey *(Tekeli, 1990, 210).* In addition, Saddam's decision in 1990 to send his oil minister to Turkey to negotiate over the water issue, can be seen as a reminder of the wide range of concerns involved in maintaining good relations.

A number of issues adversely affect Turkish-Syrian relations and the most important is the Syrian support of the PKK which started immediately after Turkey's construction of the Ataturk Dam and its talk of the "stolen province of Alexandretta". Shortly after the Gulf crisis erupted, Syria adopted a pro-western approach and, as a result, Turkish-Syrian relations improved. Another example of linkage presented by Nasrallah (1990) is that Turkish actions concerning the Euphrates could be seen as political manoeuvres carried out in association with United States interests to continue pressuring Syria through Lebanon *(Nasrallah, 1990, 16).*

Iraq and Turkey have fewer linkage issues which threaten their relations as they have no territorial claims upon each other. Up to Iraq's invasion of Kuwait in August 1990, they had considerably strong economic and political relations as well as common interests in their fight against the Kurds in northern Iraq. One must remember that their mutual economic relations were good before the Kuwait War and it is logical to assume that they will again be so in the future. All these factors enabled them to create good relations.

Iraq and Syria's relations have been heavily influenced by the ideological conflict between the separate Ba'ath regimes of the two countries, as well as by the personal hostility between the leaders, the closing of the pipeline connecting Iraq with the Mediterranean sea, Syrian support of Iran during the Iran-Iraq war and its coalition with the UN during the Iran-Iraq Gulf War.

Domestic interests:

There are several important factors that have to be taken into account when setting priorities and resources concerning the development plans of a country (see figure G1). For example priorities have to be set vis-a-vis population dispersion here mainly because rural to urban migration accounts for about one third to one half of the growth of the main cities in Turkey and Iraq. It is also necessary to plan how to achieve improvements in the standard of living of the population in rural areas, and in internal security (the Kurdish population in Southeast Turkey and the Shia population in Iraq). The development of hydroelectric power, agriculture and industry are aimed mainly to achieve these targets. The political stability of the riparians also influences the nature of the conflict since a weak nation might be too preoccupied with its internal problems to become actively involved in external disputes. On the other hand a state beset with international difficulties may well choose to divert attention from its domestic difficulties and to attempt to bring about a modicum or semblance of internal unity in the face of a presumed external danger *(Abbas, 1984, 207)*. National emotions have also been mobilized with respect to water as well as the personal prestige of the riparian leaders and these also affect the setting of priorities concerning the water development plans. Such is the case with the dams on the Euphrates river which have acquired a psychological importance as a symbol of development. The Euphrates project in Syria which has been given a high political priority, is an example of being a showcase of the Ba'ath development drive, especially in its naming the reservoir after the president Assad, his personal prestige has been attached to it.

In these circumstances internal disputes have always been likely between entrenched rural agricultural interests fighting to retain an advantageous position, vis-a-vis growing urban and industrial interests. On the other hand, if a government fails to secure food supplies, whether from internal or external sources, an atmosphere of political disquiet will emerge. Thus a natural political alliance has arisen between the countries' political leaderships and their rural communities since the former want to ensure national security, and the rural communities want to provide food for national needs *(Allan, 1992, 5)*. The political power of agriculturists has enabled the agricultural sector to exert powerful pressure on national water policy and policy makers respond to these pressures in the development of their national and international policies.

G1. Cognitive mapping

One approach which assists in the analysis of the three important factors by each riparian is that of "cognitive mapping". With this approach one can obtain a type of mental map or cognitive structure of issues as seen by the relevant actor *(Frey & Naff, 1985, 74)*. A comparison made between the cognitive maps of an issue held by each major actor is helpful in locating critical differences that may determine policy and behaviour, and for ascertaining whether the issues are real. The technique enables the analyst to identify the factors involved in the network of relationships between the states as well as to determine whether perceptions are similar and whether problems lie in conflicting interests. It also indicates whether a significant part of the conflict arises from the utilization of discrepant cognitive maps which might be harmonized through information, negotiation or other means. The mapping permits a basic analysis of power. A full application of this technique allows for the mapping of all the riparians in the Euphrates basin, the identification of critical sub-national actors, and the relationship of decision-makers to the complexity of the issues as well as to their perception of the policy environment.

The cognitive mapping will examine the factors of national interests of the three riparian states during three periods of time:

A) before the construction of the main dams, when mainly natural factors determined the availability of water to the three riparians;

B) the period between the 1960s and 1990s - which was characterized by rapid development in all the riparian countries;

C) the future period, in which the riparian development plans will be completed (see figure G2; A-C).

The thickness of the lines in figures G2. - G4. indicates the perceived strength of association between factors and interests; the thin line represents low-level interests, the medium thick line the high-level interests and the thickest line the interests which are critical from the point of view of the individual states. A crucial error in some cognitive maps is the omission of the overall importance (the evaluation or utility) of the cognitive realm being mapped. In the present instance, however, since "natural interests" is a main component and is obviously of utmost importance, this limitation is not significant *(Naff*

& Matson, 1984, 185). The more connected or embedded a cognitive element is, the more significant it is and the more resistant it is to alteration or replacement.

It is necessary to adopt a systematic approach in reviewing evidence necessary for the utilization of the three models: cognitive mapping, quantitative indicators of vulnerability due to water shortages and a Matrix model (which will be presented in the following chapter). As the same evidence will used throughout, on occasions it will be necessary to develop the discussion of the three models, there will be some repetition. This is inevitable, if each model is to be adequately addressed.

We shall apply the cognitive mapping approach first to Turkey.

G2.1 Turkey's Interests in the Euphrates water

A) Prior to the 60's

In this period the only economic interest which Turkey had in the water of the river was related to the irrigation needs of the scant local population living along the river banks. These irrigated areas were small, rarely exceeding a few hectares in extent and irrigation was solely gravitational. At this time, no use was made of the river water for the generation of hydro-electric power, although plans were being formed for the future utilization of the river water. The harnessing of the river water for industrial development had no importance whatever at this point.

In the area of foreign policy, during the period Turkey began to become aware of its position and strategic upstream location, as well as its political power vis-a-vis its neighbours downstream. This implied the existence of potential political tension in relations with Syria, on the grounds of ideology as well as Syria's territorial claims in regard to the Hatay region - all of which made the Euphrates river water an important political factor.

In the area of internal interests , such factors as the low standard of living and the negative emigration from South-East Anatolia, did not, as yet, appear to be a cardinal concerns affecting the government. Even the matter of internal security, did not at that time, require any special government intervention.

B) The period between the 60's and the 90's -

In this period a significant change came about in the level of interest shown by the Turkish government towards the Euphrates water. Widespread development was undertaken in the form of two dams (the Keban and the Karakaya) constructed for the generation of hydro-electricity and the gigantic Ataturk dam which combined the generation of hydro-electricity and extensive plans for irrigation. The anticipation of socio-economic and political benefits to accrue due to the implementation of the development plans brought about an increase in the economic value and political significance of the river water.

Economic issues: At present, the improvement of the economy is Turkey's main concern *(Inan, 1990, 5)*. The Ataturk Dam and the GAP project are currently the most important projects in Turkey but they are also the most costly. With the dynamism generated by this project, Turkey wishes to become the economic super-power of the Middle East. Turkey during this period aims to utilize its agricultural and hydroelectric potential to the greatest extent; however, the main importance has been placed on the generation of hydro-electric power. Turkey which is poor in petroleum but rich in surplus water, hopes to harness the Euphrates river in order to generate electrical energy for its expanding economy and the GAP's hydroelectric generating capacity will increase Turkey's present total power generation by 70 per cent *(NewSpot, 28 June 1990, 2)*. Turkey also anticipates profiting from a great opportunity for electricity export. In contrast, the irrigation of agricultural lands although planned to recommence in the summer of 1993 will take a long time to implement. Industrial development, based mainly on the processing of agricultural produce, will start at an even later stage these types of development have limited importance in this period.

In foreign policy the implementation of the development plans in Turkey is affecting its relations with the countries situated downstream. The subject of the security of Turkey's frontiers, has become absolutely essential, for its foreign relations with Iraq and especially with Syria at the end of 1992 especially as Syria supported the PKK rebels until 1992. The materialization of development plans affects international relations as it boosts the national image, on the one hand, while, on the other, the importance of the system of economic relations with its neighbouring countries increases as Turkey's need to export agricultural produce from the region of South Eastern Anatolia, to its southern neighbours increases. The dominant power of Turkey also aimed to exploit this tacit advantage, leading the weaker Syria, to resist strongly any likely increase in the hydraulic control by the dominant power. Thus Syria was at great pains to prevent Turkey's obtaining international financing for the GAP project successfully arguing to the World Bank, the Islamic Development Bank and others that funding should not be granted in the absence of an international agreement.

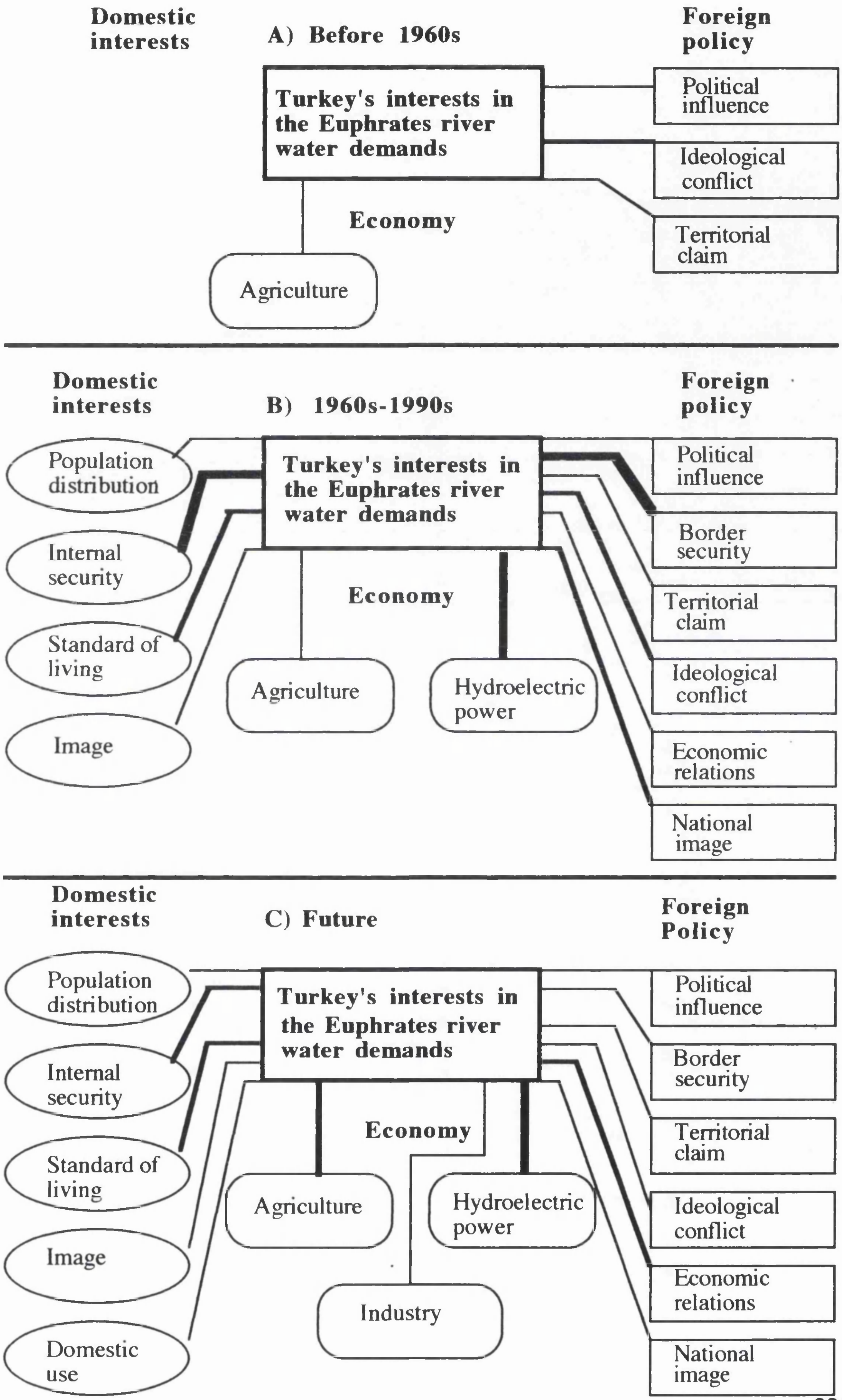
Internal interests: South-eastern Anatolia is the least developed region in Turkey. The per capita regional product in 1985 was only 45 per cent of the average per capita gross domestic product of Turkey and this is the main reason for the emigration from the area although the population density is also below the national average *(Morvaridi, 1990, 308).* Turkey hopes, by improving the standard of living of the local population and by urbanization, that migration to the main cities will slow down *(Tekeli, 1990, 206).* Another factor relating to Turkey's development plans for the area concerns the subject of internal security which has become most important in regard to the separatist movement of the Kurds in the region since the GAP region contains the bulk of Turkey's Kurdish population. The region is a target for cross-border attacks by militant Kurds but Turkey hopes that this difficult political situation can be stabilized by improving the standard of living in the region which may also weaken the support of the local population for the Kurdish separatist movement *(Waterbury, 1990, 9).* Economic plans for agricultural development in the region, the generation of hydro-electric power and industrial development are mainly intended to help solve this problem.

The development projects are linked to the names of the leaders, Ozal and Demirel, who have supported the process of formulation and implementation of these plans as well as contributing to the acceleration of implementation and, thus, to their chance of success. The strength of commitment expressed to date makes it impossible to imagine Turkey renouncing the project at this stage.

C) Future forecast:

When the development plans have been implemented, Turkey's economic expectations, based on the Euphrates water and its dependence on them, will increase. Meanwhile Turkey is, for all practical purposes, self-sufficient in food, and it wishes to remain so in the future. The present agricultural production in the GAP area is limited to one harvest every two years but with irrigation and modern technology, the soil and climate could sustain two or three harvests annually *(Tekeli, 1990, 208).* Turkey, however, expects to profit from the export of crops grown in the irrigated areas of GAP, because South-East Turkey is located in a favourable geographical position to deliver fresh and packaged foods to both the Middle Eastern countries and Europe cheaper, and in better condition, than any other supplier. Markets have also been identified in neighbouring countries and Turkey plans to export agricultural products to Iraq and Syria both of which face food deficits (Turkish exports to Iraq in 1988 were $US 986 million, and exports to Syria were $US 110 million *(Ergil 1990, 11).* When the GAP project is completed, it is estimated that Turkey will produce enough food to feed 80 million people, and 3.3 million extra jobs will have been created countrywide. The increase in agricultural production may also be expected to start a "chain reaction" in

Figure G2: Cognitive maps of Turkey's interests in the Euphrates river: pre 1960s, 1960s-1990s, future



other sectors of the regional economy, thus Turkey perceives that it cannot tolerate any limitation on its economy caused by any delays in the GAP project *(Inan, 1990, 5)*.

The cognitive maps of the three phases in its political and economic development show very clearly the shifts in emphasis in domestic and foreign interests as well as in the economic outcomes of the GAP investments. The most important contribution will be the generation of hydro-electric power which will greatly contribute towards the economic development of the country and will temporarily decrease the need to import fuel for the generation of thermal electric power. The extensive irrigated areas will contribute to the creation of jobs, raise the standard of living, become a source of foreign currency resulting from the export of foodstuffs, and provide an infrastructure for the further industrial development of the region. Turkey thus hopes that it will put a stop to the negative emigration from the region and that the problems of internal security will diminish.

In the area of foreign policy , it seems that the problem of the security of Turkey's frontiers will abate after the signing of a security agreement with Syria; but some military tension is still to be expected on the Iraqi border involving the Kurdish opposition. There is no forecast that the subject of the territorial demands made by Syria and Turkey, will significantly affect the foreign relations of the countries, since nowadays, the end of the cold war makes it possible for the normalization of their mutual relations to take effect. The subject of economic relations will assume much more significant dimensions in the future and there is no doubt that the decision about whether Turkey will become a member of the European Community or not, will have implications for the importance of the economic ties between Turkey and the neighbouring countries. Turkey is also a member of NATO and wishes to play a certain role in that organization, has important trade and financial relations with Middle East countries and is interested in economic opportunities in North America, the Black Sea area, and Central Asia. Hence, its international image is a rather important concern *(Frey, 1993, 65)*.

The development project in Turkey will affect Syria and Iraq's water supply and, together with this, the balance of power in the Middle East, both economically and politically *(Manisah, 1990, 7)*. On the other hand the most vital element in Turkey's economic approach to the region is the achievement of long-term international stability in the Middle East.

In the area of internal policy - the subject of the redistribution of population will be of cardinal significance but as the standard of living of the population of South-East Anatolia rises, this source of instability will lose some of its pivotal importance. The extensive use of the Euphrates water for the development of irrigation and industry will promote both the rise of the standard of living and its quality. Turkey looks forward to a widespread development of the municipal systems in the region and the river water is intended to provide for the municipal and rural water needs which will greatly increase in the future.

G2.2 Syria's Interests in the Euphrates water

A) Prior to the 60's :

In this period very much like Turkey, Syria's sole economic interest in the Euphrates water, was linked to the irrigation needs of the riparian population and very small number of areas were actually irrigated, mainly gravitational, along the river banks. Syria at this stage, did not generate hydro-electric power, although development plans for the construction of a dam generating electricity, and providing water for irrigation, began taking shape under the French Mandatory government.

In the field of foreign policy, Syria was aware of its upstream position relative to downstream Iraq, the former being itself in the same position in respect to Turkey. Syria's foreign relations with Turkey were affected by both territorial claims regarding the Hatay region and ideological conflicts; but with regard to Iraq, Syria was involved in an ideological conflict.

The subject of the use of river water as a matter of internal interests, did not occupy a central position in the Syrian government's concerns since the population living in the Jezirah region was sparse and Syria was mainly concerned with internal problems of political instability.

B) The period between the 60's and the 90's:

Regarding economic interests, a significant change is revealed in this period on the level of interest exhibited by the Syrian government in the river water. In this period Syria erected the Tabqa dam as well as some small dams on the Euphrates, and its tributaries. These dams were aimed at generating hydro-electric power and at irrigating extensive agricultural areas. Unlike Turkey, which was still unable to use the river water for irrigation, Syria was still irrigating some 250 thousand ha. in the nineties, therefore, the importance of river water for irrigation increased in this period. Agriculture dominates the Syrian economy and society and the agricultural sector employed about 32 per cent of the Syrian labour force in 1980 (see table H1). At that time Syria had the potential to feed its accelerating population and even export basic food products such as wheat and barley. Food security became one of the most important elements for the development of Syria's economy although in 1988 food made up 71 per cent of the country's overall imports, which resulted mainly from the rapid rise in population *(Syrie & Monde Arabe, 1988, no. 408, 1).* The aim of the Syrian government was to achieve food self-sufficiency and expansion of the irrigated areas to reduce dependence upon unreliable rainfed cultivation, full employment and national social well-being were the stated goals of the Syrian government.

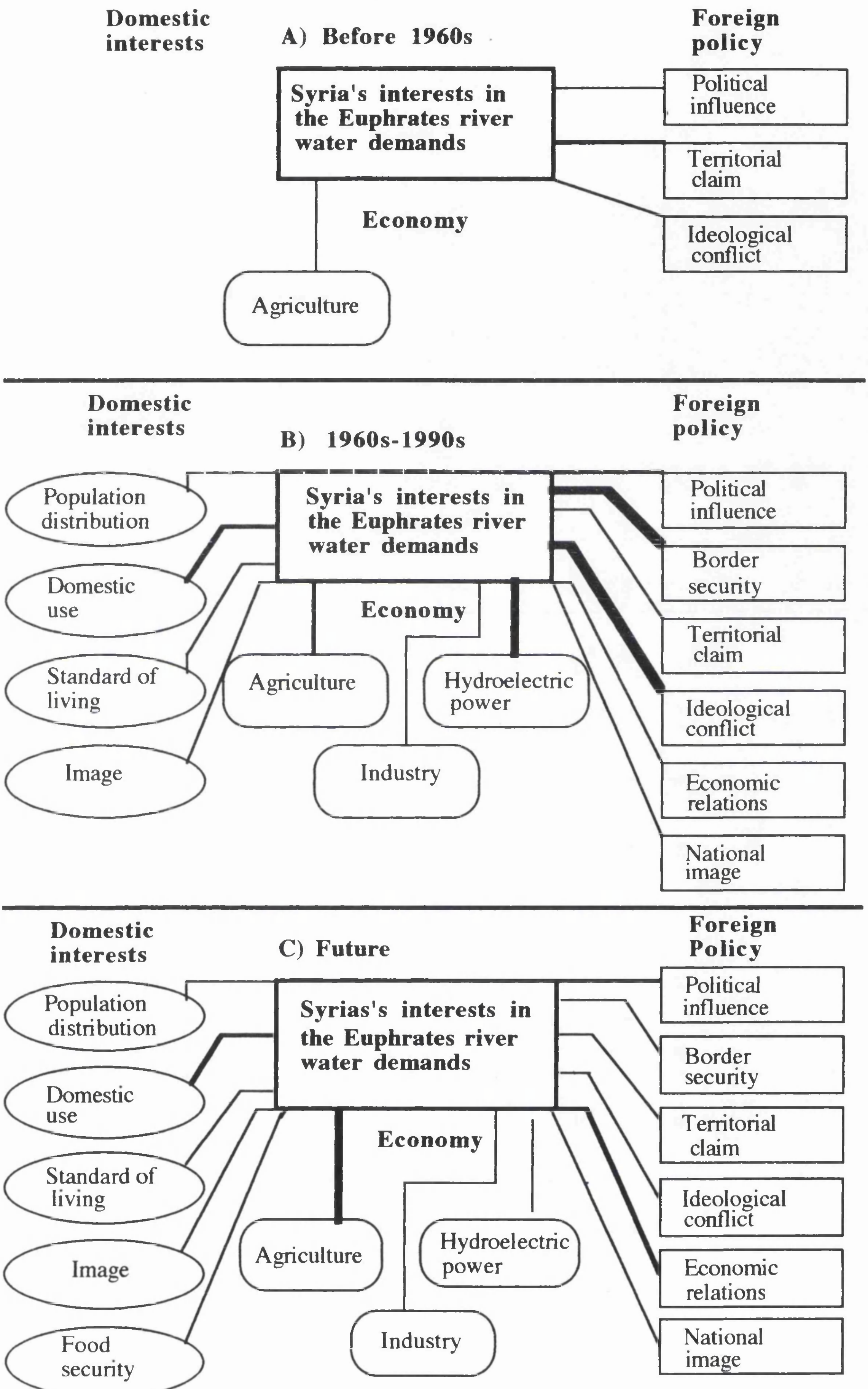
Syria was, until recently, petroleum poor but since the late 1980s it has expanded oil production. Increases in the generation of electricity are to be regarded as the key to much of Syria's future industrial development. The 800 MW of hydro-electric power generated by the Tabqa dam, was intended to supply, at least 70 per cent of the country's consumption of electrical power*(Meyer, 1987, 49).* Here too, therefore, one may point out a critical factor in a country poor in energy resources. Likewise the region saw the beginning of industrial development based mainly on the processing of agricultural products and the development of mineral resources.

In the area of foreign policy, the subject of secure frontiers turned into an international issue in which Turkey's vulnerability was exploited by Syria. After Turkey had announced the erection of the Ataturk dam in 1983 Syria began supporting the Kurdish, PKK organization. The ideological conflict between Syria and Turkey also intensified since Turkey' was a member of the NATO alliance, while Syria adhered to the communist bloc and, Turkey's developing democratic system clashed with Syria's presidential regime.

The political tension between Syria and Iraq rests mainly on the hostility between the Ba'ath parties (of the two countries) and the personal rivalry between the two respective presidents. This finds expression in Syria's support of Iran during the Iraq/Iran war and, later, in Syria's support of the allies in the Gulf War.

In the matter of internal interests, Syria's Euphrates basin, comprising the two provinces of Raqqa and Deir ez Zor, is part of the country's vast but under-populated and under-developed arid Eastern hinterland which contain only 8.3 per cent of the Syrian population *(Hinnebusch, 1989, 233)*. The rapid rate of urbanisation has put a strain on services and the infrastructure of cities and has led to the growth of shanty towns along the edges of large urban centres such as Damascus and Aleppo; the urban growth has, in turn, been fuelled by a continuing influx of people from the countryside *(Lewis, 1987, 15)*.

Figure G3: Cognitive maps of Syria's interests in the Euphrates river: pre 1960s, 1960s-1990s, future



The Syrian authorities had great hopes for the Euphrates Dam project not only with respect to its economic contribution but also for its potential to transfer water to other cities in the country. The project was also expected to help create a new class of skilled manpower and personnel who would ultimately be of great benefit to the country's development. This implied establishing new cities and towns, the provision of health care, education, communications and other social services in the region to provide a socio-economic infrastructure which would help redress the effects of the growing urbanisation of the country *(The Arab Economist, April 1978, 18).*

The success of the development plans is linked to the personal prestige of President Assad as expressed by the reservoir behind the dam bearing his name - an indication of the importance Syria attaches to the implementation of the development plans.

The Euphrates dam and the subsequent agricultural and industrial development became the showcase of modernization in Syria and thus became part of Syria's image vis-a-vis its neighbours.

C) Future forecast -

It seems that the economic importance of the agriculture based on river water will increase as a result of Syria's rapid demographic growth and its aspiration to produce enough food to meet its food needs. On the other hand, the importance of river water, to Syria's economy, through the generation of hydro-electric power will decrease, because the potential to generate electricity is restricted and the growth of the Syrian economy will eventually rest on generating thermal electricity. Therefore, the production of electricity on the Euphrates as part of the GNP will gradually decrease.

In foreign policy, the issue of the security of the frontiers between Syria and Turkey will gradually lose some of its significance as a result of the agreements made between the two countries. The ideological conflict will dwindle as one of the consequences of the crumbling of the Soviet Union. These new circumstances will also contribute to the development of the mutual economic interests of the countries.

The political tension between Syria and Iraq will continue on an ideological basis, at least as long as Sadam remains the ruler of Iraq. The same may be said of the tension involved in the distribution of river water, which turns Iraq into the principal casualty of the agricultural development of the upstream regions, as regards both the quantity and the quality of the water.

As to internal policy, the re-distribution of the population will go on being a central issue in Syria, which aspires to transfer two million of its inhabitants to settlements in the Jezirah region. Agricultural and industrial development are aimed at providing the inhabitants with a quality and standard of living which will persuade them to move into the region and establish themselves there. Consequently, more water will gradually serve domestic and industrial needs. Unlike Turkey, Syria has no internal security problems in the region nor any emigration of inhabitants moving to the country's big cities from the region.

G2.3 Iraq's interests in the Euphrates water

A) Prior to the 60's

During this period Iraq's only economic interest in the water was linked to the agricultural sector. Iraq, unlike Syria and Turkey, irrigated extensive areas, and the Euphrates river development projects in this period, were also connected to the prevention of inundation by the river.

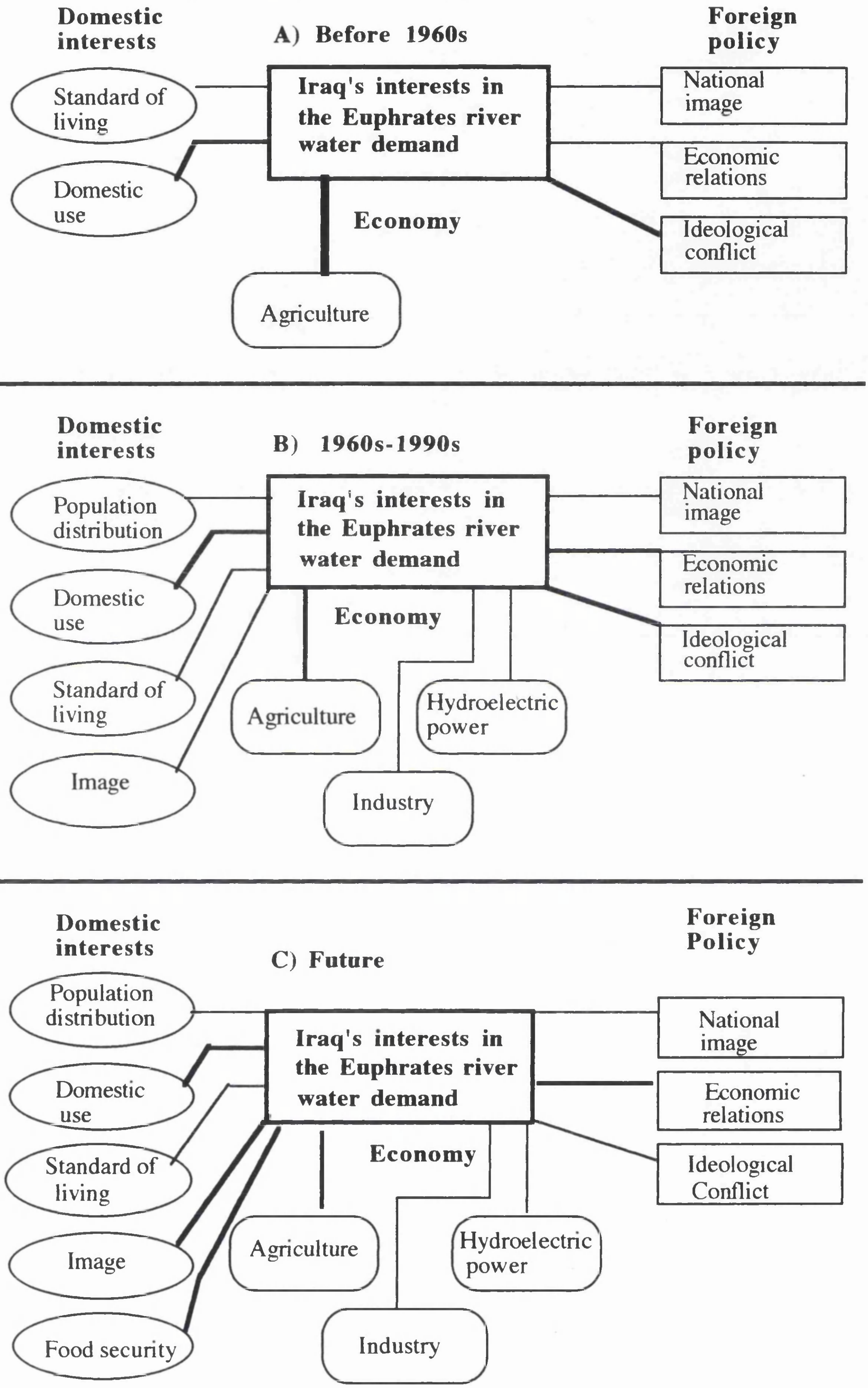
Foreign policy. - Iraq was aware of its disadvantage in being located downstream and endeavoured to reach agreements with Turkey and Syria regarding the distribution of river water. Iraq had mutual economic interests with Syria, concerning the flow of oil from the northern oil-fields of the country to the Mediterranean sea-ports and Iraq's relations with Turkey were normal.

Internal relations. - Euphrates water served household and municipal needs, thus raising the standard of living of the region's inhabitants, but it must be remembered that Iraq, during this period, was occupied by internal problems and characterized by political instability, which hindered the process of development plan.

B) The period between the 60's and the 90's -

With respect to the economy, Iraq's position was exceptional in the Euphrates basin. Its economic potential was enormous with one of the largest oil reserves in the world, and a large area of fertile land relative to its domestic needs. It had vast quantities of phosphates besides other raw materials, and abundant supplies of water. Despite its dependency upon earnings from petroleum exports, almost all the industry was based upon food processing and textiles and the agricultural sector employed 33 per cent of the

Figure G4: Cognitive maps of Iraq's interests in the Euphrates water: pre 1960s, 1960s-1990s, future



labour force in 1987 *(Fisher, 1989, 465)*, while agriculture accounted for less than 10 per cent of the country's GNP. Iraq has traditionally irrigated about a million ha. of land with Euphrates water as well as using water for domestic purposes.

The Iraqi government wished to reduce the country's dependence on oil exports as the main supplier of foreign exchange. Despite its apparently high agricultural potential, however, Iraq was not self-sufficient in food production and in 1990, not only was 90 per cent of its food imported but food imports comprised 25 per cent of total imports *(Hussain, 1990, 237)*. During this period Iraq persevered in the development of the river valley and erected the Haditha dam for the generation of hydro-electric power, and to regulate the flow of river water so as to decrease its dependence on food imports in years of drought as well as its dependence on the regulation of river-water flow from the dams in Syria. During this period Iraq relied on oil money to import foodstuffs but actually neglected its agricultural development. Compared to Syria and Turkey, Iraq has little dependence on the generation of hydro-electric power, due to its topographic structure which does not allow the economical generation of hydro-electric power; on the other hand the availability of oil makes it possible to generate cheap thermal-electric power.. Iraq does use river water with little loss for the cooling purposes in its thermal power stations.

The Iraq-Iran war and subsequently the Gulf War, (in the wake of which the UN declared an embargo upon Iraq) emphasised the problematic nature of absolute dependence upon an income derived from oil exports while having shortcomings in the capacity to produce in food to meet national needs.

Foreign relations. The ideological conflict with Syria did not allow for any cooperation between the two nations. On the other hand, Iraq's economic dependence on Turkey, particularly in the field of oil exports, prevented Iraq from taking drastic steps against Turkey's development plans, despite the fact that Iraq, thereby, emerged as the principal casualty. Iraq regularly lodged protests against Turkey's plans, but it would seem that these protests were meant to bolster its national image. It must be remembered that Iraq and Turkey share common interests, and cooperate in the security field against Kurdish rebels on the formers' common frontier.

Internal policy. Of the three Euphrates riparian states, Iraq had the largest area of irrigated land within the Euphrates basin in 1990 and the largest number of inhabitants living within the Euphrates valley but the poor standard of living in the agricultural areas has generated a strong rural to urban migration *(Mofid, 1990, 50)*. This trend has created a need to import hundreds of thousands of agricultural workers mainly from Egypt to make up for the shortage of agricultural workers. By improving the farmers' standards of living, Iraq hopes to decrease the migration rate, and to prevent the expansion of the slums surrounding Baghdad.

Another internal security factor is related to Iraq's plans for improving the standard of living which the Sunni administration in Baghdad hopes will help it gain the Shia population's support *(EIU, Iraq, 1990, 8)*. The Government of Iraq also wishes to prevent politically embarrassing food shortages (which aggravate problems of inflation and increase reliance on uncertain foreign sources) and too much importation of food which also impairs national security.

Like Turkey, Iraq suffers from the internal emigration of the agricultural population from the region and as a consequence imported thousands of farmers from Egypt in the 1970s and 1980s. This variable has induced Iraq to develop plans for the redistribution of its population and, to further this end, the standard of living of the farmers in the region must be raised.

The eight years' wars with Iran caused Iraq to make more of an effort to improve agricultural self-sufficiency and reduce its food import bill, but the UN economic embargo in 1990 has given Iraq its biggest push yet towards achieving improvements in the production and productivity of its agricultural sector.

C) Future forecast -

The principal importance of Euphrates water to Iraq, from an economic point of view, is linked to the development of agriculture. The share of hydro-electric power (out of all the power produced) will gradually decrease even further. A large number of the projects developed in Iraq, whose principal aim was to prevent flooding will become redundant as a result of the constant flow of the river, caused by the controlled release of water from the dams in Turkey and Syria. On the other hand the quantity of water in the river will be reduced and its quality impaired. This may affect the extent of agricultural areas and the type of production but Iraq has an alternative option - the use of the Tigris river water, transferred to the Euphrates through Lake Tharthar and the construction of a third river which will add agricultural land to the country.

Foreign policy. Iraq's dependence upon Turkey and Syria will grow, because the upstream states will determine the quality of water flowing in the river. The close economic ties with Turkey may be expected to be renewed and even strengthened after the embargo is raised. As for Iraq's relations with Syria, only a change in the latter's regime will improve the fabric of foreign and economic relations between the countries.

Internal policy. The Euphrates waters will continue to be important if Iraq wants to raise the standard of living of the local population, and thus prevent negative emigration from the region. To achieve this, more and more water will be diverted to domestic use. The Euphrates water is also associated with the image of the country's leaders, who wish to see massive development in the region in order to restrict the extensive importation of food into the country.

G3. Conclusion

The three diagrams in the chapter (G2-G4) clearly reflect the level of the riparians states' interests in the waters of the Euphrates river over three periods of time: the past - before the commencement of the implementation of the large development projects for the river water and when the use of water was minimal; the present - from the 1960s to the 1990s when the three states were at the peak of their implementation of development plans and the resultant use of the river water grew; and the future - after the completion of the development projects when the resultant use of the river water reaches its peak. The importance of the various factors in the determination of the level of the states' interests in the river water is based on the data accumulated in the previous chapters. A number of very significant wide-ranging conclusions can be drawn from the three diagrams.

A. The period up to the 1960s was characterized by scanty use of the river water, mainly by Syria and Turkey which are located upstream. The natural flow of the river actually reached Iraq which invested most of its efforts during this period in projects aimed at preventing flooding. Syria and Turkey, in contrast, were planning the construction of dams along the river and Turkey, in particular, was planning dams for the production of electricity which would only marginally affect the amount of water in the river. Syria was planning the construction of a multi-purpose dam for the production of hydro-electric energy and for irrigation purposes whose potential effect on the flow of water to Iraq was very limited.

Since there were, as yet, no development projects for the river in Turkey and Syria the level of economic expectations and internal interests of the states was particularly low. As a result the effect of river water usage on the foreign relations of the states was limited.

This period can be summed up as one with a limited range of low-interest level factors of marginal importance in their effect upon the network of relations between the riparians, with a limited demand for water and so a low potential for conflict over the river water.

B. the period between the 1960s and the 1990s was characterized by the accelerated implementation of development projects by the three riparians which was expressed in the building of dams for the production of hydro-electric power and dams which combined the production of electricity with wide-ranging irrigation projects. As a result the level of states' interests significantly increased and additional factors of interest accumulated.

From the economic point of view Turkey's three dams were expected to produce hydro-electric power and this would have an important effect upon the oil-poor country. Turkey had not yet begun to exploit the river water for the irrigation of large areas in south east Anatolia.

Syria intended to produce hydro-electric power with the Tabqa dam and this raised high expectations but they were not to be satisfied. Irrigation projects which demanded growing amounts of water were a central goal for Syria although is was already clear that both the area irrigated and that expected to be irrigated would be smaller than hoped for.

In contrast to the two upstream states, Iraq neglected the development of the river which, as far it was concerned, was unimportant as potential for hydro-electric power and preferred to base its economics upon the importation of feed products over the development of its agriculture.

Economic developments projects reflect the development of many other factors and the domestic interests of the states which were of marginal interest during this period now became very significant. Such development was significant for Turkey in its preventing the negative migration from the area through raising the standard of living. It was further expressed by an attempt to improve the shaky internal security which had arisen because the Kurdish revolt. The prestige of Turkey's leadership was also significantly linked to the success of the development project.

Syria encourages migration to the Euphrates river area (in order to reduce the pressure on the urban networks systems) through raising the standard of living in those areas. The development of the Euphrates valley became a matter of personal interest for the Ba'ath party and for President Assad.

These development projects had major significance on the network of foreign relations among the riparians which itself, was directly connected with the international power system (Turkey, a no Arab state, a member of NATO and with a western form of government; Syria and Iraq mainly influenced by the foreign policies of the USSR. and with governments more suited to third world states).

The system of dams built in Turkey which allowed to control the flow of the river water changed the balance of power in the region. Syria and Iraq made considerable efforts to reduce the damage involved as much as possible. Iraq and Syria which were on the brink of war in 1974, here co-operated against their common source of danger -

Turkey. In the first stage they tried to prevent and later to hold up, the building of the Ataturk Dam by trying to delay the granting of international financial assistance for constructing the dam. Syria began to support the Kurdish rebels during this period and Iraq complicated its economic relations with Turkey. This period simbolizes one of significant tension in foreign relations between the states, potential for instability linked to the ever growing demand for water and change in the strategic balance.

C. The future. By analyzing the processed taking place in the region one can postulate that despite the predictions, a reduction in the tension and lack of stability will take place in the future regarding the management of the Euphrates water. This thesis is based upon the changes taking place in a number of factors which determine the level of the states' interests in the river water: The end of the Cold War has led to closer relations between Syria and Turkey as well as co-operation between them against Iraq during the Gulf War. Iraq has become politically and militarily weaker as a result of the War, something which reduce the changes of a possible war between Iraq and Syria. Iraq needs Turkey as it is the only continental exit for its goods especially oil. Syria has officially decided to end its support for the PKK as a quid pro quo for an agreement over the division of water with Turkey. There is also an agreement over the division of water between Syria and Iraq now. Syria and Turkey are expected to realize that there is a gap between their vision of wide spread regional irrigation as it appears in the states' development plans and reality. Dependence upon hydro-electric power will develop significantly in Syria and gradually in Turkey as the hydro-electricity supplies a lower percentage of the total production of electricity in the states. All of the states will need closer commercial ties in order to export goods and agricultural produce. The subject of food security will become more significant in Syria but most of the effort will centre upon improvement of the agricultural produce and irrigation methods and not upon extending the agricultural areas into low-grade, low soil quality areas.

Iraq today, one must note, is capable of compensating itself for the loses of the Euphrates water by connecting Wadi Tharthar to the Tigris river. The construction of a system of dams would allow for a more efficient management of the water resources and it is, in fact, the quality of the water that should concern them more than the quantity.

Through the development of the model of the cognitive map an attempt has been made to give quantitative values to the various factors in order to create a hierarchy of the importance of such factors for the three states over three periods of time, and to differentiate between major and secondary factors.

With this purpose in view ten international experts on water and the Middle East were interviewed and were asked to grade the various factors involving the level of interest for the three states during the three time periods, according to the information they possessed. The results have produced a very low correlation and often a subject which appeared to be essential to one expert was only marginally important in the opinion of another. Despite this several trends pointed out by most of the experts.

Turkey

Most of the experts graded Turkey's domestic interests up to the 1960s as a factor with high implications for the level of interests in the river water as opposed to foreign relations which was seen as being only secondary. From the 1960s on into the future economic interests and foreign relations are perceived as having much more significance than domestic interests.

A. Foreign relations - Most of the experts saw the factors of national image and political influence up to the 1960s as most significant as opposed to factors of ideological conflict and border security which were of no significance during the above period. In contrast, during 1960-1990 the factor of political influence appeared and territorial claim joined the list of none important factors. In the future, the factor of ideological conflict will also lose its importance.

B. Economics - Up to the 1960s the economic interests of the Euphrates river were perceived as insignificant. From the 1960s on into the future the production of electricity is perceived as a factor which produces the most significant level of interests, followed by agriculture, while industry and services were found to have only marginal importance.

C. Domestic interests - Up to the 1960s the standard of living and internal security were perceived as being most significant as opposed to the factors of population distribution and food security which were evaluated as being unimportant. During 1960-1990 the subject of population distribution was found to have supreme importance s opposed to the factors of standard of living and the image of Turkish leaders which became marginally important. For the future, the factors of standard of living, domestic use and internal security are perceived as being more important than the image of Turkish leaders and the goal of population distribution.

Syria

Up to the 1960s the experts graded the factor of domestic interests as the most significant of Syria's interests in the river water as opposed to the factor of foreign policy which was perceived as marginally important. In contrast, from the 1960s on the factors of foreign policy and economy are seen as most significant while, during this time domestic interests became marginal

A. Foreign policy - The factors of national image and territorial claim were perceived as more important than the factors of ideological conflict, international law and economic relations. During 1960-1990 the factors of territorial claim, national image and political influence were evaluated as more important than international law, ideological conflict and border security. In the future, claim the experts the factors of economic relations and international law will become more significant and border security and ideological conflict will decrease its importance.

B. Economy - Up to the 1960s only the factor of agriculture had a marginal level of importance. From this period on the factors of production of hydro-electric power as well as agriculture became important and only the factor of industry and services was found to be marginally important.

C. Domestic interests - Up to the 1960s the factor of domestic use was perceived as most significant as opposed to standard of living, population distribution and food security which were seen as marginal factors. The standard of living, the image of the leaders and population distribution became most significant from the 1960s on into the future in contrast to the factor of internal security which became secondary.

Iraq

According to the experts grading, up to the 1960s the factor of domestic interests was found to be most significant for Iraq and the factor of foreign policy had secondary importance. In the 1960-1990 the most important interests were economy and domestic interests became marginal. In the future the experts expect domestic interests to again become most significant and foreign policy to become marginal.

A. Foreign policy - The factors of political influence, border security and national image were most important during the 1960s as opposed to ideological conflict, international law which were considered to be marginal. During 1960-1990 the factors of political influence, national image and economic relations were the most significant. International law which was considered marginal up to the 1990s will, in the future, become a major factor while international security will become marginal.

B. Economy - Grading the economic factors from the past into the future, the experts rank agriculture as the most significant factor and the production of hydro-electric power and industry and services as having only marginal importance. The factors of domestic interests such as domestic use and internal security were perceived as most significant from the past to the 1990 as opposed to population distribution, standard of living and food security which had marginal importance. The factors of internal security and the image of the leaders will, in the future, decrease importance in contrast to food security and preserving the standard of living.

One should again point out that these results are based upon a low correlation which does not permit the relative ranking of the importance of the various factors. In order to develop the subject of a hierarchy of different variables the use of other models will be made (see chapter H).

H. Models from Geopolitical Science for the Explanation of Disputes

H1. Quantitative indicator of the vulnerability due to water shortages

The cognitive map in the previous chapter helped us to identify the various factors which determine the level of the riparians interests and describe their changing importance over three time periods. The attempt to add quantitative values to the relative importance of the various factors did not prove to be effective. The two models in chapter H (quantitative and Matrix Model) allow us to quantitatively assess the various factors and so assist us in examining the issue of the research: is a military conflict between the river states over the division of the water to be expected?

Gleick (1992) claimed that although non-renewable resources such as oil are more typically the focus of traditional international security analyses, water can also fit into this framework if water provides a source of economic or political strength. This is the reason why water provides a justification for going to war or why water resources are an object for military conquest. Gleick analysis five factors that make water likely to be an object of strategic rivalry:

1) the degree of water scarcity.
2) the extent to which the water supply is shared by more than one region or state.
3) the relative power of the basin states.
4) the ease of access to alternative fresh water sources.
5) the ease of access to substitutes for water*(Gleick, 1992, 6).*

A quantitative indicator, which takes into account changing population relative to the water amount, land use and economy is shown in table H1. This table lists the riparian countries with their annual per capita water availability in 1971 and by the year 2000. According to the table Syria is in the worst situation, and by the year 2000, will fall below 1,000 m^3/year/person (or conversely more than 1000 people will need to be supplied one million m^3 of water per year). This level of water availability is typically considered the minimum per capita water requirement for an efficient, industrialized nation and therefore classified as extremely low (see table A.1). According to the table, Iraq is in a better position and in the year 2000 will have 1,300 m^3/year/person available, an amount that is also classified as very low. Turkey is in the best position with 2,300 m^3/year/person in the year 2000, an amount that is still classified as low according to international standards, but very high according to the Middle East standards.

A second quantitative indicator which measures the extent to which water supplies are shared among the riparian states, is the total water supply originating outside of the border, and which is therefore under the control of another nation. According to this factor Syria is in the worst situation, as 85 per cent of its surface water originates outside of its territory. Iraq is in a better position because only 66 per cent of its water originates outside of Iraq's border, and Turkey is in the best position among the riparian states because almost all its water originates inside Turkish territory. An alternative way to measure the vulnerability of the riparian states is the ratio of external supply to internal supply. According to Gleick (1992), where this ratio is greater than one, more than half of the nation's water supply will be subject to external political pressures and constraints *(Gleick, 1992, 16)*. From this point of view, Syria is in the worst situation with a ratio of 6.4; Iraq is in a better situation with ratio of 1.8, and Turkey is again in the best position with ratio of 0.1.

Gleick's use of quantitative values for the various factors is expressed in the selection of physical factors alone, making his approach very deterministic. Physical variables do not absolutely determine foreign policy (such as in cases where states are oil-dependent) and this is not the only factor which shapes the foreign policy of such states, for an example the U.S.A., Japan and Germany cases.

A third quantitative indicator that measures vulnerability to hydrologic conditions is the dependence on hydroelectricity as a fraction of total electrical supply. This measure can indicate both positive and negative effects on the one hand with high hydroelectric dependence bringing a high vulnerability to either natural or international changes in water availability, while on the other hand, low hydroelectric availability typically means high dependence on fossil fuels. According to Gleick (1992), a nation that relies on hydroelectricity for 50 per cent of its total energy supply, will be vulnerable to military actions against hydroelectric dams. The international alteration of flows which cross borders, and any changes in climate that affect water availability would all be strongly felt *(Gleick, 1992, 16)*. In the case study of the Euphrates river, Turkey produces the highest amount of hydroelectric power about 40 per cent of its total energy supply *(Bilen & Uskay, 1991, 4.13)*. The completion of the GAP project will increase this by 70 per cent. On the other hand Turkey being an upstream state is not vulnerable to international alteration, but is vulnerable to interruptions of oil imports as was demonstrated in 1973 and 1990. On the other hand, the importance of Syria's hydroelectric power potential will decrease because the share of hydroelectric power in total national electricity production will drop sharply, since the Euphrates river which was expected to generate 80 per cent of the country's electric power in the 1970s generated only 40 per cent in 1985 *(Maury, 1983, 322)*. The share of hydro power in the

Table H1:

Basic indicators of area, land use, population and economy (at various dates)

	Turkey	Syria	Iraq
Total surface area (1,000 km^2)	779 *a*	185 *a*	438 *a*
Area suitable for agriculture 1990 (1,000 ha.)	27,699 *b*	6,149 c	11,800 *d*
Area under cultivation 1990 (1,000 ha.)	25,305 *b*	5,626 *c*	3,300 *d*
Irrigated area (1,000 ha.)	2,990 *b*	693 *c*	1,560 *d*
Per cent of irrigated area of total cultivation - 1990	12	12	44
Population (1991- millions) *e*	58.6	12.9	19.5
Average annual growth of population (% - 1980-1990) *a*	2.4	3.6	3.6
Population (2025 - millions) *a*	91	35	48
GNP per capita ($ US 1990) *a*	1,630	1,000	2,870
Contribution of agriculture to GDP 1990 (percentage)	18 *a*	28 *a*	5 *f*
Sectorial distribution of the Labour force (1980) *g*			
Agriculture	58	32	43
Industry	17	32	26
Services	25	36	31
Urban population as a percent of total population *a*			
1965	34	40	51
1990	61	50	71
Per capita water availability *h*			
(1'000 m^3) 1971	4.9	3.0	3.6
(1'000 m^3) 2000	2.3	1.0	1.3
Euphrates water as per cent of total surface water	32	85	38
Euphrates river potential irrigation area (million ha.)	1.1	0.5	1.2
Euphrates hydroelectric Potential (MW)	5,346 *i*	885 *j*	660 *k*

Sources: a-World Development Report, 1992, 218-222, 268, 278; b,-Gulbahar, 1991, 531;c,-Syrian Arab Republic, 1991, 6/4; d-Hussain, 1990, 238; e- World Population Profile, 1991,A/5; f- EIU, 1990-1991, 14; g- Richard & Waterbury, 1990, 17,74; h- The Global 2,000, 1982, 156; I-Bagis , 1989, 52; j- Kolars & Mitchell, 1991, 153; k- The Arab Economist, October 1981, 6.

total energy supply will continue to fall because of the topographic conditions of the country which do not permit the creation of new dams. Meanwhile, the scarcity of available water and on the other hand, the development of new oil fields have cancelled the necessity to import fossil fuels. From this point of view, Iraq is in the best position, since only 4 per cent of its total energy consumption is hydroelectric power *(EIU, Iraq, 1991, No. 2, 14)*, the major part of which originates from the Tigris river and its tributaries because of topographical conditions. In addition, Iraq has an enormous amount of oil that reduces its dependence on hydroelectric power.

A fourth quantitative indicator which measures the vulnerability of the riparian states to hydrological conditions is the possibility of being self - sufficient in agricultural production, because food security is viewed by the governments as being a question of national security. By the end of the century, it is expected that the Turkish population will be about 70 million, and about 91 million by the year 2025 (see table H1).

Looking at land and population together, we find in 1991 a population density per square hectare in Turkey of 0.75 persons, very similar to that of Syria - 0.69, and 55 per cent more than that of Iraq - 0.44 persons per square hectare.

Another calculation that is more significant for food self - sufficiency is an analysis of population density per unit of area suitable for agriculture. According to this factor, in 1991, Turkey and Syria had 2.1 inhabitants per square agricultural hectare, and Iraq is again in the best position with 1.6 inhabitants per hectare.

At the same time, Turkey is one of the few countries in the world that is agriculturally self sufficient and which even has food surpluses to market. This position is even more important for Middle Eastern country. This is the reason that Turkey is in the best position among the riparian states. Iraq with the lowest population density, although without agricultural self sufficiency, but with the potential to be so, is in a better position than Syria which has a higher population density relative to agricultural area and has no potential for agricultural self sufficiency.

The combination of the index of water availability per capita, and hydroelectric dependence with the index of dependence on water originating outside national borders and the availability of food self-sufficiency provides an indicator both of the significance of water in the economy and in the domestic security of a state, and the vulnerability of a nation's energy supply to outside intervention.

Each of these components has been given a quantitative proportional weight which ranges from a value of three - (high vulnerability) to one - (low vulnerability), (see table H2) and these have been inserted into the table for the co-riparian states.

Table H2:

Summary of quantitative indicators of the vulnerability of the riparian states

	Per capita water availability	Dependence on international water	Dependence on hydroelectricity	Food self-sufficiency	Total
Turkey	1	1	3	1	6
Syria	3	3	2	3	11
Iraq	2	2	1	2	7

According to this table, Syria is the most vulnerable country to water shortages and Turkey is in the best position among the riparian states.

Please note that this model' which still requires further development, gives the different factors the same rank of importance for vulnerability. Self-sufficiency in food, for example, does not necessarily have to be equal, to dependence on hydro-electric power but the model assumes "equality".

H2. Matrix Model

With such basic information on the status of the three riparians it is possible to analyse the factors influencing their past and future relationships. In Naff & Matson (1984), the riparians which participate in the hydro-politics of the Euphrates river are each analysed according to their respective "riparian position", "power", and "interests" *(Naff & Matson, 1984, 192)*. Mandel (1991) reinforcing this point, notes that "the power ratio among riparian states involved three elements -

1) the states' overall political/military/economic power levels;
2) the states' technological power to disrupt or alter the river basin;
3) the states' geographical power reflected in a more, or less advantageous downstream position with respect to the river" *(Mandel, 1991, 6)*.

Whatever the specific water controversy among the riparians, its ultimate resolution or not depends on the power relationships involved. For this aim we have to address two more factors: the riparian position within the drainage basin, and the factor of projectable strategic power. Information on these power relationships enables the deployment of the conceptual frameworks for modelling water conflicts. Power relationships can be placed into a power matrix *(Naff & Matson, 1974, 192; Frey & Naff, 1985, 79)*. The Matrix Models contain the above five basic factors that form riparian water conflicts: riparian position within the drainage basin, projectable strategic power, economic interests, external and internal politics. Each of these components has been given a subjective quantitative weight ranging from a value of five (high significance) to one (low significance), and they are then inserted into the matrix for the Euphrates river system and applied to each co-riparian. The Matrix Model, and a process of cognitive mapping, will examine the power relationships and the importance which each political participant has attached to the river at three periods. The first period is before the 1960s, before the construction of the main dams, when only natural factors determined the availability of water to the three riparians, when there were neither water storage structures interfering with the natural flow, nor irrigation uses at a level sufficient to create competitive water demands. The second period was between the 1960s to 1990s and was characterised by rapid development by all the riparian countries; and the third is the future - a period in which development plans of the riparians will be completed. In this period new geopolitical positions are being established which will determine the potential negotiating strengths of the three riparians.

The riparian positions within the drainage basin

The comparative riparian positions need to be distinguished: upstream, midstream, and downstream. Upstream means being first with significant flow, downstream means being last and midstream refers to any riparian between the upstream and downstream nations.

In general, the upstream position of a riparian gives clear potential power advantages *(Frey & Naff, 1985, 76)*, and the upstream state may be in good position to dictate the quantity of water that it is going to use and the amount of water that will be left for the lower riparian. From this position a state can usually take action that can be contested or countered by a downstream riparian only with considerable and increasing difficulty or cost. The upstream state can present lower riparian states with a fait accompli the alteration of which would be far more demanding than the decisions and water managing activities which were made before. An upstream country can also affect the quality of a downstream country's water by diverting or polluting it, but the downstream country cannot reciprocate hydrologically. In this respect it seems that the upstream states have certain privileges and rights in the context of international law. If the lower riparian has access to alternative sources of water, that nation will be less sensitive and vulnerable to the action of upper riparians when compared to riparians who do not have any access to an alternative resource of water *(Abbas, 1984, 239)*.

The geostrategically favourable location of Turkey in the region has not diminished with time, but has been enhanced. In the past, Turkey's strategic value has usually been seen as a buffer between the Middle-East and Europe. However this role, which was valid, for example, during the Cold War, is no longer relevant. Today, the economy is Turkey's main concern and this is exemplified by the GAP project. With the dynamism initiated by this project, Turkey aims to become an economic and political superpower in the Middle East. Turkey in this context, as an upstream state of the Euphrates river, would prefer non-binding understandings concerning the allocation and management of Euphrates water. Any obligation or commitment would necessarily involve concessions to the downstream states. Iraq, in contrast, as a lower Euphrates riparian, is in a very vulnerable position concerning Euphrates water quantity and quality vis-a-vis Turkey and Syria. This is the reason Iraq is the most eager to arrive at binding commitments, that would only bind the two upstream states - Turkey & Syria. Syria, as the second midstream riparian user of the Euphrates, would want binding understandings with Turkey because it will be affected by Turkey's development plans, but loose understandings with Iraq, its upstream state *(Waterbury, 1990, 15)*.

Projectable strategic power

Projectable strategic power is defined as a nation's military capability (defensive power and projectable power) and this factor is a crucial aspect in political analysis.

The factor of projectable power refers to a nation's ability to threaten its potential opponents credibly and thus shape their behaviour in matters concerning water. The ability to project military power (such as air power, artillery and missiles) against diversionary water works has as special a significance, as have the defensive capabilities against such force. Gleick (1992) claims that the more vulnerable a nation is to water shortages or cut-offs, the more tempting the water weapon. Similarly, the weaker the downstream nation, the more likely it is that the water weapon will be exercised *(Gleick, 1992, 8)*. There is, however, no systematic analyses been made of the strategic and military implications of large scale water projects. It may be that the development and existence of large scale dams and reservoirs significantly affect the military and strategic postures of proximate nations. Large scale water installations are dangerously vulnerable, no matter how well protected. Nations with such installations will tend to be more cautious in their international behaviour, since the potential costs of military conflict are so high *(Naff & Matson, 1984, 194)*. At the same time the contribution of reservoirs and dams in the upper riparian state gives it economic and military bargaining power. It enables the upper riparian to manipulate the stream or to condition agreements on water sometimes taking into account other issues affecting the states involved. Nasrallah (1990) claims that the Arab states will have to act in concert over the water issue if they wish to prevent themselves from being caught in a position of strategic inferiority *(Nasrallah, 1990, 16).*

The riparian position within the drainage basin

Turkey - the most militarily powerful country in the Euphrates basin during the early 1990s, felt itself sufficiently secure to act as it pleased with development programmes for the Euphrates river, and had no serious fear of military retaliation from the downstream countries. Examples of this are Ozal's hinting to Syria in 1987 that Turkey might cut the flow of the Euphrates into Syria unless Damascus stopped supporting to the Kurdish rebels of the PKK *(MEED, 13 October 1989, 4)*, and Demirel's 1991 description of the Euphrates water as a "national resource" similar to oil, in addition warnings given to Turkey's neighbours not to interfere in Turkey's national resource policies *(The Middle East, August 1991, 30)*, reflect the state's confidence in its military power regarding its downstream neighbours. Syria, in 1975 on the other hand, was forced by international pressure, from Saudi-Arabia and the USSR, as well as by fear of military attacks from Iraq, to release water from the Tabqa reservoir for the benefit of Iraq.

Turkey, has the advantage of being an upstream state, with storage capacity in three major dams on the Euphrates, that store about 90 billion m^3, of water, which is equal to approximately three times the river's natural flow. These structures have the capacity to reduce the flow of the river to the lower riparian states and thus attract five points on the matrix model. Syria, the second riparian state, has only storage capacity for 13.8 billion m^3 (that is less than half of the annual natural flow), and therefore has only limited power to influence the river flow into Iraq. Even if Turkey does reduce the flow of the water in the river, it is most unlikely to reduce the flow to a level that will affect Syria's agricultural development plans, therefore Syria will get three points. Iraq as the lower riparian state will be greatly influenced by both Turkish and Syrian development projects and any period of drought in the upper Euphrates will first harm the river flow to Iraq, as happened in 1984 *(Fisher, 1991, 480)*. Iraq faces more than just the question of inadequate water supplies; it also faces high river water salinity - an inevitable consequence of the extensive new irrigation schemes upstream in Syria and Turkey. This is the reason that Iraq will get only one point.

Strategic power

Turkey, as the strongest riparian country both in the past and in the near future will get five points; Iraq, until the 1991 Gulf War, was stronger than Syria from a military point of view giving it four points; while Syria gains only three points during the period of 1960s-1990s. However, as a result of the Gulf War and the UN sanctions, it seems that, in the near future Syria will become stronger than Iraq, and this is also seen in the future matrix. Syria, will probably not take any military action against Turkey in order to secure its water but might try to influence the Turkish regime on matters concerning the Euphrates water, as it did with other bilateral issues in the past.

Economic interests

Before the 1960s neither Turkey nor Syria used the river for hydroelectric power as well as industry. The use for irrigation was minimal, so their economic expectations from the river were low (see cognitive maps); on the other hand, by 1960, Iraq was already using the river water to irrigate significant areas. By 1969 Iraq was withdrawing approximately 45 per cent of the Euphrates water flowing through Iraqi territory *(Beaumont, 1978, 38).* From table H1 we can calculate that the Euphrates water potential irrigation area in Iraq is 36 per cent of the total area under cultivation making Iraqi's economic expectations from the river quite high.

During the construction of the development projects in the 1960s-1990s, period Turkey and Syria were already producing hydroelectric power, while Syria was even using water from the Euphrates and its tributaries for irrigation and for domestic use, mainly to the city of Aleppo, and for the urbanization of the river basin. Therefore their level of expectations increased.

At that period, Iraq had based its economy on oil exporting and focused less on the agricultural sector, leading to a reduction of its expectations from the river.

For the future, it seems that the economic factor will become more significant for Turkey, as it plans to produce more hydroelectric power (about 5,350 MW) from the river, as well as up to one million ha. of irrigated land (see table H1). The Urfa/Haran irrigation tunnel, which started operating in the summer of 1993, making Turkey the major user of the Euphrates water. However, the Euphrates irrigation potential in Turkey is only 4.3 per cent of the total area under cultivation.

Syria will only produce about 885 MW of hydroelectricity and will irrigate up to 480,000 ha. of area (see table H1) but Syria is more dependent on the river as it is the poorest riparian country with limited natural resources, Syria has neither large amounts of rainfall, as has Turkey, nor a second major stream such as the Tigris, nor large valuable petroleum deposits like Iraq. The Euphrates provides about 85 per cent of Syria's water, and its irrigation potential is about 7 per cent of the total area under cultivation. As a result, the use of the Euphrates water is a central element in any Syrian economic policy. However, the plans of the Turkish agricultural and electricity authorities, are far larger than the Syrian schemes in terms of scale, and it seems, that in the future the importance of the hydroelectric power potential of the Euphrates river for Syria will decrease because the share of the hydroelectric power of total national electricity production will continue to drop sharply.

In the future, it seems that the Euphrates water will be less significant for Iraq, the user most vulnerable to water quantity and quality reductions through developments upstream, but enjoying the compensating economic effect of oil in normal circumstances. The low hydroelectric power capacity (660 MW) and the existence of the Tigris river from which there will be much less water withdrawal upstream along with the development of new irrigation areas along the new "third river" will also reduce Iraq's reliance on the Euphrates. The delivery of less water to the agricultural sector will not be easy for Iraq to achieve, particularly because of the special circumstances (1991-94) having to endure the UN food embargo. These circumstances underline the importance of local agricultural production. When Iraq re-establishes a more stable economy based on oil exports, it will, most probably, also renew its food imports and will not have to concentrate on food security programmes; but Iraq, with an external debt of about $US 100,000 million *(MEED, 27 November, 1992)*, will not become an economic superpower in the near future.

External political interests

Before the construction of the main dams on the Euphrates in the 1970s, the river played a small role in the foreign relations of the riparian states, in spite of the great importance given to the river by Iraq, the only riparian country making major use of the river (see cognitive maps).

During the recent period of the implementation of rapid development projects, the Euphrates had become a major component in the external politics of the riparian states, because they have faced a potentially explosive situation over the division of water flow from the river. As a result the Euphrates has become a burning issue in Syrian-Turkish and the Iraqi-Syrian relations and this can be seen in the 1974 and the 1990 crisis. In 1980 the three riparian agreed to establish a technical commission for the exchange of information and to assist in finding a solution to the river conflict. Up to October 1992, the riparian countries had held 16 trilateral meetings at ministerial level, but without successfully finding a way to share the water.

After completion of the development projects, Turkey will hold both the most significant position and hold the highest economic interests, because its far-reaching dam construction and irrigation programmes, will dramatically reduce the river flow to Syria and Iraq. Syria will hold a significant interest in international relations while Iraq will have less interest, as the river plays a less important role in its economy.

Internal political interests

From this point of view, the river before the 1960s was only of minor significance for Turkey and Syria. For Iraq, on the other hand, it was very important, especially for the agricultural sector and domestic use (see cognitive maps). The need for population dispersal both in Turkey and Syria, as well as Turkey's internal security problems increased their domestic interest in constructing development plans for the river. In the future, it seems that internal political interests will become urgent for Turkey, significant for Syria but less important for Iraq. Apparently, Turkey has no certain solution for the internal problem of the Kurdish population in the Southeast, and this is expressed in the emigration from the area as well as the low standard of living there. An important explanation of why the project has such a high priority has been the personal interest of both Suliman Demirel and the late Turgut Ozal. They both held important engineering posts in the past, especially Demirel as the director of the DSI, and they have remained highly motivated to push the project ahead. They have seen the GAP Project as part of their own personal and professional achievements.

Syria does not face minorities or emigration problems in the Jezirah region. The Euphrates project has had a high political priority as a showcase of the Ba'ath regime's developmental ambitions as well as being an element in the Syrian president's personal prestige.

Iraq, on the other hand, is able to find a proper answer to the emigration of the rural population by using another water resource, such as the Tharthar canal, and by using income from oil exports in order to increase the standard of living of the population in the river basin, thus either acquiring the Shia population's support or controlling it.

The main hypothesis informing this analysis is that stable riparian relations are most likely when vulnerability to water shortages is low for all parties, and the military power is equal, or when the upstream state is also the strongest. Conflict is most likely when the riparian is vulnerable to water shortages; and conflict potential is generally higher among riparians with relatively high interest and relatively equal overall ranking. The highest conflict potential is when the down stream nation is most powerful and has most interest in the water but the upstream nations also have considerable interest *(Naff & Matson, 1984, 193)*. Under such conditions, the top military power is inclined to use that power to improve its riparian position.

Table H3:

Model Matrix of changing role of the Euphrates among the riparian countries

	Riparian position	Strategic power	Economic interest	Political-interest External	Internal	Total
a) before 1960s						
Turkey	5	5	2	2	2	16
Syria	3	3	2	2	2	12
Iraq	1	4	5	3	4	17
b) 1960s-1990s						
Turkey	5	5	4	4	4	22
Syria	3	3	4	3	3	16
Iraq	1	4	4	3	3	15
c) Future						
Turkey	5	5	5	5	5	25
Syria	3	4	4	4	4	19
Iraq	1	3	3	3	3	13

The validity of these contentions is confirmed by the tensions and events of the 1960-90 period in the context of the relations between Syria and Iraq. Economic interest in Euphrates water for agriculture was high in Iraq; it had become high in Syria through the prominence given to its new land reclamation schemes. In addition both states had strong military forces although they both had major strategic priorities outside the Euphrates Basin, Iraq with Iran and Syria with Israel. It was during the 1960-90 period that there were a number of hostile verbal exchanges in 1974 and in 1990 and significant military posturing on the Syrian border with Syrian forces confronting Iraq's threatening build-up which had been brought on by the low flow of the river at the border in 1974.

According to the Matrix Model assembled for the Euphrates river, it is unlikely that a military conflict will occur in the future, considering the ranges indicated for the five factors, and the fact that Turkey, the country with the strongest interest, is the upstream state (in contrast to the situation in the Nile basin).

H3. Conclusion

According to the Matrix Model in the future, Turkey will overall be in the most advantageous position, while Syria will be in a restrained position, and Iraq will be in a poor riparian position. Apparently, there is little if any, possibility for a military conflict. However, it appears that Naff & Matson's claim that Turkey holds a lower degree of interests *(Naff & Matson, 1984, 193)* should be disregarded.

We must recall, here, that Naff & Matson developed the theory of the Matrix Model at the beginning of the eighties, a period in which there was not yet any international awareness about Turkey's development projects in Southeast Anatolia which significantly changed the level of political and economic interests for the Euphrates river. The Iraq/Kuwait war in 1991 who changed the strategic balance of forces among the Euphrates riparian states, at least in the short run.

The Matrix Model should be used with care since, in contrast to the quantitative indicator of the vulnerability model, it is much more subjective. Thus different research scholars will give different numerical values to the power matrix. Here, as in the earlier models, all the factors receive the same quantitative weight without an attempt being made to determine, for example, whether strategic power is more important than economic power or vice-versa.

The questions which has been addressed in this chapter were in first, can past levels of tension between riparians be explained by geographical, economic, political (internal and external) factors, and by the relative military strength of the riparians. Secondly can future levels of tension and possible conflict be analysed using the same approach.

The pre- 1960s period was one where water shortages were rare and only associated with national events and international tension over water was not an issue. Tension emerged in the 1970s because the high interests of Syria and Iraq occurred at a time when the military strength of the two countries were similar. The conjunction of equality of economic interest and of military strength associated with the tensions of the 1970s appears to confirm the agreement of Naff & Matson (1984) that such conjunctions are significant and predictive.

Future scenarios are uncertain, and the Matrix Model analysis applied to the 1960-1990 period in circumstances of increasing demands on Euphrates water does not predict with certainty. It is unlikely that any Euphrates power will be able to take military action, as none of the riparians will have a sufficient high military position to risk action. Nor would they ignore the likely reaction of the international community which is currently a deterrent to regional international military aggression.

The question for the future, which will certainly be one of mounting demands for water, is whether the mounting water demands can be met for each of the countries. The answer to this question is yes (see page 159) if the national resources as whole are utilised efficiently. The tension over water will also be ameliorated if economic policy adjustments are made to substitute for water by accessing water in the international market for food *(Allan, 1994)*.

This chapter, therefore, can be summarized by claiming that analysis based on methods of international relations are not sufficiently precise to be a basis for the prediction of the future behaviour of the riparians and there is place for further development of the models which might show the possibility of a military conflict developing between the co-basin states.

I. Summary

The Euphrates river system represents a complex of water problems set in the midst of many additional factors connected with the geographical conditions of the area, and the external and internal policies and the different economic approaches of the countries of the drainage basin. Many researchers claim that the future of the Middle East is linked to its water sources and these may even cause the outbreak of the next war in the Middle East. Since the important rivers in the area are also international rivers the international dimensions of water in the region have been presented to be of critical importance. In an article in 1991, for example, Joyce Starr claimed that "water security will soon rank with military security in the war rooms of defence ministers" *(Starr, 1991, 18).*

An analysis of the factors which influence the system of relations between the states shows that the region is very heterogeneous. Factors which contribute to the inter-state conflict, like those which contribute to inter-state cooperation, are influenced by geographical conditions, internal and external policies and economic development - all of which are re-projected upon water policy. One must add ethnic, cultural and ideological differences as well as the personal relations between the leaders which also adds in same cases to the climate of conflict. There is no doubt that the potential for conflict over water allocation from an international river shared by states which have correct and friendly relations will be smaller than in a region which there is much tension. Apparently the political tensions existing between the countries of a drainage basin and their inability to arrive at any common agreement over the division of the water has fed the conflict approach among many of the researchers. Since water sources have already created conflicts between various countries in the world in the past, it is reasonable to assume that, in the future, the tensions will strengthen as a result of a growth in population, a rise in the standard of living, industrial development and, principally, because of the increase of irrigated agricultural land. All of these will lead to an increase in competition between the states over the limited water resources.

A shortage of water can, on the one hand, be caused by limited amounts of available water and, on the other hand, by a rise in water demand. Each of these sources of increased demand may cause a conflict over water as defined by Frey & Naff (1985). The shortage of water is the heart of the problem and the shortage of water is, "a zero-sum security issue and thus creates a constant potential for conflict" *(Frey & Naff, 1985, 67).* But on the other hand, from an economic point of view water is part of a non-zero-sum economies where it is possible to substitute for water and as a result, politicians avoid conflicts.

Many factors have contributed to the assumption that a military conflict over the division of the water of the Euphrates is expected:

The geographical conditions - the collection basin of the Euphrates is influenced by the physical conditions caused by the topography and climate. Large areas of arable land are located along the length of the river and these areas in South East Anatolia in Turkey, the Jezirah area in Syria and the Mesopotamia plain in Iraq will allow a total of 3 million ha. to be irrigated according to the development plans of the various states. Since the aforementioned areas have arid or semi-arid climates they are dependent upon river water for irrigation. As a result of the high level of evaporation large amounts of water are needed for this. This factor is very important since more than 90 per cent of the river water in Turkey and Iraq and more than 85 per cent of the Euphrates water in Syria are designated for irrigation.

One must add the climatic differences in the water source region in Turkey. This difference exists on a monthly basis - rainfall only in Winter, and on an annual basis - rainy years as opposed to years of drought. This fact has caused the need to control the river flow and store the winter water supply for summer and the annual water supply from wet years for dry years.

Population - the growth of population is a central factor which influences the possibilities of there being a conflict over the river water. The populations of the three countries are growing very rapidly and, as a result, the number of inhabitants will virtually double by 2025 - from 90 million in 1990 to 174 million in 2025 (see table H1). Accordingly, the demand for water in all three countries is expected to grow because of the need to supply the food to feed the population, to service industrial development, urban development and the expected rise in the standard of living. The growth in population will also create the need to invest in the implementation of development plans for population dispersal. Population density throughout the whole region of the Euphrates basin is relatively low so the states are encouraging migration to its lowland area or, alternatively, are trying to prevent negative migration from it. The larger the population living in the river valley the more the demand for water will grow and the lower the quality of water will fall.

There are other aspects of the population sharing the river water which contribute to the conflict and are linked to the fact that the population is very heterogeneous. They represent different languages, ethnic groups, races and cultures and contain minorities, the most important of which are the Kurdish population in South East Anatolia and the Shia population in South Iraq. These minorities contribute to the tension in the area. It appears that the only feature that all these races, ethnic and language minorities have in common, is the religion of Islam.

The political and economic structure - the different economic and political structure of the drainage basin countries also contributes to the tensions between them. In Syria and Iraq the basic economic system is socialistic in contrast to Turkey which is based on capitalism. In Turkey there is a democratic regime in contrast to the presidential regimes in Syria and Iraq. In addition to this factor there is the traditional enmity between the Ba'athist parties of Syria and Iraq which has existed since their independence and which has always been accompanied by bitterness and suspicion; one must remember that Syria twice supported military forces which fought against Iraq, first during the eight year war between Iran and Iraq and then when they took an active role against Iraq during the Gulf war. Since then the Syrians have continued in their attempts to bring about the fall of the present regime in Iraq. Other political factors which increase the suspicion of Syria and Iraq are Turkey's close links with the western world, its membership in NATO and its being a non-Arab country.

An additional common economic subject shared by the drainage basin states is the policy of water subsidy. Agricultural water is supplied free in Syria and Iraq and, according to all economic theories, this creates waste. In contrast, Turkey aims to charge for the use of water but, because of the system of flood irrigation, the price is set according to the size of the cultivated area and not according to the amount of water used - such an approach does not contribute to saving water.

Other factors - a number of other factors also contribute to the atmosphere of tension and suspicion between the states. The development of the river valley is seen, mainly by Turkey and Syria, as a matter of national image and a symbol of the development program. This is also linked to the inter-personal images of the leaders who wish, at least externally, to demonstrate their determination and serious approaches to the development programs.

The subject of the division of the Euphrates water, is closely connected to the subject of Syria's territorial claims from Turkey in the Hatay region, and to security agreements primarily connected with the subject of border crossing and Syria's support of the Kurdish PKK organization.

It appears that all the above factors, in fact, feed the development of idea and theories which foresee the possibility of a military conflict over the division of the Euphrates' water. One must, however, remember that there are other variables connected with water scarcity which, for example, raise the principle question of whether the shortage of water is an internal or external threat to the stability of a state.

This poses a number of questions:

A. Is a shortage of water for members of the Euphrates drainage basin expected?

B. Does the conflict between the countries arise out of the difficulty of dividing the water which, in turn, causes the political conflict or do the economic, security or ideological factors project themselves on the water issue?

C. Is a military conflict between the states of the drainage basin of the river expected?

A. The possibility for shortage of water among members of the Euphrates drainage basin.

A critical aspect of the Euphrates water issue is that of how an agreement over the division of the river's water supply could be reached. As we have seen there is unfortunately no agreement between the riparian nations over the average amount of natural water flowing in the river (which can be assessed at 30 billion m^3/year give or take ten per cent). This number, lost its importance when, in 1987, Turkey promised to transfer a constant amount of water annually: 500 m^3/sec on the average, and not a specific percentage of the river's annual water supply. In this way the average annual amount of 15.8 billion m^3 which Turkey undertook to transfer to Syria was established. This approach has brought about the situation whereby if the calculated yearly flow presented by Turkey was exaggerated, it will have to bear the consequences.

According to this calculation and other data about the flow which Turkey has presented, the average amount of water is 30.3 billion m^3 at the Turkish/Syrian border, that is to say an average amount of 14.5 billion m^3 of the river water is supposed to remain in Turkish territory. Of this total, according to the information in figure D1.2, close to 3 billion m^3 will be lost by evaporation and about 11 billion will remain for irrigation purposes. This calculation is even higher than Turkey's official data which claim consumption of 10.1 billion m^3 for irrigation from the Euphrates river (see table C1.8). Calculations concerning the amount of water which will remain for Syrian use, should be based on the latest bilateral agreement signed between Syria and Iraq in 1990. This agreement determines that Syria should receive 42 per cent of the water transferred by Turkey (15.8 billion m^3 according to Turkey); and Iraq should receive 58 per cent of this total - equivalent to 9.16 billion m^3. As a result Syria's share, according to the agreements should be 6.6 billion m^3 per year. 2 billion m^3 which Syria receives from harvests from the Euphrates tributaries should be added to this. As a result the final total reaches 8.6 billion m^3 per year. If we accept the claim made by Kolars & Mitchell (1991) concerning the influence of Turkish irrigation on Syria, then in the future, Syria will benefit from additional amounts of water estimated at between 1.1 and 1.4 billion m^3 annually which will be added to the supply from the Euphrates tributaries through the subterranean aquifer despite the fact that the quality of water might be lower *(Kolars & Mitchell, 1991, 134).*

The minimum amount of water which will be left for Iraq - 9.16 billion m^3 will be correct only if Turkey and Syria succeed in using all the water at their disposal. Since, according to estimates made by experts, Syria is not capable of irrigating all of its cultivable land, the annual amount of water, after calculating the evaporation and return flow, Syria's need will be 7 billion m^3 *(Kolars & Mitchell, 1991, 275-279).* Thus the annual amount of water which will reach the Iraqi border will probably be 11 billion m^3 annually. This amount of water which will continue to reach Iraq is based upon a water division agreement as well as Syria's ability to use its relative allocation. One must also consider the amount of water Iraq is capable of transferring from the Tigris through the Tharthar depression and the Tharthar/Euphrates canal, which was completed in 1988. According to Iraqi claims the level of salinity of the water transferred through the Tharthar depression is high, and the use of this water for irrigation in the Euphrates basin will cause the salination of 325,000 ha. of agricultural land *(Baghdad Observer, 15 January, 1990, 1).*

As the flow of water continues each year, however, its quality will improve. According to research done by Al-Hadithi (1979), an annual quantity of 7.3 billion m^3 can flow a through the Tharthar/Euphrates canal. One can thus expect that the amount of annual general water which will be at Iraq's disposal in the Euphrates basin in the year 2,000 will reach 18 billion m^3. This amount of water should satisfy Iraq's needs. Iraq needs 16 billion m^3 to irrigate 10.5 million ha. and another 1.2 billion m^3 for industry and domestic purposes - a total of 17.2 billion m^3 per annum. If, however, as Al-Hadithi claims, there is an improvement in the irrigation methods which today, lose about 5 billion m^3 of water annually in the irrigation channels alone an amount of 9.3 m^3 annually and another 1.2 billion m^3 for industrial and domestic use will supply Iraq's needs. Large surpluses of water will be created in the river or, alternatively, the need to transfer water from the Tigris river will be cancelled *(Al-Hadithi, 1979, 103-117).* One needs to remember that both Turkey and Syria base their agriculture in the Euphrates valley on flood irrigation, a system which can be changed and so lead to water economy. Water can also be saved by raising less wasteful agricultural crops.

Distinctions between flow calculations over periods of time need to be made here. Until Turkey completes the filling of the reservoir behind the Ataturk dam in 1995, it will continue to allow a regular annual flow of 15.8 billion m^3 of water to Syria. In the decade after 1995, however, it seems that the amount of water flowing in the river will grow until Turkey and Syria reach maximal exploitation of the river water for agriculture. Thus, by the middle of the first decade of the 21st century, the amount of water in the river which will reach Iraq will be even greater than shown in the calculations made above.

These calculations lead to the conclusion that, according to the best estimates available it appears that the factor of the amount of water will not be a principal issue of contention between the states. One should note that there is the possibility that, in fact, the various articles published by western scholars over the last twenty years may have created psychological pressure on the leadership and public opinion creating the fear of future water shortages - especially in Iraq and Syria. Clawson (1971), for example, calculated the amount of future water needed by the states from the Euphrates river for irrigation to be 40 billion m^3 - a figure which is 25 per cent higher than the average amount of water in the river (see table D1.2). Beaumont (1978) calculated the maximum amount of water at 36.5 billion m^3 - a figure higher by 15 per cent than the annual average over many years (see table D1.3). Soffer (1992) claims that between 1990-2005 a serious conflict will break out between the states over the division of water. Soffer bases the reason for the conflict on the future water consumption in 2005 which will reach 45 billion m^3 - a figure 40 per cent higher than the average annual river flow *(Soffer, 1992, 117-128)*. The highest amount is that calculated by Waterbury (1990). According to his calculation the amount of future water needed by the riparians in the Year 2005 is 53 billion m^3 - a figure 65 per cent higher than the average annual flow (see table D1.6).

The question one must ask is what is the possible source of error in the above calculations. It appears that there are several common factors:

1) Not distinguishing the fantasies of leaders and state development programmes from the area which will ultimately be irrigated in practice seriously distorts estimates of future water use. Both the Turks and the Syrians, for instance, have admitted that they are incapable of carrying out their development programmes fully first because of the quality of the soil, secondly because of agreements over water allocation and thirdly because of the need to let water flow in the river to produce hydro-electric power. It appears that Turkey will, ultimately, irrigate only 625,000 ha. as opposed to the 1,083,470 ha. in the development programme *(Briefing, 15 January, 1990, 7)* and Syria will irrigate a maximum of 480,000 ha. instead the 650,000 ha. which appears in the development programme *(Kolars & Mitchell, 1991, 275-297)*.

2) Disregarding existing agreements over water division also leads to an exaggeration over the potential duplication of use. Although there is no common agreement for all the states, there are bilateral agreements between them. Disregarding agreements creates a situation in which, for example, Kolars & Mitchell (1991) reach the final conclusion which leaves 4.4 billion m^3 for Iraq on the simplistic assumption that Turkey and Syria complete all of their development programmes (*Kolars & Mitchell, 1991, 212)*.

3) Not discriminating between data presented by states for the purposes of bargaining during negotiations over water division and the states' real need for water is

misleading. At the meeting between the three nations in Baghdad in 1965, for instance, Syria demanded 13 billion m^3, Turkey 14 billion m^3 and Iraq 18 billion m^3 - a total of 45 billion m^3, an amount 40 per cent larger than the average flow over several years. Iraq's and Syria's demands in this case are clearly for purposes of bargaining *(Naff & Matson, 1984, 92)*.

4) A no less important matter which might cause a lack of clarity and lead to enormous and unrealistic estimates regarding development programs is the quality of the data. One must remember that the different figures concerning the amount of water in the river annually, the development programmes, the amount of irrigated land, seeding periods and irrigation methods, calculations concerning return flow and the water quality - are all figures provided by the various governments which have decided how and whether to publicize them. The agricultural development of Iraq, for instance, is considered to be a secret associated with the national security of the country. In contrast, Syria for its own purposes, does not publish figures about irrigated areas or the amount of water it pumps from the Tigris river. Turkey does not publish calculations made on return flow and provides unrealistic estimates about the amount of water it is planning to use for irrigating a hectare of agricultural land. This lack of reliable data, undoubtedly makes research difficult and contributes to enormous estimates - especially concerning the potential of the river water for agriculture.

5) Politicians have internal political incentives to present a scenario of conflict relating to the water scarcity which will affect the capacity to produce food, the quality of life, health as well as the production of energy and industry. This argument is easier to project than one based on variables such as internal or external tension - which are less understood by the population. Also strategic research institutes, as well as International Relations experts prefer to present a view based on conflict and so encourage the development of climates of conflict between the states. It similarly appears that experts generally tend towards giving more weight to pseudo-quantitative factors since it is relatively easier to estimate them than ethnic, cultural, ideological and symbolic factors. On the other hand if Syria and Iraq admitted that agreed amount of water satisfies their needs, they would lose an important bargaining chip in their external relations.

We can answer here the question whether a shortage of water is expected along the Euphrates drainage basin. It seems, in fact, that no shortage of water from the Euphrates river is foreseen which might prevent countries carrying out their development programmes in the drainage basin.

B. Political, economic and ideological sources of potential conflict.

If water resource deficiency is not an inevitable source of long term conflict, we thus, need to examine a second possibility namely that political, and ideological tensions between states could project themselves on water politics and management or vice versa.

In this examination of the Euphrates as an example of a conflict over resources we have a quite complicated situation in which the relations between cause and effect are far from clear.

We can refer, here to the most serious conflict which brought Syria and Iraq to the brink of war in 1974-75. It is probably doubtful that the conflict was principally about the quantity of water but was more influenced by other tensions which existed in the relationships between the states. It is, perhaps, possible to prove this by the fact that Turkey, whose part in stopping the flow of water in the river was at least equal to Syria's, was not accused of this by Iraq in order not to damage the relations between them. A further confirmation can be formed in the fact that the restoration of flow in 1975 did not improve the bilateral relations between Iraq and Syria.

The 1990 "water crisis" was caused by Turkey's decision to stop the river flow for a month in order to carry out works to enable the start of the filling the Ataturk dam. Turkey made sure that downstream countries were compensated in order to ensure that the promised annual amounts of water not be infringed upon, produced a sharp protest from Syria and Iraq who claimed that it was an act of international piracy. One can see, that both states understood that there was a temporary, technical need to stop the flow and the agreement was only over the amount of time needed for this.

There is no doubt that Turkey's ability to stop the flow of the river bothers Syria and Iraq very much since it changes the strategic balance in the area - although it appears that their protests against Turkey also served internal and external political needs. Neither of the two states threatened to use their armies against Turkey, and the principal implicit threat was existing to the economic links. This shows that the heart of the conflict is linked to political and economic factors and although the subject of the division of the water river makes an additional contribution to the tension it does not create it.

C. <u>The possibility for a military conflict to arise out between the states of the drainage basin.</u>

Many experts claim that conflicts over water have, in the past, caused and will, in the future, cause a war over this resource. Gleik (1992) for instance writes: "Water has already been a source of conflict among nations. We fight for access to water, we use water as a tool and weapon in battle, and we target the water facilities of our enemies". "In arid and semi arid areas of the world, where water is already a vital resource, conflicts over access and possession are likely to worsen" *(Gleik, 1992, 13)*. It is a fact that the existence of agreements over water rights influences the external relations of the states - but agreements are not "wars" according to conventional meanings. Many examples given by experts - from the Korean war to the Gulf war - do relate to the fact that reservoirs and water installations were damaged; but these were not wars in which water was central to the out-break of war. The 1967 war between Israel and the Arab states, in which water resources were also captured, contributed greatly to the development of the idea and models of wars fought over water among various scholars - although this is clearly a unique case.

Is it a fact that the existence of various regions in the world in which the inhabitants suffer from malnutrition (partly because of internal wars and partly because of climatic factors) has not caused any state to try and conquer additional sources of water.

In order to examine the chances of war breaking out over the division of Euphrates water, an examination of factors was carried out over three periods of time. The factors included: the different interests the nations have concerning the Euphrates river, the level of vulnerability in case of water shortage as well as the reasonable chances of war over water sources.

An analysis of the variables shows that, from the point of view of the states' vulnerability to water shortage, Syria is the most vulnerable because of the high percentage of total Syrian Euphrates water which comprises. Euphrates water is also of great importance because of the considerable amount of electric power produces in the river and Syria's strong desire to reach a situation in which it can reach self-sufficiency in food production. Iraq, on the other hand, is less vulnerable since its water economy is larger, its dependence on hydro-electricity production is lower owing to its greater wealth in oil, and because its economic situation (after the world's boycott ends) will again allow the state to continue to base itself upon the importation of food products. Iraq's vulnerability is mainly expressed by its being the state that will be most heavily influenced by Turkey's and Syria's development programmes for the Euphrates river. Turkey's situation is the best of all. The amount of water per inhabitant is relatively large, its dependence on international rivers is small and has the best placed with respect to self-sufficiency in food production. On the other hand, Turkey's dependence on hydro-electric power is the greatest although it can, in the case of continuous drought years, determine its own scale of priorities between electricity production and agricultural development.

The Matrix Model of changing role of the Euphrates among the riparian countries examines the theory of the possibilities for war which arise out of the possibility of water shortage. An examination of the factor concerning the location of the state in the drainage basin shows that Turkey is upstream and so has the best location. Syria will be influenced by Turkey's development program and Iraq's downstream location is the worst since it will be influenced by the development programmes of both Turkey and Syria.

An examination of the military power factor is the most significant for the readiness of a state to fight. Turkey, here as well, is in the best situation since it is militarily the strongest state in the drainage basin, it is militarily linked to the NATO pact and the development of reservoirs on the Euphrates river give it the possibility to use water strategically power against its downstream neighbours. In contrast, Syria is very limited in its ability to control the river flow in the direction of Iraq because of the low storage capacity in reservoirs. It must also be emphasized that Syria has also become weaker from the point of view of the strategic links which, in the past developed with the USSR. Iraq's military strength was stronger that Syria's in the 1980's, but the Gulf War changed this situation and Syria has little to worry about in the future from any Iraqi military action.

An examination of the economic interests of the states in the development of the river's resources shows that here also Turkey has the strongest interest. Only Turkey can produce a significant amount of hydro-electric power and it is the only state which still does not use the river's water for irrigation purposes. Turkey's great agricultural potential also creates far-reaching expectations concerning the creation of livelihoods, raising the standard of living of the local population and the development of the area as the Middle East's "grain market".

Syria's economic expectations are lower because of its relatively low hydro-electric potential and smaller land areas in the drainage basin which can be cultivated. Together with this, however, one must remember that Syria is the poorest country in the drainage basin and so is heavily dependent on the Euphrates which supplies most of the water in the country.

From an economic point of view Iraq has the lowest set of expectations from the Euphrates water, mainly because of its ability to base itself on oil revenues. From the point of view of electricity production the river has no significance. It appears that the economic sanctions against Iraq after the Gulf war of 1991, have actually created an awareness that there is a need for food self-sufficiency. Thus one cannot completely ignore the economic expectations of the river states in regard to food production.

From the point of internal policy it seems that Turkey, again has the most significant interests in the development of the river. Turkey suffers a great deal from internal problems connected with the Kurdish population living in the area, as well as the negative migration of the population which strains the infrastructures of the large cities in the country. The only solution the state sees to these problems is connected with creating places of work and raising the standard of living for the inhabitants of the region. One needs the river water to produce electric power for irrigation and for industrial development.

Syria in contrast, does not suffer from problems of minorities in the region or from negative population migration. The opposite is true and Syria aims to transfer population to the region in order to reduce the pressure in the centre of the country.

Iraq, which like Turkey suffers from negative migration from the river valley, can in principle solve its problem by using oil revenues to raise the standard of living for the population. Iraq, however, usually uses the water to increase its control over the Shia population mainly living near the southern part of the river.

According to these principles which are expressed in the Matrix Model, Turkey, militarily the strongest state, is located upstream and its internal interests in the development of water sources are the strongest. Syria, has the worst location, is militarily weaker and has moderate economic and political interests. In contrast, Iraq has the worst geographical position, currently the weakest military strength and the lowest economic and political interests. Referring to the Matrix Model (section c) which attempts to examine the possibility of military conflict in the future, suggests an answer to the third question and an assertion - there is not expectation of a reasonable possibility for military conflict between the nations of the drainage basin, since the downstream states do not have the military capability or the economic and political motivation to try and achieve their right by force. It should be noted that the theoretical models which have been applied in this work have revealed themselves to be subject to difficulties deriving from their owing to their great subjectivity and because the different factors could not be ranked according to a hierarchy of importance. Analysis based on the methods of international relations are not sufficiently precise to be a basis for the prediction of the future behaviour of the riparians. There is place for additional development in the construction of the theories.

It is reasonable to assume that, in the case of a future conflict over the division of the river water, political or economic pressure will be applied as has been done in the past (Syria's support of the PKK) but this will not cause war to break out between countries. One may also assert here that the construction of the reservoirs and water installations in the drainage basin of the river reduce the chances of war because of their vulnerability. The danger of damages to the water installations influences foreign policy making it more cautious. The recognition of the cost of modern warfare also, undoubtedly, lessens the chance of a war breaking out. On the other hand, agricultural and industrial development in the drainage basin of the river will also demand more economic cooperation between the states.

Economic activity in the region such as the export of oil from Iraq to Mediterranean ports, will be encouraged by the development of trade in agricultural and industrial products - it is reasonable to expect that these developments will also contribute to the development of economic and, later, political links between the nations. Turkey has been particularly energetic in encouraging a prospect of increased mutual economic interdependence and the creation of a regional economic trade and development zone.

The projects involving the construction of numerous reservoir on the Euphrates river, principally in Turkey, can contribute much to the development of the downstream states. This is because of the capacity which has been created will stabilize the flow of the river water throughout the year, prevent the flooding which once characterized the river and continue to release water from the reservoirs in times of drought. This capacity is very important for the development of agriculture, especially during the summer months when the river flow used to be low and the need for water for agriculture the greatest. One must remember that Syria and Iraq, without investing any money, will benefit from this. The large project for the prevention of flooding in Iraq and the annual cost of maintenance will also now become superfluous. There is no longer any need to build additional reservoirs to store water in Syria and Iraq or to stabilize the flow of the river. Moreover it can be expected that these developments will encourage Iraq and Syria to improve their irrigation systems and increase the efficiency of water use.

According to Turkish claims, one can expect the evaporation from the Ataturk reservoir to increase the moisture in the air. This might create a belt of 30-50 km. in the North Jezirah area of Syria and make it rainier. The completion of Turkey's irrigation channels on the Syrian border might, likewise, encourage Syria and Turkey to reach agreements in order to continue them into Syrian territory for irrigating the desert region at virtually no expense *(Frankel, 1991, 285)*, but this subject has not been fully investigated.

On the other hand, it must be emphasized that the construction of reservoirs gives a most significant strategic advantage to Turkey - something which Iraq, but mostly Syria, finds hard to accept. The quality of the river water will also be harmed as a result of return flow to the river from agricultural land which will receive large quantities of agro-chemicals. As a by product of the industrial development and rise in population larger amounts of sewage will, likewise, flow into the river - something which might cause damage particularly to Iraq. This is not yet part of the major order of priorities in the network of relations between the nations but it is only logical that it will be in the future.

One must remember that the countries are carrying out their development programmes with no cooperation taking place between them, and that no overall agreement for the division of water exists. The programmes are similar in their aims - control of the river water, the production of hydro-electric power, the irrigation of arid and semi-arid regions and industrial development. Because of the different geographical, political and economic conditions, the states operate according to different agenda and motivations and without cooperation - so the tension over the river water will probably continue to be a central issue in the framework of the nations' foreign relations.

The findings of this study can be summarized by a number of additional conclusions that were arrived at during the research:

It is impossible to define the Euphrates system as a closed system especially in the case of Iraq where other resources like the Tigris river flow through the

Tharthar/Euphrates canal which also plays a role in satisfying the demand for water. Thus the overall water balance of the Euphrates, the Tigris and their tributaries needs to be examined in order to determine the water needs of the riparians states and be taken into consideration regarding the sharing of the water.

There is sufficient water in the Euphrates system to meet the social and economic needs of the riparians until 2025 notwithstanding the proposed projects in Turkey. This adequacy relates also to the capacity of Syria and Iraq to utilize water that has been and will continue to be restricted by environmental and institutional impediments. Thus it appears that the division of the water will not be a cause for war between the states and that other political and economic factors play a decisive role in determining the network of relations between the states. Neither Syria or Iraq will lack the water necessary for existing developmental projects in the near future but this fact does not solve the problem of their inability to ensure their food security. Therefore the solution to any periodic and long term water deficits will be in the global political economy in which the riparians have already participated and will continue to participate according to their individual interests as opposed to their sometimes conflicting interests as riparians. The political economy of water is subordinate to the global political economy of food and to the political economy of trade in food.

Since there is no co-operation between the riparians for the common development of the river basin, the individual economies can and will solve their problems independent of their riparian neighbours in the global system something which, in the future, will lead to closer economic and political co-operation between the states.

Principles of international law are unlikely, in the case of the Euphrates, to be a significant basis for a procedure for sharing water and since the principles and instruments of international law are difficult to put into practice, the riparians will have recourse to other remedies which are applicable such as international trade.

Water sharing dominates the current thinking of the downstream riparians but they will increasingly adapt to the idea that they can find substitute for water as they recognize that this solution has been the remedy to their food production problems during the past two decades and will remain a major remedy in the future.

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