Chapter 3

ROLE OF WATER IN THE SYRIAN ECONOMY

In Syria, the relationship between water resources development and economic development is clearly reciprocal. Water development has been constrained by the sluggish economy, the slow rate (indeed, negative in some years) of economic growth, and the lack of access to capital or credit for financing projects. In turn, economic growth is made more difficult by the nonavailability of water resources for irrigation and industry, and by the magnetic attraction of better services -- health care, clean water, superior schools -- that the metropolis offers to rural manpower.

3.1 General Economic Situation

The positive trade balance of early 1988 presents the first glimmer of moderately good economic news to be seen in Syria in the present decade. The general picture has been more one of industrial stagnation, delayed projects, shortages of materials, consumer austerity, and deficits. The difference in 1988 can be defined in two words: "water" and "oil"[4541].

Throughout the 1980s, the rains have come either too little or too late. In 1988 the rains have been plentiful and at the right times. This, plus the introduction of improved strains of wheat, have produced a record grain harvest, with a significant reduction in the need for food imports. Cotton is also expected to yield a bumper crop in early 1989, if 1987's out-of-season cloudbursts are not repeated. Last year's untimely rains helped to raise the level in Lake Assad, which relieved the shortfall in electric power, but they decimated the cotton crop[4541][4485].

At the same time, the coming on stream of light-crude oil fields in the Deir ez-Zor area have reduced Syria's need for oil imports to virtually zero[4541]. When the newly discovered Omar field begins to produce in 1989, Syria will become a net exporter of light crude in addition to the heavy sulphurous crudes from Hassakah province that Syria has been exporting for many years. Thus, the financial burden of importing energy has been lifted and Syria may in future turn a small profit on its oil production. It was estimated in 1985 that the simple replacement of oil imports with local production would save the Syrian treasury some SL 2 billion per year[4388].

This slightly improved situation is reflected in Syria's current budget. The total public expenditure, which had diminished in absolute terms from 1986 to 1987, was up more than 20% from 1987 to 1988 -- although that still represents a reduction when the 50% inflation rate is factored in. The SL 51.5 billion budget (see Table 3.1) is divided into current expenditures, SL 29.7 billion, and investment expenditures, SL 21.9 billion. In the current expenditure budget, the major item as usual is defense (44%), while the largest allocation in the investment budget is for water and power (24%), with agriculture coming second with 20%[4484]. (Water and power constitute a single line in the Syrian budget.) On the revenue side, the increases under exceptional and other do not represent projected real increments in income; rather, they reflect the depreciation in the official rate of the Syrian pound from 3.925 to 11.20 per US dollar.

The allocation for water and power reflects a significant upgrading of the priority of that sector in Syria's planned development. In 1987 the allocation from that year's greatly diminished development budget (down 10% over 1986) had been 43% for water and power. The two year total put water and power at a third of total investment, compared to the average 10% which had been allocated to it in most previous years.

In light of the economic and sectoral performance of the 1980s, this emphasis is obviously needed. The basic indicators for the period 1981-87 are shown in Table 3.2. The steadily increasing figures for gross domestic product are deceptive because of the inflation factor at market prices. In fact, the growth rate was negative in several years. More telling is the balance of trade which has been steadfastly negative until 1988. Exports and imports both reached their nadir in 1986. Exports were down because of stagnation and crop failures. Imports were in part curtailed by official austerity measures, although smuggling -- a major industry -- took up some of the slack in consumer goods. Indeed, the volume of black market trade in goods and currency is so large as to render official statistics incomplete, if not unreliable[4436].

Both import restrictions and credit constraints have taken their toll of Syrian economic and infrastructural development. The private sector has been complaining for years of its difficulties in obtaining the inputs necessary for production[4210]. In summer of 1988 it was reported that many factories had been forced to close through lack of raw materials and spare parts[4571]. By mid-decade, the Syrian government had begun instituting incentive programs for entrepreneurs, including special exchange rates on expatriate capital for private investment, streamlined import procedures for industrial equipment, and legal mechanisms for the export of profits[4211]. The economic sectors open to private investment were expanded, and new categories were established for mixed public-private sector enterprises[4210]. These new inducements to private enterprise were clearly intended to harness one of Syria's

Table 3.1

SYRIA: CURRENT BUDGET REVENUES AND EXPENDITURES
(SL mn)

	1985	1986	1987	1988
Current Expenditure	23,500	24,508	24,195	29,665
of which:				
defense	13,000	13,600	13,200	13,319
elementary education		3,641	3,803	4,894
public debt		1,385	1,747	3,911
price stabilization		1,400	900	900
Investment expenditure	19,448	19,333	17,508	21,880
Total expenditure	42,948	43,841	41,703	51,545
Revenue	42,948	43,841	41,703	51,545
Taxes and Duties	10,400	12,040	14,159	16,790
Services	344	382	594	1,434
State sector surplus	13,200	14,443	15,129	12,071
Exceptional	5,200	4,890	2,379	4,626
of which:				
loans & external		1,749	2,143	4,540
Other	13,804	12,086	14,159	16,623
of which:				
aid		7,682	7,682	7,830
donations		700	519	1,644

Sources: MEED 9/9/88(4571); MEED 3/21/87(3566); MEED 6/19/86(4430); EIU 1987:4(4484); al-Shariqa al-Khalij, 9/24/86(4247).

Table 3.2
SYRIA -- BASIC ECONOMIC DATA

	1981	1982	1983	1984	1985	1986	1987 E
GDP at market prices (in SL bn)	66.49	70.53	73.29	75.34	79.55	86.36	-
GDP (% real growth)	10.2	3.2	1.8	-3.6	0.7	-3.0	-1.9
Inflation (%)	18.4	14.3	6.1	9.3	17.2	36.1	50.0
Population (mn)	9.0	9.3	9.6	9.9	10.3	10.7	11.1
Exports (fob $ mn)	2,230	2,032	1,928	1,859	1,640	1,325	1,500
Imports (fob $ mn)	-4,843	-3,703	-4,152	-3,801	-3,591	-2,480	-2,800
Balance of Trade	-2,613	-1,671	-2,224	-1,942	-1,951	-1,155	-1,300
Current Acc. ($ bn)	-0.28	-0.25	-0.82	-0.85	-0.95	-0.43	-0.85
External Debt ($ bn)	2.20	2.24	2.29	2.4	2.73	3.06	3.40
Reserves ($ bn) *	2.29	2.20	0.05	0.27	0.09	-0.01	-
Exchange Rate [Av. LS per US $]	3.925	3.925	3.925	3.925	3.925	3.925	**3.925

E = estimated. * Not including gold. ** SL 11.20 per US$ as of Jan 1988.
Black market exchange rate in 1988: (min) LS 50 - (max) LS 100 per US$.

Sources: EIU 1988 Country Profile 88-89 (4363) ; EIU 1988:1 (4486) ; EIU 1988:3 (4541) ; EIU 1987:4 (4484) ; EIU World Outlook 1986 (4127) .

most valuable resources -- the energy and ingenuity of its people. It remains to be seen how many expatriate Syrians will come forward to reinvest capital and effort in their homeland.

But the lack of international capital does not discriminate between the free enterprise and government sectors. The public sector also suffers delays. News reports throughout the 1980s tell of projects completed but waiting for mechanical equipment[2195], and of small local projects begun in the 1970s and not yet complete in 1986[4284]. Important water projects such as the sewerage schemes for Aleppo, Homs, Hama -- and even Damascus -- have been delayed from year to year due to shortage of funds. Contracts were finally signed in early 1988 for the Homs and Hama plants[3853], after Syria's improving debt service record to the World Bank enabled that institution to release the loans that had been allocated to Syria almost a decade earlier.

In its 1980 report on Syria[1266], the World Bank predicted that Syria's laudable ambition to provide safe drinking water for its rural population had a probability of success "close to zero" because of lack of capital and skills. In part this has been a self-fulfilling prophecy, since the hold the World Bank placed on loans allocated to Syria (a precedent which is customarily followed by many other international lenders) has impeded Syrian development projects and undercut Syria's ability to meet its obligations at home and abroad. It is also true that the complications of Syrian bureaucracy have occasioned delays in projects that were in no way dependent on outside finance. Indeed, there have been completed water projects that could not operate because of jurisdictional disputes over which agency should collect the fees and maintain the systems[2346].

Syria's financial problems are very real, neither a figment of an international banker's imagination nor a construct of domestic red tape. In 1988, its external non-military debt stood at $4 billion, half again as much as the total operating budget for that year, almost 90% of that year's budget for current operations and development investments combined, and more than half of the last reported year's GDP. (That was 1986 since Syrian statistics are published two years late.) Service on that debt constitutes more than 13% of the current expense budget for the most recent year[4571][4754]. It will require several years of favorable external trade balances to translate that surplus into general economic recovery sufficient to pay off interest and import the materials needed for industrial production and infrastructure development.

3.2 The Agricultural Sector

As is true in many Middle Eastern countries, agriculture is by far the most significant consumer of water in Syria. Despite the fact that irrigated farming produces only 10% of Syria's annual harvest, nearly 90% of the water used in Syria in 1981-82 was applied to irrigation, and there is no reason to believe the proportion is any less today. It is therefore important to examine the position of this most thirsty of economic sectors, which provides 20% of Syria's GDP, 13% of its exports, and employs 33% of its workers[1280].

Syria is one of the few countries of the region that is potentially self-sufficient in food[4576]. In normal years, it is estimated that Syria's overall food sufficiency rate is 86%[4211]. Syrian agriculture, however, remains vulnerable to the vicissitudes of the rainfall regime, although this instability should not be allowed to disguise the significant gains in agricultural productivity since 1970[3317]. This improved performance has not kept pace with population growth, and the early 1980s -- a period of drought -- saw Syria compelled to import basic foodstuffs to feed its people. A 1985 report to the Food and Agriculture Organization sets forth Syria's performance at mid decade and projected need to the end of the century.

Table 3.3

Syrian Food Production and Need
(million tons)

Product	Produced 1984	Need 1984	Need 2000
Grain	1.98 mt	4.0 mt	6.8 mt
Meat	0.099 mt	0.42 mt	0.72 mt
Dairy	0.702 mt	2.5 mt	3.9 mt
Eggs	0.856 bn	1.8 bn	3.1 bn
Vegetables	2.2 mt	2.4 mt	4.1 mt
Fruits	0.742 mt	0.9 mt	1.3 mt
Industrial Products	0.651 mt	1.77 mt	3.0 mt

Source: al-Sharq al-Awsat[4160].

Although Syria has not realized its full potential to achieve food self-sufficiency, it has during recent decades registered among the highest growth rates in per capita agricultural productivity for the region. As of 1980, Syria's growth in agricultural value added per capita compared to its neighbors as follows:

Table 3.4

Value Added in Agriculture
($ per capita per year)

	1961	1980	% Change
Egypt	140	393	+181
Iran	189	582	+207
Iraq	142	480	+238
Saudi Arabia	--	391	--
Sudan	134	391	+192
Syria	50	311	+522
Turkey	300	886	+195

Source: McLachlan[4575], p. 35.

After the politically turbulent years of the 1940s and 1950s in Syria, the starting point in 1961 was perhaps understandably low, with a per capita value added less than 40% that of Sudan, the next lowest country on the list, and only one-sixth that of the highest, Turkey. It should be noted that several of the countries to which comparison is made rely heavily on irrigation whereas Syrian agriculture was and still is predominantly rainfed. It is also apparent that Syrian agriculture has in this time period done much to catch up with the productivity of its neighbors.

This improvement is due only in part to the expansion of irrigation, which has consumed 80% of agricultural investment but the results of which have been disappointing at best[3317]. The Ghab project is productive, with both irrigated and dry farming. Peasants work in cooperatives for officially planned crops and then, as private enterprise, plant interim crops for local market between the official cycles[4255]. The costly Euphrates project, on the other hand, has experienced technical problems and crippling delays. Year after year, the area of land Euphrates reclaimed has fallen short of planning goals and only in 1986 did the newly irrigated hectarages exceed the irrigated land flooded by the Euphrates Dam in 1975[4569].

Syria's advances have been registered primarily in dryland crop production during years of adequate rainfall, and can be attributed to improved plant strains and more advanced on-farm technology. Several productive and disease-resistant grains have been developed by the Scientific Agricultural Research Directorate of the Ministry of Agriculture, in cooperation with ICARDA[4437], but the upgrading of technology is perhaps best illustrated by the introduction of machines and fertilizers.

Table 3.5

Technological Change in Agriculture

Year	Irrigation Sprinklers	Irrigation Pumps	Mechanization Combines	Mechanization Tractors	Fertilizer tons applied
1963	205	20,990	1,566	2,093	61,900
1970	1,163	29,042	1,328	2,929	111,780
1975	1,325	40,416	1,607	9,030	189,935
1980	1,081	47,206	2,244	21,145	305,365

Source: Manners[3317], p. 274.

The use of tractors has increased tenfold, the use of fertilizers has gone up five times. The use of sprinklers has also increased significantly, and has been the subject of scientific study on its limitations and feasibilities in Syria[4129]. Unfortunately, little attention seems to have been paid to the water-conserving micro-irrigation (drip) technologies that might solve some of the Euphrates region's gypsum problems as well as save water.

Agriculture is and will continue to be a major employer of Syrian manpower, an important means of livelihood for its citizens, a source of export revenue in good years, and a priority item for Syrian development.

The cotton crop has been a significant earner of foreign exchange in the past and, given the right rainfall at the right seasons, can be in the future. How much the crop earns, of course, fluctuates with world prices. Moreover, in years of good rainfall there is no reason why Syria should not, at present population levels, be a net exporter of grain.

The proportion of the population employed in agriculture is down -- from well over half two decades ago to about a third now -- but those figures need elaboration. It is not always clear whether female family workers are included in the totals or to what extent male breadwinners may be supplementing the family treasury with off-farm income. (The same observation holds true also for city dwellers, who may work in a government office in the day and drive a taxi in the evening to make ends meet.)

Official investment in agricultural development remains high. In recent years, agriculture has received on the order of 20% of Syria's government investment budget, as well as significant amounts of credit for individual peasants through the Agricultural Cooperative Bank and other agencies. Food self-sufficiency is a high priority for the 1986-1990 Five Year Plan[4160].

For these economic reasons, agriculture will continue to be an important productive sector in the Syrian economy. These considerations are reinforced by political goals, which under the ruling Baath Party have emphasized the development of the countryside and the organization of the peasants as a political power base. However, as the gap between water supplies and water usage narrows, it is likely that Syria will have to alter its priorities away from the prestige irrigation projects and concentrate instead on increasing productivity and efficiency in the food sectors of rainfed agriculture.

3.3 The Economics of Water

In Syria as in the rest of the Middle East, the development of water resources is an essential ingredient of national development. Like all of its neighbors, Syria charges the construction of water infrastructure to the national investment budget and does not pass on those costs to consumers. Like some of its neighbors, Syria also provides a considerable subsidy on the operational costs of producing water and maintaining systems, and there is considerable disparity in the application of these subsidies across the spectrum of users.

3.3.1 Use of Water by Sector

In Chapter 2, we presented projections of water use in Syria based on predictions regarding population growth and migration, the realization of development plans in agriculture and industry, and the need to improve the quality of life and health for Syria's citizens. Assumptions were made as to the pace at which development would be implemented, and what efficiencies would be possible and demanded by circumstances. In Tables 2.7 through 2.14, these calculations were presented by hydrologic region. We summarize that information here in Table 3.6 by economic sector.

The figures in Table 3.6 are based on projections from the base-line year of 1981/82, for which we have the latest actual census and actual land-use reports for irrigation. Comparing these projections based on actual statistics with the aggregates offered by UNESCWA[4053] for 1986, we see in Table 3.7:

Table 3.6
SYRIAN WATER USE BY ECONOMIC SECTOR PROJECTED TO YEAR 2015
(in Mcm)

	1981/82	1990	1995	2000	2005	2010	2015
Domestic							
Euphrates	175	300	388	446	492	556	655
Orontes	80	128	158	191	215	253	299
Damascus	145	236	291	357	405	462	545
Coastal Plain	46	79	96	116	130	147	173
Yarmuk	18	32	41	49	55	62	69
Aleppo	--	--	--	--	--	--	--
Steppe	31	53	69	84	96	110	127
TOTAL Domestic	**495**	**828**	**1,043**	**1,243**	**1,393**	**1,590**	**1,868**
Agricultural							
Euphrates	2,800	4,900	8,387	10,476	10,465	10,455	10,445
Orontes	1,191	1,196	1,185	1,175	1,165	1,157	1,143
Damascus	935	935	925	916	907	899	891
Coastal Plain	364	540	538	661	659	657	655
Yarmuk	141	153	153	149	145	144	144
Aleppo	727	777	827	877	925	960	960
Steppe	--	--	--	--	--	--	--
TOTAL Agricultural	**6,158**	**8,501**	**12,015**	**14,254**	**14,266**	**14,272**	**14,238**
Industrial							
Euphrates	6	6	6	6	6	6	6
Orontes	58	58	58	58	58	58	58
Damascus	75	75	75	75	75	75	75
Coastal Plain	52	52	52	52	52	52	52
Yarmuk	--	--	--	--	--	--	--
Aleppo	80	80	80	80	80	80	80
Steppe	17	17	17	17	17	17	17
TOTAL Industrial	**288**	**288**	**288**	**288**	**288**	**288**	**288**
TOTAL							
Euphrates	2,981	5,206	8,781	10,928	10,963	11,017	11,106
Orontes	1,329	1,382	1,401	1,424	1,438	1,468	1,500
Damascus	1,155	1,246	1,291	1,348	1,387	1,436	1,511
Coastal Plain	462	671	686	829	841	856	880
Yarmuk	159	185	194	198	200	206	213
Aleppo	807	857	907	957	1,005	1,040	1,040
Steppe	48	70	86	101	113	127	144
TOTAL	**6,941**	**9,617**	**13,346**	**15,785**	**15,947**	**16,150**	**16,394**

Source: Tables 2.7-2.13, calculations by author.

Table 3.7
Comparison of Water Use Data by Sector
(in Mcm/year)

This Study:	1981/82	1986	1990	UNESCWA: 1986
Domestic	495	661	828	432
Agricultural	6,158	7,329	8,501	6,480
Industrial	288	288	288	288
Total	6,941	8,278	9,617	7,200

Sources: Table 3.6 and UNESCWA[4053].

This comparison is instructive in two ways. First, it shows the paucity of the information available for the UN agency. The figure for industrial use, identical to our own, is derived from a 1980 World Bank[3101] estimate reflecting surveys done in the late 1970s. Apparently the United Nations has no more recent information than we do, and agrees with our own assessment that industrial use has not increased. Second, it demonstrates points of disparity. The UNESCWA aggregate for domestic use in 1986 is less than our calculations based on the actual census for 1981, and the UNESCWA report on irrigation use is only marginally greater than our calculation based on 1981/82 land use and is considerably -- 850 Mcm -- less than our projection for 1986.

The UNESCWA report does not elaborate on the sources of its figures and may be based on some fairly crude estimates which do not, for example, allow for systemic losses. It does, however, point up the direction in which our own calculations may be expected to err. The financial constraints that have postponed Syrian water projects -- both municipal/domestic and agricultural -- will in the main have the impact of reducing water use below the levels predicted. Improvements in efficiency will be held up along with infrastructure for use, but the increment in use per added hectare of irrigation is far greater than the savings to be realized per hectare through conservation technologies. Hence, delays in irrigation projects translate into significant delays in the net growth of water use.

At all events, our calculations predict a 280% increase in domestic use and a 130% increase in irrigation use between 1981 and 2015. Agriculture is by far the dominant water user (89% in 1981/82), and its share of water use will decrease only slightly (87% in 2015) even though its rate of growth is less. Overall growth in water use, if not constrained by diminishing supplies, will be slightly less than 140% in that time period.

3.3.2 Water Costs, Prices, Subsidies

It has been customary in Syria to charge users only for the operating costs of water supplies, not for capital investment in infrastructure development. In rural areas, drinking water is supplied free from public taps or standpipes but house connections are supposed to be metered. The low income level of rural families imposes constraints on house connections. In urban areas, the proportion of residents served by house connections is well above average for countries in the Middle East and North Africa (70% in 1975). In both rural and outlying urban areas, families not serviced by public water systems acquire water for domestic use either from private wells or by purchase from vendors with tanker trucks[1266)(3101)].

While nearly all of the urban connections are metered, many meters are either broken or malfunctioning. It is estimated that in 1980 only about 54% of urban water production was paid for[3101)]. This reduces the revenue substantially. Indeed, the revenues collected from metered water supplies in Syria cover only half the costs of production. The most recent report on production costs and tariffs (World Resources 1987[4653)]) indicates that urban water in Syria costs about $\$0.25/m^3$ to produce and that the average tariff charged is $\$0.13/m^3$.

Syria's water tariff structure is graduated, depending on amount of use and category of user. Part of the fees are collected as connection costs (i.e., purchase of water rights), part of them are collected against measured usage. Urban usage fees were reported in 1980 by the World Bank[3101)] and in 1983 by UNESCWA[xxxx)]. Rates vary according to city.

Table 3.8
Water Prices in Syria

	SL/m^3	US$/$m^3$
Damascus, first 45 m^3 in three months:	0.20	0.05
Damascus, over 45 m^3 in three months:	0.50	0.13
Aleppo:	0.30	0.08
Homs:	0.25	0.06
Vendors (buying):	0.40	0.10
Vendors (selling):	10.00	2.55

[SL 3.925 = US$ 1 at this time period. The official rate as of 1988 was SL 11.20 = US$ 1.]

The last item, purchasing water from vendors, hits hardest the urban poor who live outside the city limits and who can least afford to pay.

The water Syria has been using to date has been relatively low cost. Damascus, for example, has traditionally been served by the Figeh Spring which flows downhill to the networks of the capital. Until recently, when pollution has rendered it undrinkable, Homs and Hama took their water from the Orontes at little cost. Aleppo, until the middle of the present century, drank directly from the Quweik River.

Now, with pollution of surface waters, Syrian cities have come to rely often on groundwater or long-distance pumping. For this production, costs are estimated to range from $\$0.31/m^3$ to $\$3.41/m^3$ [4383]. The costs are at the higher end of the range when production from a borehole is less than 5 liters per second, or when it is pumped from a depth greater than 75 meters. Thus, the fees listed in Table 3.8 do not begin to match actual production costs, not to mention capital development.

Agricultural water is almost wholly subsidized. The *Syria Times* [1280] reported in 1984 that it is normal practice to subsidize peasant families while implementing agricultural development projects. This was elaborated two years later by Meliczek [4569] who stipulated that to date no fees had been collected for irrigation water in Euphrates project areas. In the same year it was reported by the official paper, *al-Baath* [4364], that farmers in the Ghab obtain most of their irrigation water "illegally" from government irrigation canals. Since the Ghab project region has passed far beyond the development stage (it was operational in 1969), the non-enforcement of -- or non-compliance with -- fee collection in that district seems to reflect a general policy pattern.

This is a far different picture from the situation in Syrian agriculture in the 1950s. At that time, pumps to supply surface water for irrigation were privately owned and operated. The World Bank (cited by Manners [3317]) reported then that pump owners could exact from 45% to 60% of a crop simply for supplying the water. Groundwater wells, which account for more than 40% of the irrigated area, are still often privately developed.

Water for light industry is supplied in some areas by the municipal water systems at municipal rates; these tend to be minor users. Heavier industrial consumers usually own and maintain their own wells. While in theory wells and pumps are licensed, monitoring is perfunctory and information on withdrawal and recharge is sketchy.

3.3.3 Investment in Water Development

Since the advent of Baath Party rule in Syria in 1963, nearly all major water development has been done by the government. Before that time, it had been the "cotton sheikhs" of the Jezireh who had installed the pumps, supplied the seed, provided the know-how and transport to market, and transformed their previously independent tribal kinsmen into sharecroppers[4362]. The Baath Party, whose original power base was drawn from the periphery, set agrarian reform as a major priority. This involved land reform, empowering the rural peasant at the expense of the urban merchant, and raising the level of services and quality of life in the countryside. In short, the Baath needed the peasants and so had to provide them with the water they needed for better health and hygiene and to enhance their livelihood.

Although Syria has suffered delay after delay in some of its important water projects (sometimes because of technical difficulties, as in the Euphrates region, but more often because of financial problems), the amount of effort and money that Syria has invested in water development is impressive. World Resources 1987[4653] reports that Syria had by the early 1980s expended $100 per capita in the rural regions and $250 per capita in the cities for drinking water development alone. This would yield a total investment of $1.576 billion.

A more complete -- though still partial -- listing which includes irrigation projects is given in Table 3.9. That table has several lacunae, the most important being the main dams associated with the Ghab project. These were completed before the present regime and were financed by Syrian resources. (Projects planned but not yet contracted have costs in square brackets.) Table 3.9 has been collated from more than twenty sources, often contradictory. Where more than one cost figure is given, we have listed the highest. Further, the dollar and Syrian pound figures may not agree as they have been cited at varying times and using differing exchange rates. The purpose of the table is simply to give a crude order of magnitude for what has been undertaken.

The dollar values (converted at the official SL 3.925 rate that obtained until 1988) are summarized in Table 3.10 and a comparison is made to a similar compendium prepared by UNESCWA in 1986[4674].

Table 3.9
MAJOR WATER DEVELOPMENT PROJECTS IN SYRIA
(partial list)

Date	Location	Project	Purpose	$ mn	SL mn	Funder
Euphrates						
1975	Euphrates	Tabqa Dam	I,E	408	3,800	Sy,USSR
1987	Euphrates	Tabqa exten.	E		60	Sy
1986	Euphrates	Baath Dam	E	197	770	Sy,USSR
199?	Euphrates	Tishreen Dam	I,E	[383]	[2,000]	Sy
1985	Euphrates	Balikh Canal 1	I	64	270	Sy,WB
1988	Euphrates	Balikh Canal 2	I	89	570	Sy
1987	Euphrates	L.Assad Pump St.	I,M		450	Sy
1988	Euphrates	Balikh Pump St.	I,M	24	150	Sy
2000?	Euphrates	Khabur Project	I,M,E	[1,622]		Sy
1988	Euphrates	Khabur Dam	I,M,E	"	1,300	"
1990?	Euphrates	W. Hassakah Dam	I,M,E	"	1,500	"
1990?	Euphrates	E. Hassakah Dam	I,M	"	2,200	"
2000?	Euphrates	Khabur irrigation	I	"	[?]	"
??	Euphrates	Deir ez-Zor net	M	[5]		EC
1986?	Euphrates	Mangmt & purific	M	12.7	48	EC
??	Euphrates	Suweidiya net	M	[3.7]		EC
1972	Euphrates	Bab Hadid dam	M,I		2	Sy
1974	Euphrates	Jawadieh dam	M,I		0.5	Sy
1980	Euphrates	Mashuq dam	M,I		4	Sy
1985	Euphrates	Jarrehi dam	I	72		Sy
1986	Euphrates	Middle Euph Proj	I	170.5		Sy,Japan
1988?	Euphrates	Maskena canals	I	553.5		Sy,Japan
??	Euphrates	Lower Euph Proj	I	[118.4]		Sy,WB
Aleppo						
1978	Aleppo	L.Assad Pipe	M	116	461	Sy
??	Aleppo	Wastewater	M	[70]		WB
"	"	"	M	[112]		Sy
198?	Afrine	April 17 dam	I,E	?	?	Sy

M=Municipal & industrial; I=Irrigation; E=Hydroelectric power.

Sy=Syria; WB=World Bank; AFESD=Arab Fund for Economic and Social Development; SFD=Saudi Fund for Development; EC=European Community; USSR=Soviet Union; USAID=U.S. Agency for International Development.

Date	Location	Project	Purpose	$ mn	SL mn	Funder
Orontes						
--	Orontes	Kattineh Dam	M,I,E	?	?	Sy
--	Orontes	Rastan Dam	I,E	?	?	Sy
--	Orontes	Mehardeh Dam	M,I,E	?	?	Sy
1985	Orontes	Kashieh Dam	I	?	?	Sy
199?	Orontes	Homs wastewater	M	10.5		WB
199?	Orontes	Hama wastewater	M	7.5		AFESD
??	Orontes	Ghab irrigation	I	[53.3]		AFESD
Damascus						
1978	Damascus	City networks	M	260	1,027	Sy
1985	Damascus	Figeh spring	M	15		Sy,USAID
??	Damascus	Wastewater	M	[30]		SFD
199?	Damascus	Control system	M	10.7		AFESD
Coastal Plain						
1985?	Coast	Tishreen 16	I,M,E		?	Sy
??	Coast	Thawra Dam	I,E	[166.6]	[400]	Sy
??	Coast	Thawra canals	I	"	[306]	Sy
198?	Coast	Salah ed-Din dam	I		42	Sy
198?	Coast	Beit er-Rihan dam	I		27.5	Sy
198?	Coast	Huweiz dam	I		16	Sy
198?	Coast	Khalifeh dam	I		15	Sy
??	Coast	Sinn Project	I	?	?	Sy
1985?	Coast	Soreet spring	I	?	?	Sy
1985?	Coast	Salfan Dam	I	?	?	Sy
??	Coast	Akkar Plain	I	?	?	Sy
1984?	Coast	Muzaina Dam	I	?	?	Sy
Steppe						
1978	Suweida	Jabal Arab Dam	M		10	Sy
1978	Suweida	Sahut Bilat Dam	M		3.5	Sy
1980	Suweida	Jubran Dam	M		5	Sy
1980	Suweida	Mushnaf Dam	M		5	Sy
1984	Suweida	Teir Dam	M		1	Sy
1984	Suweida	Rum Dam	M		7	Sy
1984	Suweida	Khazema Dam	M		1	Sy
??	Suweida	Zif Dam	M,I	?	?	Sy

M=Municipal & industrial; I=Irrigation; E=Hydroelectric power.

Sy=Syria; WB=World Bank; AFESD=Arab Fund for Economic and Social Development; SFD=Saudi Fund for Development; EC=European Community; USSR=Soviet Union; USAID=U.S. Agency for International Development.

Date	Location	Project	Purpose	$ mn	SL mn	Funder
Yarmuk						
1982	Deraa	Sh. Meskin Dam	M,I	6	14	Sy
1982	Deraa	Sh. Meskin canals	I	"	12	Sy
1982	Deraa	Tafas Dam	M,I		4.5	Sy
1982	Deraa	Tafas canals	I		5	Sy
1984	Deraa	E.Deraa Dam	M,I		5	Sy
1984	Deraa	Ayun Ahd Dam	M,I		6	Sy
1985	Deraa	Deraa Dam	M,I		22	Sy
198?	Deraa	Adwan Dam	M		10	Sy
198?	Deraa	Tseel Dam	M	4.6	7	Sy
1988?	Deraa	Abdin Dam	I		22	Sy
1986	Quneitra	Ghadir Bustan Dam	M		12	Sy

References: 0406,0744,I267,1298,2195,2232,2252,2348,2434,3101,4131, 4162,4165,4175,4214,4285,4484,4485,4486,4541,4674.

M=Municipal & industrial; I=Irrigation; E=Hydroelectric power.

Sy=Syria; WB=World Bank; AFESD=Arab Fund for Economic and Social Development; SFD=Saudi Fund for Development; EC=European Community; USSR=Soviet Union; USAID=U.S. Agency for International Development.

Table 3.10
FUNDERS FOR MAJOR WATER PROJECTS IN SYRIA
(in US$ million)

	UNESCWA[4674]		Other Sources	
Syrian government	3,529.7		2,858.7	
External, of which:	215.7		899	
World Bank		111.7		173
AFESD		30		70
Japan		65		
USAID		9		
SFD				30
EC				21
USSR				605
	3,745.4		3,757.7	

References: 0406,0744,1267,1298,2195,2232,2252,2348,2434,3101,4131, 4162,4165,4175,4214,4285,4484,4485,4486,4541,4674.

Both of the above, UNESCWA and the list detailed from a variety of mainly journalistic reports, are incomplete. What they do show, however, is an investment in excess of $3.7 billion dollars. This is close to the current $4 billion total of Syria's external debt and gives some measure of the importance that has been allotted to water development. The consideration is also incomplete in that each municipality and province has also undertaken water projects. In 1985, reports from five out of the country's fourteen provinces totaled an allocation of more than 2 billion Syrian pounds for local water projects. This is a deceptive figure, however, since many projects are carried over from year to year. In one recent year, Latakia province reported that only a quarter of the previous year's allocation for water projects had actually been used[2346].

Such private financing of water development as still occurs is mainly in the agricultural sector. The most important provider of credit to the agricultural sector is the Agricultural Cooperative Bank, founded in 1884 and the oldest lending institution in Syria[4392]. It operates some 59 branches throughout the country, with representation in every province and many of the districts and subdistricts. In 1986, it provided some SL 1,700 to its clients in four categories of loans: short-term cash (less than one year term); short-term in-kind (agricultural inputs at term less than one year); medium term (one to five years, usually for machinery or livestock); and long-term (five to ten years for land

improvement, irrigation, orchard development, selected building construction). The growth of agricultural credit is summarized in Table 3.11.

Table 3.11
Growth of Agricultural Credit by Sector
(in million SL)

Year	Public	Cooperative	Private	Total
1970	4.5	40.5	117.0	162.0
1975	5.7	83.1	170.2	259.0
1978	10.8	149.1	177.8	337.7
1979	14	175	238	427
1980	17	188	242	446
1981	31	260	294	585
1982	28	309	355	703
1983	31	407	438	876

Sources: Hopkin[4392], El-Akhrass[4437].

Other sources of agricultural credit include:

- o Commercial Bank and Industrial Bank (directly or through agribusinesses, mainly to finance export of crops);
- o General Machinery Company (about 75% of all private tractor purchases financed by GMC);
- o merchants (either a forward contract for sale of crop, or an advance on operating expenses with crop to be purchased at harvest time);
- o food processing plants (advance money for raw products they need);
- o Tobacco Monopoly (interest-free loans in-kind and cash for inputs and development);
- o outside grants and loans for development projects;
- o self-financing (retained earnings and off-farm income).

Credit for infrastructure development is only an insignificant segment of the loans granted by the Agricultural Cooperative Bank (less than 2% per year[4392]) and other sources of agricultural credit. Most of the loans are for the purpose of providing seasonal inputs for production. It seems safe to assume, therefore, that nearly all important water development in Syria is done by the government -- either central or local.

The most recent variation on infrastructural development in Syria is the expansion of the category of mixed public-private sector investment to include agriculture and industry. This mixed category had previously included only the tourism industry. The Prime Minister announced the terms of the new investment category in 1986[4210]. The first mixed agricultural company was founded later that year; businessman Saeb Nahas was elected chairman of Ghadaq (Arab Syrian Company for Development of Agricultural Products) in 1987[4486]. In an economy long characterized by large state enterprises, with private enterprise relegated to very small artisanships and commerce, this opening could be a tentative first step toward the development of a private domestic capital market.

3.3.4 Electrification

Investment in water infrastructure in Syria is complicated by the fact that electrification is also a high priority for the Syrian government. The sparkling nightlights of the Euphrates Valley in the seventies, in stark contrast to nighttime darkness of the sixties, bear visible testimony to the efforts that have been expended. Electricity along with water is an important ingredient in improving the standard of living in the countryside. The Syrian regime has set 1990 as its target date when all 5,400 villages with population more than 100 will have electric power[4363].

To this end, Syria has sited many of its water projects at locations where dams can serve also the purpose of producing hydroelectric power. In Table 3.8 above, ten of the major projects comprising 75% of the dollar amounts invested are for multi-purpose installations that provide electricity as well as storing water. Six of the dams of the Euphrates basin include a hydroelectric generating component which will serve local users and provide power to the national grid. The main Euphrates Dam at Tabqa at one time produced up to 87% of Syria's electricity. That proportion was reduced to slightly over three-fifths by the early eighties because of rapidly increasing usage and added generating capacity elsewhere, even though production at the dam stood at an all-time high of 2.6 million kwh[2786]. Later in the decade production was reduced, as five out of the dam's eight turbines were shut down due to the low water level in the river[0744]. The subsequent power shortages and daily blackouts in Syria's major cities were an occasion of lively debate in Syria's People's Assembly; two cabinet ministers resigned in an atmosphere of harsh criticism[yyyy].

In addition to developing its hydroelectric potential, Syria has been investing in thermal generating capacity throughout the country -- some oil fired[4486], some gas fired[4364], and some to burn the coke residue from the Homs refineries[4484]. A related development is the bidding for a gas gathering and distribution network in

the Homs-Palmyra area[4485], as well as the utilization of associated gas in the Thayyem oil fields[4541]. Projects under construction or on the drawing board would nearly double Syria's electric power capacity by 1992 -- adding 1,948 MW to its 1986 installed capacity of 2,334 MW[4363] -- in the unlikely circumstance that all projects were completed on time. Looking to the more distant future, the Syrian government is reported to be studying the feasibilities of nuclear and solar power with technical help from the Soviet Union.

The interrelated priorities -- water and electricity -- make it very difficult in Syria to separate purely water sector investment from purely electric sector investments. Both are important, both serve the overriding political goal of improving the quality of life in the countryside, and both occupy the same line in the national investment budget. Both are also essential ingredients in the economic development of the country at large.

3.3.5 Water Research and Technology

Water-related research in Syria is conducted mainly by the government, with important supplements from the Arab League's ACSAD (Arab Center for the Study of Arid Zones and Dry Lands) in Damascus and from the World Bank-affiliated ICARDA (International Center for Agricultural Research in Dry Areas) in Aleppo. Modest amounts of research are done by the faculties of Damascus and Aleppo universities.

Since agriculture is the most important consumer of water, agricultural research is intrinsically connected with water studies. The Scientific Agricultural Research Directorate of the Ministry of Agriculture and Agrarian Reform conducts most of the work that is done in Syria. In 1983, SARD received almost half (SL 8.4 million) of the SL 17.4 million allocated to agricultural research. Its responsibilities include research on food crop varieties, vegetables and fruits, plant protection, food processing, and animal protection. It supplies information on new developments to farmers and, through the ministry's extension service, provides answers to problems that arise during the producing season. Agricultural land and water use are the responsibility of the ministry's Soil Directorate, which in 1983 received an allocation of SL 4.6 million[4437].

Other contributors to agricultural research include the Cotton Bureau and the Directorate of Steppe, Rangeland and Sheep (both under the Ministry of Agriculture and Agrarian Reform). Non-MAAR directorates that contribute include the General Administration for the Development of the Euphrates Basin (GADEB), the General Organization for Sugar, and the General Organization

for Tobacco[4437]. The Ministry of Defense has been active in some projects, especially in the area of drilling[4207] and meteorological services[zzzz].

The area of contribution of these agencies has been varied. SARD and ICARDA have been jointly involved in developing and testing new plant strains suited to arid zones, and in educating farmers to use the new seeds, with financial help from the World Bank, IFAD, FAO, and the Government of Canada[4363][4437]. GADEB and ACSAD have provided research on the gypsiferous soils of the Euphrates region[4328] and on the applicability of sprinkler irrigation techniques[4129] in Syria. ACSAD, with assistance from the Soviet Union, has undertaken surveys for deep fossile groundwater in the Syrian steppes[2255][4573]. This is a continuation of the groundwater and geological studies that ACSAD itself has carried on for some years[4274]. The Ministry of Agriculture and the Ministry of Defense have independently drilled for water, sometimes highly mineralized, that can be used to grow fodder shrubs to pasture flocks of sheep in the semi-desert regions[4207]. This is in addition to the ongoing work of the agricultural extension services.

In research as in other areas of economic development, progress in Syria is constrained by the shortage of qualified manpower[2254]. While Syria's scientists are well trained and have conducted an impressive quantity of excellent scientific research, there are not enough of them to perform all the tasks that need doing. This shortage is felt keenly at the intermediate levels, where more graduate agronomists ("agricultural engineers" in Syrian parlance) are needed to staff the extension services and provide direct training and advice to the farmers[4437]. One journalist complained recently that the expertise existed (in the Ghab region), but that the number of experts was inadequate and, further, they lacked even motorcycles as transport to take their knowledge to the farmers who needed it[4364].

3.3.6 Marginal Cost of Water

Since, as a matter of consistent policy, Syria does not intend to amortize the cost of water infrastructure development through users fees or any other direct assessment, the question of marginal cost of water is highly theoretical. The costs and benefits of water development are, of course, very real items in the national economy of the country, but they are not standard categories in Syrian government reports.

To get some idea of what water production and development actually costs Syria in comparison to the fees that are collected, let us consider the following data for 1986:

Estimated population:	10.484×10^6
Municipal/Industrial consumption including systemic loss:	915×10^6 m^3/yr
Total consumption:	$8,278 \times 10^6$ m^3/yr
Water investment to date:	$\$3,757.7 \times 10^6$
Lost opportunity cost on capital invested at 5%/yr:	$\$187.9 \times 10^6$/yr
Average cost of production:	$\$0.25/m^3$
Average fee on M&I:	$\$0.13/m^3$

From these data we can derive the following:

1) Total cost of production is $2,069.5 million per year, or $197.40 per capita per year.

2) Total investment, if amortized over twenty years, would require an installment of $187.89 million for this year or $17.92 per capita per year.

3) Lost opportunity cost on the capital at 5% would be $187.9 million for this year, or $17.92 per capita per year.

4) Total cost for each Syrian citizen for water production and investment would be $233.24 per capita per year.

5) Fees paid for domestic and industrial use only would be $118.95 million or $11.35 per capita per year.

Therefore, the Syrian economy is subsidizing the water use of each citizen to the tune of $221.89 per year.

It should be understood, of course, that the major portion of this subsidy does not go to individual citizens but rather to agriculture, which provides employment to a third of Syria's workers and, in good years, supplies most of its food needs and cash crops for export. Few countries in the modern world actually charge their farmers the full cost of building water facilities, maintaining and operating them, and producing and supplying water for irrigation. Such a policy would price the farmers' produce out of the market, both regionally (since all Syria's neighbors subsidize water development) and globally. Such a calculation is useful, however, in evaluating the productive potential of the various economic activities available to the country. Social and security considerations, as well as tradition, will impel most countries to engage in agriculture, but the weight to be given to it should be determined after examination of the actual costs.