

Water Resources Management in Yemen

Contribution to the CDR Yemen

by

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Draft: January 20th, 2000

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CHAPTER I - Basic Data and Trends

A. Introduction identifying the Block and coverage of the paper.

Background

Yemen is one of the oldest irrigation civilizations in the world. For millennia, well developed techniques and institutions helped the nation get the most out of its scant water resources.

In recent times, the country has fallen into a water crisis characterized by very rapid mining of groundwater, extreme water supply shortages in the major cities, and limited access of the population to safe drinking water.

The main causes of the water crisis are familiar from other countries of the Middle East: rising demand as population grows and market-led agriculture develops; groundwater exploitation getting out of hand; and a framework that has promoted expansion rather than efficient use and sustainable management.

Yemen, however, stands out amongst countries in water crisis. First because of the gravity of the problem - in no country in the world is the rate of exhaustion of aquifers proceeding so fast, in no country in the world is the capital city of the nation literally going to run out of water in a decade.

Second, Yemen stands out because of the lack of the governance structures that would allow anything approaching a real solution to be simply imposed from the top. The only conceivable way to control groundwater use is to take users into partnership - as joint trustees of the resource. But even these solutions will inevitably be arduously brokered and slow to bear fruit.

But the challenge has to be met, if the country is not to become a desert. Even if the results of action can be no better than a partial solution, the results of inaction would be catastrophic.

Coverage

This Building Block covers water resources management, irrigation, and rural and urban water supply and sanitation. It brings together the analysis of the problems and reviews the essential components of a strategy to deal with the crisis. Many of these components were previously discussed in the Bank's 1997 Water Strategy Sector Report and more detail can be found there. The present report reflects the considerable progress since then, and refines and sharpens the agenda.

The common theme of this report is that policies and institutions at the center have to work in partnership with water users, engaging stakeholders at all levels in a reform agenda. This is as true for urban and rural water supply and sanitation, as it is for irrigation. Self-management and self-regulation will be at the heart of a solution to Yemen's water resources management crisis. The main elements of the agenda are: a campaign to generate national consensus on actions to be taken; macroeconomic policy reforms to create the right signals for water conservation and efficiency; harnessing private sector energies in urban water supply; placing the

sector on a sound financial footing, and a partnership approach to engage rural water users in self-management of their own resource.

The immediate step is awareness - and ownership - by the Yemeni nation, followed by decisive action.

In the longer term, the economy has to diversify away from activities heavily dependent on water.

Recommendations in the 1997 Note have been broadly accepted in Yemen, and some are under active implementation. In December 1998, Government adopted a national water strategy that largely reflects these themes. Donors have also been actively involved, and there is broad consensus at that level too. Thus the agenda discussed here is to a large extent a shared agenda, but where there are differences of view between Government and other parties this is noted.

The recommendations made in the 1997 report also form the basis for IDA's own proposed interventions in Yemen's water sector.

B. Brief overview of key indicators and trends

Yemen has little water

Yemen's total annually renewed water resources are estimated at 2.1 billion m³ (BCM). With a population of around 14 million, available resources thus amount to little more than 130 m³ per person each year. This compares with the Middle East and North Africa average of 1,050 m³, and the worldwide average of 8,300 m³. According to worldwide norms, domestic uses alone require up to 100 m³ per person per year, and food self-sufficiency requires 1000 m³. In order to feed Yemen in cereals alone, an annual water availability of 16 BCM would be necessary. This compares to the 2.1 BCM actually available. Plainly food self sufficiency is not an attainable goal.

Thus, Yemen is a water-scarce country. Resources are unevenly distributed, too; 90% of the population has under 90 m³ annually. Notable is the prevalence of groundwater in water resources - 60 percent of renewed resources (1.3 BCM) is groundwater recharge.

Most water is already fully exploited - and often overexploited

In 1994, water use was estimated at about 2.8 BCM. The country thus overdrew its resources of 2.1 BCM by 0.7 BCM. In general, all surface water sources in Yemen are harnessed and exploited, and in most areas groundwater is already being exploited beyond the level of recharge. It is estimated that there are about 45,000 private wells in the country (although some estimates are considerably higher) and about 200 drilling rigs. Government's sporadic attempts to license and control wells and drilling rigs have not been successful.

Mining is worst in the western half of the country

The most stressed area is the western portion of the country - the mountains, escarpments and coastal plains (Zones 1-4 on the map) - which contain more than 90% of the population. In this western half of the country in 1994, groundwater¹ use was 1.8 BCM, recharge was 1.1 BCM, a 70% overdraft. Usable storage in the western half is about 35 BCM, so at present rates of extraction the area will be dry within 50 years.

The situation is particularly bad in the highlands

In the densely populated highland valleys and plains (Zone 1 on the map), the situation is even worse. In the Sana'a basin, where 10 % of the population live (1.5 million people), use in 1994 was 224 million m³ (MCM), recharge was 42 MCM, a 400 % overdraft. The water is literally running out. **Ground-water is expected to be pumped dry in the Sana'a basin in about ten years time.** In Qa' Al Boun near Amran water levels have dropped 60m in the last twenty years - and 30m in the last five years.

Only in the south-east may there be any significant untapped reserves

The exception to this picture of overdraft is Hadramawt in the sparsely populated south-eastern area of the country, 500 km from the capital, where recent resource assessments have revealed a water resource that could be as much as 280 MCM of annual recharge, together with vast storage, equivalent to several thousand years of supply at current rates of use in the area.

C. Key aspects of our Block-specific knowledge base - four main problems

Four severe water problems have developed in recent years

Since time immemorial Yemen practiced sustainable irrigation and lived in balance with its resources. Since the creation of the modern state, however, very rapid changes have taken place which have produced some of the most severe water problems anywhere in the world. The four main problems are briefly discussed in the following paragraphs.

(1) Groundwater is being mined at a fast and accelerating pace.

In many areas of Yemen, groundwater is being mined so fast that it is literally running out, representing a severe risk for the economy. In some of the most stressed areas of the country, agriculture is running out of water. Witness the case of Wadi Bani Khawlan near Ta'iz, where uncontrolled groundwater extraction for agriculture and water sales by upstream riparians have drained the aquifer and led to drying up and the abandonment of agriculture further down the wadi. The trend has been driven by technology and economics, and by the uncertainty and scarcity of the traditional spate and spring sources.

(2) Major cities have grown very short of water

Major towns are also running out of water. The present main sources of supply to Sana'a, the Eastern and Western Wellfields, which are currently delivering 600 liters per second (lps), are drying up and by 2008 will deliver only 100 lps. In the summer of 1995, the city of Ta'iz received water once every 40 days.

The effect of transfers to towns is felt in rural communities too. The city of Ta'iz taps water from the Wadi Al Haima, and even though the city claims the water comes from a deeper stratum than that used by local farmers, the Wadi is certainly drying up.

(3) The sector's finances and investments are inadequate

For many years, financing of the country's water sector was under emphasized. As illustrated in the following table, for the last three years public investment in water was significant when compared to total investment, but only equaled about 1% of GDP. Two thirds of annual investment has gone to the urban sector, yet overall coverage ratios for water supply have barely improved—mostly because of the increasing pace of urbanization for which investment has not matched. Urban sewerage coverage has improved significantly in Sana'a, Aden and a handful of smaller towns where donors are active, but not elsewhere.

**Table 1: Water Sector Investment 1998-2000
(RY 000)**

Year	Investment by Agency or Ministry					% of Total Investment	% of GDP
	NWSA	MOA	GAREWS	NWRA	Total		
1998	8,246,860		2,643,114	762,495			
1999	6,107,000	659,000	2,006,000	454,100			
2000		652,192		840,000			

The lack of financial stability is evident for both expenditures and investments. Approximately 75% of NWSA Branches cannot cover monthly operating and maintenance costs from the revenues collected, and donors frequently note a lack of timely counterpart funds for their projects.

(4) Many people, particularly the poor in the cities and the countryside, do not have access to safe water

Nationwide, about 60% of urban households are estimated to be connected to mains supply - but often that supply is inadequate. In Sana'a, the public utility, NWSA, supplies only 36% of households: two thirds of the water consumed in Sana'a does not come from a safe public supply, and much comes from shallow wells in contaminated groundwater beneath the city.

The urban poor are faced with higher costs. The NWSA supply is cheap - as little as Rls 20/m³ (13US cents), but poor people usually have to buy their water from private vendors at very much higher prices - Rls 50-200/m³ (35-140 US cents). As a result, the costs of the poor are much higher and the quantity purchased is very much lower. In Sana'a, for example, those buying from the private sector exclusively (including most of the poor) consume only 28 liters per day (lpd), against 80 lpd for those connected to the NWSA system. In addition, private supply is unregulated and often contaminated, being pumped from the shallow aquifer

The negative impact of inadequate water supplies on the poor is even more marked in rural areas, where 81% of the population, and most of the poor, live. Only about 20% of rural households (49%) have access to safe water, compared to the average for the Middle East and North Africa Region of 82%. Access to safe sanitation is limited to 19% of households. Government programs for rural water supply have concentrated on the area around the capital to the neglect of the poorer, further-flung areas. Sanitation has been largely neglected, with consequent environmental and health problems.¹

¹ Sources: Rural Water Supply Sector Study, Cosgrove et al for World Bank, August 1996; and Yemen Poverty Assessment, World Bank (Report No. 15158-YEM, June 26, 1996).

Yemen has the region's lowest life expectancy (54 years) and the highest infant mortality (9.6 percent of live births). A leading cause of death in infants and children is diarrhea, partly caused by unsafe water and poor sanitation. Children living in rural areas experience on average seven cases of diarrhea a year. Rural under-five mortality rates deteriorate markedly in households that do not have access to safe water or sanitation.

Access to water also has an important impact on the lives of women. In rural areas unserved by piped water, women and girls typically spend up to seven hours a day fetching water.

...finally, institutions in the water sector are weak.

Like most public sector authorities and ministries in Yemen, those dealing with water are understaffed and generally lack the expertise to address the challenges facing them. Since the time of unification in 1990, and just at the time when the most serious water issues were surfacing, NWSA, NWRA and the Ministry of Agriculture, all experienced a steep decline in their salary levels and a simultaneous departure of their most qualified staff. Today, these key institutions all have difficulty developing effective policies and strategies, implementing projects, and bringing the needed expertise to bear on the sector's difficult problems.

D. Role of the Block in Yemen's broader development and with particular respect to poverty reduction

The Role of Water in the Economy

Water is a major element in Yemen's economy. Most water (over 90%) goes for irrigation. Two thirds of output in the agriculture sector (equivalent to over 12% of overall GDP and one third of all tradables) comes from the irrigated sector. Remaining agriculture and livestock production is heavily dependent on water availability. At the level of water supply and sanitation, health status and urban and industrial development are critically dependent on water availability. The economic consequences of the water crisis are likely to be very severe.

Supply costs are likely to rise sharply as water has to be brought from further and deeper

In Sana'a, the options now being explored for the next sources of supply cost from \$0.50/m³ to well over US1.00/m³. Drilling for new groundwater sources for Sana'a has taken place to a depth of over 2 km. The ultimate - and nightmare - option for the capital is desalination and transport up from the coast, estimated to cost up to \$6.60/m³.

There is increasing conflict over water resources.

The city of Ta'iz, faced with problems over the apparent depletion effect of its extraction from Wadi Al Haima, negotiated with the neighboring rural area of Habir to extract water. The negotiations dragged on for years in a difficult atmosphere and even though agreement was reached implementation has proved difficult.

Meanwhile, the search for new water sources continues through an extensive drilling program, but it often experiences substantial delays caused by spirited opposition from rural residents. Given the dire and worsening water situation in Taiz, a more practical means of transferring water from rural to urban areas will have to be devised. But the costs - and risks - of formulating and putting in place such a mechanism are high,

and implementing any agreement will require substantially more institutional capacity inside the government than we see today

Already, shortages of water are constraining urban and industrial development.

In Sana'a, NWSA is unable to keep pace with new housing establishment and industrial development. New development is obliged to buy water from private sources at prices as high as Rls 50-200/m³ (35-140 US cents).

The existence of the rural economy is threatened.

Agriculture supports 60 percent of the population and produces 18 percent of GDP. The whole rural economy is vulnerable to declining water availability. In the Al-Irra area north of Sana'a, a typical farmer has deepened his well 50 m over the last twelve years - increasing his costs - but he has still seen the amount of water he can extract drop by two thirds. With higher costs and only one third of the water, this farmer can no longer make a living from farming.

The growth of livestock production – a key source of income for the poor – is constrained by lack of water

In the livestock sector also, on which poor people are very dependent, water is a dominant constraint. Considering Yemen's precarious water resources, the availability of water for livestock production will decrease. Further expansion of production then can only be achieved through **water conserving production methods** (rangeland grazing, crop residue use) or through **increased used of imported feed and fodder**. Without the introduction of improved techniques, future demand for livestock products will have to be met from imports. Already, current import levels of these products represent over 200 million m³ water each year, one tenth of the national availability.

Water and the Poor

Public policy in water has not favored the poor

Public programs have tended to confirm an inequitable distribution of water. One example is targeted and subsidized agricultural credit through CACB. In effect, it is the better off who generally succeed in getting hold of this cheap money, and then often failing to repay. Another example is modern spate irrigation projects, where development tended to favor upstream users and to neglect consultation and association of farmers in decisions about development and management. A third area is in groundwater drilling. Here, public policy hitherto has been "hands off", and the absence of any administrative or traditional controls on drilling has concentrated a valuable resource in the hands of the locally powerful. In addition, public policy has given the landowners access to the cheap credit and equipment that enable them to drill. The poor who lack the means to develop their own water resource then have to pay for irrigation or rely on rainfed cultivation. Finally, potable water supply in towns has concentrated on established areas rather than on the poorer neighborhoods, and in rural areas on those governorates nearest to the capital, predominantly around Sana'a.

Chapter II - International Comparisons

Low per capita availability in Yemen compared with other countries

Yemen is amongst the driest countries in the world. Even by MENA standards, Yemen is one of the worst off countries in terms of renewable water resources per capita. Per capita water availability of 130 m³ is about one eighth of the MENA regional average 1,000 m³, and only 2% of the world wide average 8400 m³ in 1997.

Table 2: Renewable Water Resources Per Capita

<i>Country Name</i>	<i>Renewable Water Resources Per Capita</i> <i>(m³/capita/year)</i>		
	1980	1997	2015
Egypt, Arab Rep.	1,424	966	735
Jordan	396	198	128
Morocco	1,531	1,088	830
Portugal	7,069	6,998	7,142
Saudi Arabia	257	120	69
Yemen, Rep.	246	130	82
MENA	1,678	1,045	742
World	10,951	8,336	6,831

Source: Adapted from World Development Indicators 1999, WB Original date are compiled by the World Resources Institute from various sources and published in World Resources 1998-99. The values in 1980 and 2015 were calculated using the WB Population estimation.

Low availability exacerbated by high population growth

Yemen stands out as one of the highest population growth countries even in the MENA region, which also shows the highest growth rate in the world (2.7 % in 1980-1997 and 1.9 % in 1997-2015). The population growth rate of Yemen has been about 3.7 % (1980-1997 average) and is expected to be about 2.6 % (1997-2015).

Due to the rapid population growth, renewable water resources per capita have decreased from about 250 m³ to about 130 m³ (1980 – 1997), and are expected to decrease further to about 80 m³ in 2015. Over the same time span, the MENA regional average also decreased from about 1700 m³ to 1000 m³ (1980-1997) and is expected to decrease to about 700 m³ in 2015.

Table 3: Population and Population Growth

<i>Country Name</i>	<i>Population</i> (millions)			<i>Population Growth</i> (%/year)	
	<i>1980</i>	<i>1997</i>	<i>2015</i>	<i>1980-1997</i>	<i>1997-2015</i>
Egypt, Arab Rep.	40.9	60.3	79.2	2.3	1.5
Jordan	2.2	4.4	6.8	4.2	2.4
Morocco	19.4	27.3	35.8	2.0	1.5
Portugal	9.8	9.9	9.7	0.1	-0.1
Saudi Arabia	9.4	20.1	35.0	4.5	3.1
Yemen, Rep.	8.5	16.1	25.5	3.7	2.6
MENA	174.1	279.6	393.9	2.7	1.9
World	4,429.9	5,819.6	7,101.4	1.6	1.1

Source: World Development Indicators 1999, WB The population estimates are produced by the Human Development Network and the Development Data Group of the World Bank in consultation with the operational staff and resident missions.

Predominance of rural population dependent on water for a livelihood

Yemen remains an intensely rural country, with over two thirds of the population (64%) still living in the countryside, well above the MENA average of 42%. The rural population has gone up from 4.8 million to 10.5 million (1960 – 1998). Population densities have tripled over the last four decades and this “densification” of the rural population is still continuing apace. The absorptive capacity of the rural economy is being challenged.

Table 4: Rural Population (% of total)

<i>Country Name</i>	<i>1960</i>	<i>1970</i>	<i>1980</i>	<i>1990</i>	<i>1998</i>
Egypt, Arab Rep.	62.1	57.8	56.2	56.1	54.6
Jordan	57.3	49.5	40.1	32.0	26.9
Morocco	70.7	65.5	58.9	51.8	46.1
Portugal	77.9	74.1	70.6	66.5	63.0
Saudi Arabia	70.3	51.3	34.1	21.5	15.5
Yemen, Rep.	90.9	86.7	79.8	71.1	63.8
Middle East & North Africa	66.6	58.6	52.0	46.0	41.6
High income: OECD	32.0	26.7	24.6	23.3	22.1

Source: World Bank SIMA database

Table 5: Rural Population (million)

<i>Country Name</i>	<i>1960</i>	<i>1970</i>	<i>1980</i>	<i>1990</i>	<i>1998</i>
Egypt, Arab Rep.	16.1	19.1	23.0	29.4	33.5
Jordan	0.5	0.7	0.9	1.0	1.2
Morocco	8.2	10.0	11.4	12.5	12.8
Portugal	7.0	6.7	6.9	6.6	6.3
Saudi Arabia	2.9	2.9	3.2	3.4	3.2
Yemen, Rep.	4.8	5.5	6.8	8.4	10.5
Middle East & North Africa	66.4	76.5	90.3	109.0	118.6
High income: OECD	202.0	185.8	184.8	185.6	184.7

Source: World Bank SIMA database

Table 6: Population Density (people / km²)

<i>Country Name</i>	<i>1961</i>	<i>1970</i>	<i>1980</i>	<i>1990</i>	<i>1996</i>
Egypt, Arab Rep.	26.6	33.2	41.1	52.7	59.5
Jordan	10.0	17.0	24.5	35.6	48.5
Morocco	26.7	34.3	43.4	53.9	60.2
Portugal	97.7	98.8	106.7	108.2	108.5
Saudi Arabia	2.0	2.7	4.4	7.4	9.0
Yemen, Rep.	10.2	12.0	16.2	22.5	29.7
MENA	9.3	11.9	15.8	21.6	24.9

Source: WB SIMA database

Importance of agriculture sector in Yemen

The agriculture is still an important sector for the national economy in the MENA region; the GDP share is about 14 % (1997), and the employment share is still about 35 % (1990).

In Yemen, the importance of agriculture sector is much more prominent. The GDP share is about 18 % (1997), but the employment share is more than 60 % (1990), which is much higher than any other country in the MENA region.

Table 7: Agriculture Sector

<i>Country Name</i>	<i>Value Added</i>		<i>Employment</i>	
	<i>(% of GDP)</i>		<i>(% of total employment)</i>	
	<i>1970</i>	<i>1997</i>	<i>1970</i>	<i>1990</i>
Egypt, Arab Rep.	29	18	52	40
Jordan	12	3	28	15
Morocco	20	15	58	45
Portugal	n.a.	4	32	18
Saudi Arabia	4	6	64	19
Yemen, Rep.	n.a.	18	70	61
Middle East & North Africa	13	14	50	35
World	9	4	55	49

Source: World Development Indicators 1999, WB

In Yemen, the irrigation coverage of total crop land has increased from about 15 % to 30 % (1960 – 1996), which is much faster than other MENA countries, due to rapid development of groundwater exploitation and spate irrigation projects, which has surely contributed to the increase of the agriculture productivity. Yemeni agriculture does well to concentrate on higher value cash crops, particularly for the irrigated areas where the opportunity cost of water is highest; cereal production has decreased from about 95 % to about 50 % (1961 – 1996), which was much faster than other MENA countries.

Table 8: Irrigated Land as proportion (%) of Total Crop Land

	<i>1961</i>	<i>1970</i>	<i>1980</i>	<i>1990</i>	<i>1996</i>
Egypt, Arab Rep.	100.0	100.0	100.0	100.0	100.0
Jordan	10.5	10.8	11.0	15.8	18.3
Morocco	12.6	12.3	15.4	13.6	13.0
Portugal	20.4	20.1	20.1	19.9	21.8
Saudi Arabia	29.3	25.7	30.6	25.9	38.6
Yemen, Rep.	15.5	18.3	19.8	23.5	31.3
Middle East & North Africa	22.6	24.6	26.0	32.9	35.1

Source: World Bank SIMA database

Table 9: Cereal production area as proportion (%) to total arable area

	<i>1961</i>	<i>1970</i>	<i>1980</i>	<i>1990</i>	<i>1996</i>
Egypt, Arab Rep.	69.0	70.2	86.5	n.a.	90.9
Jordan	n.a.	93.0	61.7	34.1	31.5
Morocco	57.3	63.8	59.8	66.0	68.0
Portugal	75.4	65.3	45.6	32.0	31.1

Saudi Arabia	24.0	24.9	24.0	28.7	15.2
Yemen, Rep.	95.0	81.3	62.3	61.3	48.9

Source: World Bank SIMA database

In MENA, the average share of agriculture in total water use is still about 90 % in spite of the increasing urban water demand. In Yemen, the situation is more conspicuous, in spite of the severe water scarcity. The share of the agriculture water use in Yemen is about 92 % as a result of the rapid progress of irrigated agriculture. In fact, the rapid development of groundwater irrigation over the last twenty years has contributed to the rapid extension of the irrigated area, at a pace faster than any comparator country.

The large share of agriculture and the pressing shortages of water in the cities has intensified the tensions between urban and rural sectors about the allocation of the dwindling supply. In consequence, urban-rural water transfer is becoming one of the most important water strategy agenda items for Yemen along with irrigation efficiency improvement.

Table 10: Water Use Share

<i>Country Name</i>	<i>Agriculture</i>	<i>Industry</i>	<i>Domestic</i>
	<i>%</i>	<i>%</i>	<i>%</i>
Egypt, Arab Rep.	86	8	6
Jordan	75	3	22
Morocco	92	3	5
Portugal	48	37	15
Saudi Arabia	90	1	9
Yemen, Rep.	92	1	7
MENA	90	4	6
World	69	22	9

Source: World Development Indicators 1999, WB. Original data are compiled by the World Resources Institute from various sources and published in World Resources 1998-99.

Slow progress of water service in Yemen

The urbanization trend has contributed to the increase of domestic water demand in the urban areas where the water consumption rate per capita is much higher than rural areas.

The access ratio to safe water and the sanitation coverage in urban areas is above 90 % in most of the MENA countries. By stark contrast, in Yemen, the access rate to safe water stays at about 74 % even in urban areas and as low as 14 % in rural areas, far lower than other MENA countries.

Urban sanitation coverage in Yemen is about 40 %, which is also much lower than other MENA countries. These poor water service level may have contributed to the lowest life expectancy (54 years in 1997) in the region as well as to the high infant mortality rate (about 10 %), which is much higher than any other countries in the region.

Table 11: Access of urban population (% of population) to safe water

Country Name	%	Year
Egypt, Arab Rep.	95	1996
Jordan	98	1990
Morocco	97	1995
Portugal	97	1985
Saudi Arabia	98	1990
Yemen, Rep.	74	1995
Middle East & North Africa	98	1990

Source: World Bank SIMA database

Table 12: Access of rural population (% of population) to safe water

	%	Year
Egypt, Arab Rep.	74	1996
Jordan	94	1990
Morocco	20	1995
Portugal	(50)	(1985)
Saudi Arabia	54	1990
Yemen, Rep.	14	1995
Middle East & North Africa	70	1990

Source: World Bank SIMA database

Table 13: Access of urban population (% of population) to sanitation

	%	Year
Egypt, Arab Rep.	100	1995
Jordan	100	1988
Morocco	97	1995
Portugal	100	1990
Saudi Arabia	100	1990
Yemen, Rep.	40	1995
Middle East & North Africa	93	1988

Source: World Bank SIMA database

Table 14: Access of rural population (% of population) to sanitation

Country Name	%	Year
Egypt, Arab Rep.	49	1996
Jordan	75	1993
Morocco	39	1995
Portugal	100	1990
Saudi Arabia	55	1990
Yemen, Rep.	14	1995
Middle East & North Africa	55	1988

Source: World Bank SIMA database

Table 15: Life Expectancy and Infant Mortality Rate

Country Name	Life Expectancy at Birth (years)		Infant Mortality Rate (per 1,000 live births)	
	1980	1997	1980	1997
Egypt, Arab Rep.	56	66	120	51
Jordan	64	71	41	29
Morocco	58	67	99	51
Portugal	71	75	24	6
Saudi Arabia	61	71	65	21
Yemen, Rep.	49	54	141	96
MENA	59	67	95	49
World	63	67	80	56

Source: World Development Indicators 1999, WB Data are from United Nations Department of Economic and Social Affairs, Population and Vital Statistics Report; demographic and health surveys from national sources; and UNICEF, The State of the World's Children 1999.

Great seasonal and location variation of water resources availability in Yemen

In the MENA region, the average annual precipitation is less than 400 mm in most of the areas, with a range between about 50 mm and 1600 mm. Most of the areas spanning from the middle of the Arabic Peninsula to southern Iraq are desert receiving less than 50 mm rainfall in a year, while the mountainous areas along the Mediterranean coast receive more than 1000 mm precipitation mainly due to melting snows. Because of the low precipitation in most of the areas, perennial water is observed only in the Mediterranean coast countries and the Tigris - Euphrates River.

In Yemen, the average annual rainfall is less than 200 mm although the high mountain areas, where the population is concentrated, receive about 250-400 mm and more, with peaks > 1000mm in the highlands around Ibb. Surface water is taken from wadis during floods mainly in two rainy seasons, April – May and July –

September, except some springs producing perennial water. Wadis are dried watercourses in most of the season except a few flush floods and flows seeping out of the shallow aquifer. Many diversion weirs and dams have been built since ancient time in order to harness the floods runoff to maximum extent. Most of these major hydraulic facilities have been constructed by the government authorities, which have deteriorated due to lack of budget and poor coordination with local farmers for operation and maintenance.

Also, there are great discrepancies between water demand and availability depending on the regions in Yemen. The gap is the greatest and on the rise in the western intermountainous areas including the capital city Sana'a and Hodeida. These cities are mainly exploiting fossil aquifer, which would be exhausted in ten or twenty years. No sustainable options are available except for inter-sectoral water transfer through irrigation efficiency improvement, wastewater reuse, and groundwater recharge enhancement, considering the high altitude of the cities.

No international rivers in Yemen – but social and governance problems instead

The only advantageous point to address the water problems in Yemen is that there are no international rivers crossing the national boundaries and Yemen is in a position to tackle the problems without harsh and prolonged negotiation with other countries, such as in the Jordanian basin and the Euphrates River.

But still, Yemen has different type of difficulties with many independent minded tribes and strong centrifugal tendencies. A high degree of local autonomy and weak governance makes it hard to address water issues, particularly for urban-rural water transfer, let alone inter-basin water transfer. The devolution of the water management authority to local water user groups is extremely important in this decentralized political environment.

CHAPTER III – Development Goals and Prospects

A. Brief Description of Explicit or Implicit Government Goals

Objectives, Constraints and the Challenge of Sector Management

Yemen is struggling with the consequences of these rapid and unplanned developments which are mining resources at a perilous rate. Reform attempts will be shaped by the objectives the nation sets for itself, and will be limited and formed by natural conditions, circumstances of the past and the varying interests of the stakeholders. This chapter tries first to analyse what are or might be the nation's objectives in tackling the water crisis. The chapter then sets the water crisis in its physical, social and political context, and thereby tries to describe the framework within which reforms can take place.

Objectives

Yemen has three vital objectives in the water sector

Yemen has recently adopted a national water strategy that sets out the general framework for water resources management and sector reform. In addition, other policy statements such as the Five Year Plan do contain some statements which act as a point of reference. Finally, policy being what Governments do and not what they say, the public expenditure program and other actions give some hints about the direction of policy. However, governance is weak in Yemen, and there is a large gap between what is intended to happen and what happens, and probably a large gap between what is said and what is intended. Some reading between the lines is therefore necessary.

Objectives will be analyzed around the three main problems previously identified: groundwater mining, cities short of water, inadequate access to potable water.

....to return water use towards a sustainable basis

Yemen cannot continue to live off its water capital - the horizon of complete exhaustion of the resource is too close. Reforms must take place that will return water use *towards* sustainability.

Towards sustainability because full sustainability is not achievable. In the case of the Sana'a basin, a 1992 analysis [UNDP] estimated that with all conceivable demand and supply management measures applied, 57% of remaining aquifer storage would still be lost by the year 2010. Even if the mechanisms were invented to sharply reduce extraction, in many areas the abandonment of resource mining would have catastrophic consequences on the rural economy.

Every nation takes decisions about the speed and scale at which natural resources may be mined. The challenge is to take the decisions in a rational framework and to be capable of dealing with the ultimate consequences of depletion. This will require action to slow down the rate of depletion, with the main effort in the most severely affected areas and in areas key to aquifer recharge, combined with alternative strategies for development of rural incomes. Irrigation efficiency improvement and groundwater recharge enhancement could help increase the sustainability of aquifers.

...to facilitate transfers of water from rural to urban areas

With the growing water shortage, competition has arisen between town and country over the water resource. In some cases this has been resolved through the market, but at risk to the resource. In other cases, Government had simply appropriated water in a way seen as unfair by rural people. What is needed is a workable legal and planning framework that will allow a sustainable flow of water to cities in a way acceptable to both rural and urban dwellers. Basin management approaches and the development of community based user groups would be an option to be explored.

....to increase coverage of clean water supply and sewerage and so improve health and reduce poverty.

The low coverage of the population, and the consequent impacts on health and poverty, have been mentioned above. Government rightly has plans to increase coverage. The challenge will be to ensure that this is done in an affordable and sustainable way. In urban areas, the existence of a lively private sector is an asset to develop. In rural areas, community involvement is already strong and this can provide a pointer to future strategy.

B. Assessment of Prospects for Reaching the Goals

Structural Constraints to Sector Management

Models for water sector management working in other countries have to be adapted to the Yemen context

The model for water resources management generally advocated by the World Bank supposes an integrated Government management function responsible for policy, water allocation, regulation and environmental aspects. In Yemen, it is difficult for Government to execute this integrated function for a number of reasons.

Yemen differs physically

The predominance of groundwater makes for individual exploitation, and makes control difficult. The fragmented geography and hydrology, and the predominance of dispersed rural water uses make central control and master planning difficult. The mismatch between population and remaining resources reduces planning options too; most of the population and economic activity is concentrated in the water-depleted western highlands, making it difficult to explore alternative water sources such as the Hadramawt aquifer or desalination. In addition, most irrigation in the very water-stressed highlands is small scale and private. Only a few modernized spate schemes along the coastal margins represent that large scale irrigation which typically would allow the Government a measure of control over resource development and allocation.

...institutionally

Modern public institutions and systems are developing slowly in Yemen and the role of central government is balanced by the strong influence of decentralized, traditional structures. This makes it difficult to impose a vision of development from the center. The predominance of the public sector in modern spate irrigation has also made the key activities of operation and maintenance dependent on the public purse, and activity has been severely affected by the fiscal crisis of recent years.

The system of laws and rights is similarly a compromise. There is no clear modern system of water rights, and neither modern nor traditional systems have coped with the sudden irruption of tubewell technology, which has a power to produce water - and to mine common resources - quite unforeseen in the *shari'a*. Work is going on to develop a modern law, but enforcement at the local level will take time.

....and economically

There are stronger - often distorted - incentives to agricultural water use than exist in most countries, due to Government incentives, capital transfers - and the phenomenon of *qat*. Agricultural overuse of water is very profitable, and can compete with urban uses in some cases.

History of Sector Management - and the Challenge Ahead

Until recently, approaches to the water sector in Yemen were fragmented. When awareness of the water crisis began to grow in the early 1990s, there was no institution within government with the mandate or power to take the lead. As a result, a lot of studies, reports - and even three draft laws - were prepared but with little practical result. At the same time, a number of Government agencies took decisions that affected water resources without any coordination.

A central planning institution has been created

After years of effort to work with the structure of the High Water Council, Government passed a decree in 1995 to create the National Water Resources Authority (NWRA), with responsibility for water resources planning and monitoring, legislation, regulation and public awareness.

....but a central management function will take time to build and is not sufficient

NWRA will take time to build capacity and credibility. In its first three years, NWRA has set up a competent technical staff at headquarters and opened two branches. It has consolidated the data base, revived the water resource monitoring program, and prepared the first regional water management plan (to tackle the dire water problems of Taiz). It has also developed the national water strategy and obtained the endorsement of the Council of Ministers to it. It has also drafted a new water law and begun to introduce regulation.

The above is a substantial achievement. However, NWRA's actions remain tentative; management is weak, there is little sense of mission in the institution, and NWRA has little leverage over other institutions. At the field level, NWRA has had no impact on water user behavior.

In any case, given the natural, social and political factors tending to decentralization in Yemen, regulation and central planning by themselves are unlikely to have much impact in the foreseeable future.

Decentralization and partnership with stakeholders are also necessary

The argument that Yemen is by nature and circumstance decentralized has been made above. To succeed in water management in Yemen it will be necessary to exploit this "natural decentralization", even to turn it to advantage. Decentralization to local areas allows planners to deal with a more manageable hydrological, social and economic unit. Decentralization also creates more possibility for stakeholder participation in planning and management - and without involvement of the stakeholders little will happen. In addition, there are the classic arguments in favor of decentralization - closeness to market, more efficient information flow, more adaptability to local conditions. In all this, the focus has to be on rural areas where the resource overuse problem is concentrated. A major effort is required to understand the attitudes, incentives and constraints of rural users, to develop communications channels, and to design incentives and support programs that can help users to change their behavior.

Management of change in rural areas has to work from existing rights systems and management practices

The definition of rural water rights in a way that reconciles modern need with traditional custom is essential. And improved management needs to be founded on traditional management and regulatory and dispute resolution procedures. Again, understanding these is an essential precondition to action.

Government's influence on water resources management will be mainly felt through the economic framework and public expenditures

In the context of Yemen, with the relatively poor prospects for imposing workable controls and regulations, Government's influence on water resources management will be felt most through policy adjustment - particularly correction of the distorted incentive framework and changes in public expenditure.

Government can also act on sectoral reforms in both water supply and irrigation

Government is a major player in both urban and rural water supply - through NWSA and GAREW - and in irrigation, particularly spate irrigation and small dams, through MAI. Reform programs have been adopted for all three sectors.

For ***urban water***, a sector restructuring study was carried out in 1995/96. This was followed, in 1997, by Cabinet adoption of a progressive sector policy which envisages substantial managerial and financial decentralization and regulatory reform. The reform program is now underway, including the widespread adoption of decentralized management approaches that allow for local branches to propose their own tariffs, retain 90% of their revenues, and enjoy a certain measure of management freedom. In a second stage, Government will shortly establish the first autonomous regional water and wastewater corporation (for Sana'a) with its own independent Board of Directors. The Government has also begun to explore options for private sector participation -including a long-term lease arrangement for the capital, scheduled to be in place by early 2001. The financial health of the urban water sector remains precarious, but officials appear determined to reverse the downward trend that dominated the 1990's—primarily through a series of recent tariff increases and the adoption of improved commercial practices.

For ***rural water***, a sector study was carried out in 1996. The report (Cosgrove et al 1996) was discussed at a workshop in August 1996 and GAREW began tentatively to implement the recommendations. Recent developments include: preparation of a pilot project (for IDA and Netherlands financing) that will test the decentralized and user driven approaches to rural water and sanitation that have been so successful worldwide; decentralization of GAREW to local level offices; and the launch of a consultative process between all stakeholders to prepare a detailed policy and reform program for the sector.

For ***irrigation***, MAI conducted a workshop in Aden in March 1997 that resulted in a declaration (the "Aden Agenda") that users and user groups should progressively take over responsibility for the management of public spate schemes, at least of the networks, if not headworks. EDI assisted MAI in conducting a workshop on irrigation management transfer in 1999, and a project is under preparation that will start testing handover mechanisms for spate schemes in Lahej and Tehama. Government is also conducting a pilot project in Taiz (Taiz Water Supply Pilot Project) that is testing ways to engage water users in rural areas in an integrated and participatory approach to water resources management in partnership with Government agencies.

There is thus a rich agenda and some progress on reform at the sectoral level. The challenge - as always in Yemen - will be effective and sustained implementation.

Chapter IV - Factors Relevant to BB Development Goals

A. Factors Relevant to BB development Goals - Positive

Level of awareness of the problem

The beginning of change is to recognize that there is a problem, and the water issue in Yemen has moved to the very top of the national consciousness. The press is full of discussion of the problems, and every citizen has some level of awareness. More concretely, a number of national conferences have contributed to the debate in recent years, the cabinet and the President's Council have discussed it on several occasions, and some specific actions are being taken – examples include the creation of NWRA, the setting up of the Technical secretariat and the implementation of the urban and rural water supply reform agendas, the Aden Agenda and the start of its implementation, the systematic pursuit of the macroeconomic reform agenda that has an impact on water (diesel pricing, import regime, credit pricing), the agreement to a CAS that has a heavy water reform and investment content and the adoption of the national water strategy in 1998. Governance issues still predominate – but the move is in the right direction, and for ways in which even a weak government can still have a big influence see below (Past success....).

Past success of Government policy on irrigation

Stimulated by the pricing of groundwater below economic cost, coupled with the absence of regulation, a rapid expansion of well irrigated production took place over the last two decades. The well irrigated area increased from 37,000 ha in 1970 to 368,000 ha in 1996, 32 percent of the farmed area. Production of high value crops multiplied rapidly, and groundwater irrigation now accounts for two thirds of agricultural output by value. In spate irrigation, public development over the last two decades increased the production and productivity of the schemes enormously. The great Tehama schemes are spoken of as the "breadbasket of Yemen".

Table 16: Change in Yemeni Agriculture 1970-1996

	1970	1996
Share of agriculture in GDP	45%	15%
Share of land cultivated to:		
- cereals	85%	61%
- cash crops	3%	14%
Total cropped area	1,266,000 ha	1,155,000 ha
- rainfed	1,056,000 ha	579,000 ha
- modern spate irrigated	10,000 ha	120,000 ha
- well irrigated	37,000 ha	368,000 ha

Source: Agricultural Statistics Yearbooks, and Yemen: Agricultural Strategy Note, Report No. 17973-YEM, IBRD, June 1999

This rapid irrigation development must be counted successful, as a reputedly "weak" Government has promoted very rapid development that has substantially modernized the agriculture sector and brought self-

sufficiency in many high value food products like fruit and vegetables. The benefit has been spread across a large section of farmers.

Current cereals policy and the absence of a food self-sufficiency policy

Yemen now produces only a fifth of its cereals needs, the balance is imported. In some countries, this might raise the spectre of a campaign to improve food self-sufficiency. In Yemen's case, the country is largely self-sufficient in high value crops like fruit and vegetables where it has a pronounced comparative advantage. But it has no comparative advantage in cereals production, and therefore import is the most rational policy. Fortunately, this does seem to be an issue in Yemen; Government has had access to cheap imported cereals which are efficiently distributed internally, and Government has never pursued a campaign to promote domestic cereals production.. This has allowed agriculture to focus on higher value crops.

Change in Irrigation Water Pricing Policy

Government, after twenty years of keeping irrigation water prices down, is now putting them up. For the rationale for this, see the Box. In groundwater the price of diesel is shooting up - from 2 US cents per litre to 10 US cents per litre over the last two years, and it is set to rise further to about 16 US cents per litre within two years. The supply of cheap credit has dwindled and interest rates have risen. Controls on fruit and vegetable imports are being dismantled. All these actions will bring the cost of groundwater closer to the economic cost. There is even talk of regulating groundwater development and extraction.

For spate irrigation, a law allowing water charges to be levied has been passed, and Government is considering involving user groups in operation and maintenance with a view to ultimately handing over schemes to users. This would effectively get users to pay the full recurrent cost of spate water.

Why is Yemen Raising the Price of Irrigation Water?

For twenty years Government with donor support has been able to satisfy important objectives and constituencies with the help of low or zero irrigation water prices. What has changed?

- First, Yemen has been in economic crisis constantly since 1990. Since 1995, the country has adopted a package of stabilization and adjustment measures. These entail the elimination of policy distortions, particularly those with fiscal repercussions: the diesel and credit subsidies to groundwater, the operation and maintenance subsidy to spate, and the cereals subsidy disincentive to traditional systems are all due for elimination under this rubric. Thus water prices will go up as a fiscal imperative.
- Second, the "weak" state has become weaker. Government is no longer able to shoulder the managerial and financial responsibility for irrigation management. Sharing of management and costs leading to ultimate hand over to user groups is the option that is inevitably being explored. This item also figures in the structural adjustment program which calls for the reduction of the role of the state in economic activity.
- Third, real problems of sustainability stemming from environmental degradation, particularly groundwater depletion and damage to watersheds and terrace systems, have encouraged Government to change its objectives. Sustainability has perforce become as important an objective as increasing incomes.
- Fourth, an important role is played by donors, who once supported - explicitly or implicitly - the policies they would now encourage Government to change. In addition to strong donor backing for the structural adjustment program, donors have been important in promoting the "sustainability" agenda, the "small government" agenda and the "community group/participation" agenda. Donors also encourage "demand management" for water through the pricing mechanism.
- Fifth, Government itself, under pressure of "failure to deliver", has begun to change its view of how development should happen and who are the participants. It has started to adopt an agenda of decentralization. A rhetoric of community development, participation and NGOs has arisen, and there are some actions to transfer responsibility to lower levels and to popular control.

B. Factors Relevant to BB development Goals - Negative

Since the 1970s, Yemen has witnessed very rapid changes, often unmatched by development of instruments of governance. Many of these changes have a profound effect on water use. Despite the encouraging movements noted in the previous section, most of these factors still persist and will represent a constraint on Yemen's ability to change and reform.

Demand for water has risen with population growth

The population has doubled in the last twenty years, and Yemen currently has one of the highest rates of increase in the world (3.3 percent). Demographic changes have increased demand for water and for products whose production requires water, particularly agricultural produce. The same changes have contributed to a large increase in the rural population. Intensified agriculture has employed many of the extra people, in some cases an increase of four times in the space of a single lifetime - and provided them with a higher standard of living. But the strain on natural resources has become intense. With the rural population slated to double over the next twenty five years, absorption capacity will be stretched.

Commercial agriculture for qat and other profitable cash crops makes water use very profitable

Agriculture has developed rapidly with the growth of market opportunities. Profitable cash crops have been adopted - particularly grapes, vegetables and - the largest and most intractable problem - *qat*, which has exploded² in the last twenty years as a social and agricultural phenomenon. This has increased the incentives to use water.

Mining of groundwater has been made possible by new technology

The advent of tractors, chemical inputs and -- above all -- tubewell technology has made possible the shift away from age old farming practice based on careful husbandry and family labor. Technological changes have made extracting groundwater easy. The import and use of this technology has never been regulated.

New technology and water resources development was – and is - encouraged by economic policy

For twenty years, Government actively encouraged water use by a series of direct and indirect subsidies. Principal examples include the following:

- Diesel fuel, used in most water pumps, was for long priced at a quarter of its equivalent international level. Today, after several years of structural adjustment, the price is still only two thirds of international levels. Electricity, used in some pumps, is dearer but is still subsidized.
- The Cooperative and Agricultural Credit Bank (CACB) used to lend for the purchase of water pumps at nominal interest rates of 9 to 11 percent, compared to market interest rates above 20 percent. Now CACB rates are set to rise and there is a policy discouraging credit for groundwater development , but there remains an undoubted subsidy for those who may still access credit.
- International donors continue to provide concessional funding for water pumps.
- Urban water supplied through the public system is priced low compared to the cost of supply and to the opportunity cost, with consequent negative fiscal and equity impacts.
- Fruit, vegetables and *qat*, highly water intensive crops, were for twenty years favored by import bans that raised their profit margins and hence their attractiveness for farmers. Government has agreed to remove these bans (except for *qat*), but they are still applied at least selectively.

² *Qat* production and marketing is a huge industry. Although not recognized anywhere in official statistics, *qat* is estimated to contribute 25% of GDP, 16% of employment - and to account for 30% of water use. The profitability of *qat* can justify irrigation by tankered water [at a cost of over US\$1/m³].

It is evident that past policies constituted a powerful engine pushing in the direction of exhaustion of Yemen's aquifers. Now changes are taking place in the right direction, but there is still a long way to go.

Changing the relative price of irrigation water may have a negative impact on rural producers, particularly the poor

These changes, precisely because they reduce incentives to water use, are likely to affect the profitability of using groundwater. During the background studies for the Agriculture Strategy Note, a static model was created to assess the impact of these policy changes on principal fruit and vegetable products. Assuming subsidies were removed in one step without any change in farmer behavior, the model showed a reduction in income of 13 percent for three products. This is equivalent to a drop in agricultural GDP of 3 percent. Thus, once the adjustments are complete, incentives to overuse of groundwater will have dropped – but so would incomes, unless efficiency improvements were made.

Law and tradition provide little support to water conservation in the modern age

For centuries, traditional society managed common resources like water and pasture in a sustainable way. Social changes and powerful economic incentives have relaxed traditional controls over resource use. Government has not stepped in to replace these traditional controls with modern regulation. In the case of *qat*, the absence of Government policy has allowed the huge growth of consumption.

Environmental degradation has added to water problems

Deforestation, the abandonment of terraces and of traditional water harvesting systems and the consequent degradation have provoked widespread soil erosion, increasing risks of floods - witness the severe floods of 1996 - and reduced recharge of aquifers.

Public institutions have not been efficient

Government's urban water utility, the National Water and Sanitation Authority (NWSA) has not done well. Its internal efficiency indicators are all unfavorable: unaccounted for water is 40 percent minimum; collections are only 64 percent of billings; there are too many staff - 8-24 staff per '000 connections against an international norm of 4-5;; and internal cash generation is low – partly reflecting low tariffs, and partly because of poor day-to-day management. Nor is local government any better; in Bajil the utility run by the municipality went bankrupt. Observing this discouraging experience with public sector institutions, the Government's strategy is now to grant individual branch office autonomy and to encourage the private sector to selectively take over managing service delivery and commercial operations.

Government's rural water supply agency, the General Authority for Rural Electricity and Water (GAREW) has not been effective in reaching rural communities. There is a heavy concentration of its activities in a few areas (80 percent in the Governorate of Sana'a alone), schemes are begun but run out of money (500 schemes are suspended incomplete) and the sustainability of completed schemes is poor.³ Recent initiatives by Government to decentralize GAREW hold out some hope, but it will take a lot of time and effort to get the institution reoriented to a decentralized and participatory approach.

³ Source: Rural Water Supply Sector Study, Cosgrove et al for World Bank, August 1996.

Other public institutions have fared little better: agricultural research got off to a good start in the 1970s and 1980s in both north and south but, since unification of the two Yemens in 1990, the combined Agricultural Research and Extension Authority (AREA) has suffered from lack of strategic focus and a very low budget for actual research. Yet there is a crying need for good technology for improving returns to water in irrigation and for alternative technologies in water harvesting and dryland farming. Recent work on the research and extension strategy, the introduction of participatory approaches in the Rapid Impact Program and the cooperation of AREA in the development of an Agricultural Technology and Productivity Project for IDA financing in 2001 are signs of hope, but the challenge of reforming mentalities and habits in the public service is enormous, and probably the stimulus of competition e.g. under competitive research grants will be needed .

With donor support, Government has developed or improved spate irrigation systems throughout the coastal plains. Now, the Ministry of Agriculture and Irrigation (MAI) does not have the resources to operate and maintain these schemes; as a result, the systems are deteriorating, water distribution - and hence farm productivity - are dwindling, and the systems are increasingly vulnerable to damage from the flash flood flows in the wadis. Again, the reform agenda offers hope – but preparation work done for the future project suggest that the process of reducing Government involvement will be a difficult and risky one.

Public expenditure patterns have not helped

Recent reviews of the public expenditure program show a program skewed towards capital expenditures, with not enough attention to user participation in design, financing and management, and inadequate operating budgets for key services like research, extension, and water resources management. Urban cost recovery is improving, but still not high enough to make a substantial contribution to financing needed investment.. There is too much emphasis on water resource development, too little on conservation. In the last two years with the influence of the PSMAC program there have been improvements, but these are slight and do not yet affect the underlying structure of the budget, nor the mind set of those who make it up.

Qat

Finally, groundwater development has been encouraged by Government's complaisant, even supportive, attitude towards the explosion in production and use of *qat*, a soft drug now chewed by most Yemenis on a daily basis. The demand for *qat*, which has its origins as a sufi elixir and which used to be confined to the few, has exploded with the economic and social development of the last thirty years. Now some estimate *qat* to represent 20 percent of GDP and to consume 30 percent of irrigation water. Government has allowed this development by absence of regulation or of any effective taxation, and has encouraged it by an import ban (Ethiopian *qat* is cheaper). Farmers have taken up *qat* cultivation enthusiastically, attracted by its favourable characteristics of high profitability, high returns to water and well organized, cash based marketing. Now Government would like to build on recent high level actions regarding *qat* and to hold a national conference to develop a strategy. Room for manoeuvre is, however, scant.

CHAPTER V – Policy and Program Priorities

A. Policy and Program Options for Relieving the Constraints

What Solutions Are Realistically Available?

This chapter analyzes what practical solutions to Yemen's water crisis are available. These solutions are mostly ones on which action has already begun in some form. Some longer haul actions are also proposed. The following table lists the proposed solutions according to the **principal** problem each might resolve - but of course water flows, and each action may have some impact on all three problems.

Table 17: Summary of Proposed Solutions

Problem	Macro Solutions	Sector Management Solutions	Local Solutions	Level	Longer Term Agenda
Groundwater Mining	Move to efficiency pricing for water National debate Act on qat Reorient public expenditures	Regional planning Try regulation Water conservation programs for agriculture	Community partnership		Capacity building Policy and strategy Water law Long Term Perspectives Study
Cities are short of water		Regional planning Water markets			
Limited access to potable water		Urban water sector restructuring Promote local private supply Action plan for rural water supply			

Macro Solutions

Move to efficiency prices for water

Government is able to send powerful signals to users through the pricing system. The challenge is to remove all the distortions and incentives that have led to overpumping of groundwater - effectively to change relative prices to discourage groundwater use. The agenda includes: raising diesel prices to border parity levels, levying higher tariffs and taxes on pumping equipment, eliminating credit subsidies - and perhaps eliminating credit programs - for pumps, and removing current incentives (such as import controls) to the production of agricultural products that are water intensive, notably *qat*. Making these changes would carry significant costs of adjustment, some of which would be felt in other sectors (e.g., the transport sector would also pay the higher diesel price).⁴ However, action on relative prices has the strong merit that Government can actually do

⁴ Although there would indeed be increases in transport costs, raising the price of diesel would also contribute to recovery of road user costs and would be consistent with the Government's policies for the transport sector. Reducing domestic petroleum consumption through higher diesel prices would also increase the exportable surplus of petroleum, with positive economic benefits. There would thus be benefits as well as costs in the effects on other sectors.

it, whereas other actions like trying to regulate and control water user behavior at the well head are much more difficult in the Yemeni context. In addition, most of the above actions are part of overall structural adjustment reforms that Government wishes in any case to make, for fiscal or macroeconomic reasons. The impact on water is thus a by-product of the larger program.

Conduct a national debate on water

Change in the water sector, particularly in the cost of water or in the amount of water used, would be an intensely difficult and unpopular agenda amongst many constituencies – particularly large groundwater users. Only if there is a nationwide recognition of the nature of the crisis and significant national commitment to tackling it can there be hope that the needed tough solutions can be adopted and implemented. Government, under NWRA coordination, has begun the process of national debate on water, and has launched a public awareness campaign. These tentative beginnings need to be reinforced and expanded. The objective should be to build on the benefits of change - improved access to potable water, more equitable conditions for rural-urban transfers, sustainability of the resource - and so create national consensus for a partnership between all sections of society to tackle the crisis.

Act on qat

Qat is the most important crop in Yemen and the country's greatest consumer of water. It cannot be ignored. Government should include *qat* in statistics, make it the object of research and extension in order to exploit water saving potential⁵, and support a long-term education and public awareness campaign on *qat*. Ideally, an NGO should take the lead on public awareness on *qat*. The successful anti-smoking campaign in many countries over the last three decades should provide ideas. The process has begun, with recent decisions by leading figures to renounce *qat*, and the preparations for a national *qat* conference in 2000.

Reorient public expenditures

Public expenditures are the practical expression of Government policy and can have a powerful influence on outcomes in the water sector. Recent reviews of the public expenditure program made a series of recommendations to reorient expenditures in line with sectoral reform. First, adequate resources have to be allocated to sector management (NWRA), to water conservation in agriculture and to participatory approaches to water management. Second, major investments in improving access to safe water in town and countryside are justified, but these resources should also support improved management (e.g. decentralized or privatized management in NWSA, a decentralized, more participatory approach in GAREW), and investments should be refocused on poorer areas and communities. Third, the current inequities implicit in public spending should be eliminated - credit schemes for well owners, upstream development of dams that take from downstream, the skew in NWSA and GAREW towards the "haves". Finally, NWRA should assume its role of coordinating sector investment, including donor programs. These recommendations have been substantially adopted – but they need to be reflected in much more substantial changes in the budget in 2000.

⁵ Government recently instructed AREA to begin research on the agronomics of *qat*, which is a move in the right direction.

Sector Management Solutions - Groundwater

NWRA should concentrate on regional planning

The mandate of the new sector management institution NWRA is very ambitious; realism of expectations is essential. NWRA will have a vital role to play centrally in sector coordination among different institutions and donors. But in the key planning function, given the problems inherent in central planning approaches, NWRA is rightly giving priority to particularly vulnerable areas, for which it intends to develop regional water management plans. These plans work with a manageable local area - the Ta'iz region, the Sana'a basin - and bring together all the water resources, economic and social information needed to permit rational choices about water allocation and management. The plans also look at aspects like watershed protection for recharge, at wastewater as a potential resource, and at the problem of flood control. The database will be important to allow an informed dialogue, management and monitoring of results. The key is to make sure the plans are developed - and implemented - in partnership with all stakeholders, particularly rural water users. Work has been substantially completed in Taiz, and is of good quality. Weaknesses are: slow pace of planning, so that events tend to overtake the plan; lack of consultation and participation of key stakeholders; and lack of leverage over other institutions to get them to do what is proposed in the plan.

Ta'iz will be followed shortly by Sana'a, where the challenge will be to prepare the plan at the same time as Government and IDA are preparing an investment project.. Hadramawt should be a priority, too, as the region's vast unexploited resource represents an opportunity for national economic development. Action in Hadramawt now would guide development and also avoid the catastrophe of uncontrolled private development.

Try regulation

Although attempts at regulation have been unsuccessful up to now, the growing crisis - and the proposed national debate and partnership approach - should begin to create a climate in which regulation can become a possibility. NWRA should work with the users and communities to initiate the licensing and control of drilling rigs, as it would be empowered to do under the new draft water law (see below). A good place to start is the Sana'a basin where a pilot regulation program could be carried out in conjunction with the proposed new investment project. The program should be initiated in partnership with the local community and with close monitoring and evaluation.

Water conservation for irrigated agriculture

As irrigation uses over 90% of water, water conservation in agriculture is an imperative. The objective to preserve as much as possible of the rural economy whilst reducing water use highlights the need for efficiency improvements, maximizing returns to water. The aim is to increase the return per m³ of water. The following elements should be systematically factored in to all agricultural planning and projects (as they are, for example, in the proposed Sana'a Basin project):

- ***systematic program to promote efficiency*** - irrigation water can be saved by the introduction of piped conveyance and distribution systems, using PVC or galvanized pipes, which have been successfully implemented under LWCP. Also, localized irrigation improvements, such as drip and bubbler technology, can also be adopted to increase efficiency. This needs to be combined with agreements to prevent the saved water from being used for irrigation expansion. A national

program is required, but it could start in a high priority test area – as is now proposed under the Sana’a Basin project.

- **revived research and extension**, especially research in advanced irrigation techniques, including economic and financial returns; and further promotion of advanced irrigation technology. Research and extension on rainfed systems, including water conservation and harvesting, and on livestock should be pursued vigorously, as is proposed under the forthcoming Agricultural Technology and Productivity Project (ATPP);
- **incentives for conservation activities** - e.g, hill farming subsidies to maintain the terraces etc. During review of the draft of this report, Government suggested creating a water conservation fund, and a mechanism like this could be used to provide subsidies to support water conservation investments. Such activities are already being financed under MAI’s AFPPF Fund and their extension and linkage to water strategy should be considered;
- **review of the potential for dams** - technical, social and economic aspects of dams in Yemen should be re-examined, particularly in the context of the small dams program on which Government has embarked. Recent work done by Government with IDA suggests there are major economic and technical issues with the dams program, including safety issues, but that a properly executed program could provide an excellent complement to the overall water strategy. The exercise should also cover the related issue of groundwater recharge, which was raised by Government during review of the draft of this report;
- **spate rehabilitation and management** - in order to ensure that spate irrigation schemes are properly maintained and the water efficiently used, users should increasingly take responsibility for their operation and maintenance. At the same time, many schemes are in poor and fast deteriorating condition. Government has already launched a process of “participatory irrigation management (PIM) and is preparing a project called the Spate Irrigation Improvement Project that will cover both rehabilitation of schemes and their progressive handover to users. EDI, which has good experience in PIM, has helped mount workshops to explore this agenda and develop an action plan. This is in line with Government’s statement of intent under the Aden Agenda;
- **testing other sources** - the potential for irrigation through reuse of treated wastewater and use of saline water has been studied under the Land and Water Conservation Project, and the lessons should be applied under the Sana’a Basin Water Management Project; and
- **alternative rural enterprises** - in the long run, diversification out of agriculture will be necessary. Government and donors should introduce alternative income programs and a safety net for rural communities.

Sector Management Solutions - the Urban Supply Problem

Develop new sources within an integrated regional planning framework

Search and development for new sources of supply for cities has to be done, as far as possible, within the context of the regional water management plans that NWRA will be developing (see above). The cooperation between NWRA and NWSA on the search for a new source for Taiz (under the IDA-financed Taiz Pilot Water Supply Project) is a first example of working in an integrated framework. Under the IDA-financed Sana'a Basin Water Management Project, now under preparation, the high quality deep aquifer in Sana'a basin should be freed for drinking water in exchange for a package of management and efficiency improvement measures, including treated wastewater reuse and enhanced groundwater recharge for irrigation along with irrigation efficiency improvement schemes.

Organize water markets

Water markets are already well established in Yemen, ranging from opportunistic tanker sales by well owners to supply schemes for whole towns. The latest example is the quasi-purchase of water by Ta'iz city from Habir. Government is reluctant to officialize such markets, and there are many issues associated with water markets based on groundwater sales, including: (i) *ownership* - what is the law that gives one group or individual the right to sell? (ii) *definition* - how can a fugitive and uncharted resource be quantified so that it can be sold? (iii) *regulatory* - how can it be ensured that water sales are not depleting the resource? Nonetheless, this is an essential area for further development as (a) water markets are a fact - they are developing fast and the law and regulation need to catch up if only to get some control over the depletion problem; and (b) some form of market exchange is essential to ensure the transfer of water out of agriculture and into towns. NWRA should set up a task force to work on this issue. The necessary studies could be done during preparation of a future urban supply project, or the Sana'a Basin Water Management Project. The result should be incorporated into the water law (see below).

Get the finances right

Many NWSA branches survive on a financial shoestring, with no reserves and frequently only able to pay essential expenses every month. Sometimes, revenues do not even cover the payroll requirement, and past due energy bills are common. The financial problem is caused by two problems. First, the level of tariffs has often lagged behind inflation and changing environments. The Government has been systematically addressing this problem through a series of rate hikes starting in late 1998. It has also increasingly permitted localized tariffs to be instituted that are based on a cost of service analysis. Second, there is a significant management problem in most NWSA branches which has led to lax commercial practices. For example, customer receivables exceed three months sales in virtually all NWSA branches, and some reach to eight months sales. Solving this problem is more difficult than raising tariffs. It incorporates the need for civil service reform, a complete implementation of the sector's decentralization and autonomy policies, and a more commercially oriented way of thinking.

Sector Management Solutions - Improving Access to Potable Water

Implement reform of urban water supply through NWSA

The urban water supply reform agenda for NWSA is well-defined and, under the aegis of the Steering Committee and the Technical Secretariat, implementation is proceeding. The agenda provides for two stages: stage one calls for NWSA to decentralize, for branches to have more autonomy, and for internal reforms to improve incentives and reduce staff; under stage two, branches would progressively be turned into regional corporations that could associate private management and ultimately private capital. In view of the urgency of the urban water supply crisis and the suitability of several municipalities for private sector management, stage two should be accelerated. In practice, some branches could simply skip stage one - already many branches, including Sana'a, Al-Mukalla, Ta'iz, Al-Hodeida and several secondary cities have acquired a much higher degree of independence. There is also agreement to explore private management options for Sana'a, and the same approach could be considered for Aden and other major towns. Still lagging are the more difficult and specialized areas regulatory framework reform and the setting up of the regional water and sanitation corporations. Some progress is being made on these issues, but IDA and other concerned donors may have to take a more active role if the pace of change is to accelerate.

Promote local private supply

The urban water supply reform agenda discussed above focuses on NWSA, which supplies less than half of urban water nationwide. In fact, Yemen is notable for the active involvement of local private investment and ownership in urban water supply. Two thirds of the capital's water requirements are met by private supply, and several whole cities are supplied by private utilities (Zabid, Bajl ...). Steps should be taken to promote further development of private supply, in order to increase coverage and reduce costs. This could comprise: legislation defining the rights and duties of private water suppliers; the development of a series of concession agreements for organized private supply to towns, with an exclusive groundwater extraction zone in which the concessionaire has an interest in conservation; and working out of a system of "light regulation by exception" to protect the public interest and ensure sustainable exploitation of the resource. This light regulation could be contracted out as it has been in Gaza. Study and action on this agenda should be a top priority as it can hold the key to improving quality and coverage of service for the majority of Yemen's urban population. The Technical Secretariat is studying this agenda. An important related issue is sanitation and the protection of groundwater quality. Private sector development has to take account of the evacuation and treatment of wastewater if a major environmental and health disaster is not to occur.

Implement reforms and an action plan for rural water supply

The importance of rural water supply for health, women's development and poverty alleviation has been discussed above. Government recognizes the need to expand coverage, and many communities have initiated self-help schemes to bring in potable water. Efforts so far, however, have left Yemen far short of its objectives. In addition, problems are emerging with existing schemes as water sources run dry and as the communities' capacity for self-financing has diminished with the disappearance of remittance income and the decline in incomes nationwide. Hitherto, outside involvement in the rural water supply sector has been scant and there was a need to improve the knowledge base. A review was therefore carried out jointly between Government, other Yemeni stakeholders and the donors, beginning in June 1996, to assess the sector and its needs, and focusing on the scope for community participation in design, financing and management in the present economic climate. The principal recommendations of the review (Rural Water Supply Sector Study,

Cosgrove et al, August 1996) have been adopted, and are being incorporated in the upcoming IDA-supported project. The principal components of reform are: (a) strengthening community initiatives to promote sustainability, including association of communities in projects from the earliest stages, training, financial cost sharing and access to technical help and credit for major maintenance; (b) development of institutional capacity to deliver projects in a cost-effective and participatory fashion, with a focus on GAREW, which needs to decentralize its operations, and on partnerships with other agencies, notably NGOs. The Technical secretariat, with Netherlands support, has recently revived the process of drafting and adoption of a sector reform program for rural water, and this should lead to an agreed proposal by mid-2000.

Measures at the Local Level

Promote community partnership and self regulation

Decentralization and partnership with rural users of groundwater are an essential complement to attempts to coordinate and manage the sector from the center. Such an approach has to start from a recognition that it is the water users who have the problem (i.e., depletion) and that only water users can act on the solution (i.e., reduce pumping). The essence of the partnership approach is for agents of change (Government, NGOs, donors) to work with users and communities to develop practical proposals for local groundwater management, working from existing rights systems and management practices. An IDA-supported study, the Decentralized Management Study (DMS) carried out in 1996 on rural water use showed that there is a basis for community involvement and self-regulation. Based on the DMS, the IDA-financed Ta'iz Pilot Water Supply Project is testing a partnership between Government and local communities for joint management of allocation and conservation of groundwater. The lessons of the pilot project need to be documented, and this partnership approach should be developed and adopted within the regional management plans for all vulnerable areas. The proposed Sana'a project will be the second case.

In the Longer Term

Capacity building is essential - for NWRA and others

NWRA deserves the full support of all stakeholders, and donors should take the initiative to promote this. However, early performance has been disappointing – perhaps too much was expected of the infant institution. It is vital now that NWRA focus on building credibility by some successful actions. In order to do this it needs to refocus on key high impact actions – particularly regional planning, the data base, public awareness, and the water law. Also, NWRA needs to clearly define its role and working relationships vis-a-vis other sector institutions. Some changes in NWRA are also advisable – management needs new dynamism, an oversight board needs to be created representing stakeholders from both within and without Government, and a system of adequate financing and incentives for its operations needs to be worked out.

Further water sector training is needed for all sector institutions. There should be an emphasis on essential skills currently in short supply, particularly economics and the social sciences, both in training and recruitment.

Pass a water law

NWRA has prepared a new draft water law, which reflects good principles for water resources management.

The draft should be amended to ensure that not too much is centralized on NWREA and that there is adequate provision for stake holder involvement. Also, although the draft is sound on the key question of water rights and property; it is essential that the implementation of the law reflects both traditional approaches and the new partnership approach, and that there is an adequate provision of for verification and registration of water rights. The proposed Sana'a basin project will provide an ideal testing ground for implementation of the law and particularly for the recognition of water rights.

Study and plan for the long term

Government should prepare a "long term perspectives study" of options that will provide for development of a less water-intensive economy, including the development of regions where there is more water, and of sectors that are efficient water users. The study should also link the water issue to policy on population.

B. Pros and Cons of Policy Options

Strategy is vital

The exceptional nature of Yemen's water crisis cries out for a strategic approach. The problems are many, the solutions proposed are legion, capacity to implement solutions is weak. It is imperative to prioritize and to concentrate effort on a coherent, integrated approach to solutions. This is the essence of strategy. The 1998 Government strategy provides a good framework, but it remains a comprehensive rather than a prioritized document. Some sense of proportion and priority needs to be adopted.

Change will be a long term process

The challenge is to bring about a major adjustment in the behavior and the economy of a nation. This requires national consensus and considerable persistence. Experience in other countries of effecting change in natural resource management is that two to three decades of dogged application are necessary. What is required is that Government, other stakeholders and the donors persist in the process of analysis, decision taking and change over a number of years, building in partnership. The strategy will change, deepen and - above all - be implemented during this process. A broad national debate, involving stakeholders and mobilizing the nation at large through public awareness campaigns, is needed. **Clearly, the role of strong political leadership in this is vital.** Ultimately, full ownership of a reform program is needed. There will be costs, and it will be important to have some successes and some corresponding benefits to show. IDA and other donors have to remain consistent and committed too.

Build consensus

Consensus building at two levels is needed: one level is a national debate with key stakeholders and decision makers in order to build constituencies for change. This will require a dialogue with a broad range of actors, including politicians (from the President down), traditional leaders, the press, universities etc. Activities such as conferences, media events, seminars, films etc. are an appropriate way of developing this dialogue. The process has begun, but needs more sense of direction. Developing consensus for change will also require

careful attention to incentives. The expected outcome would be a reform program that is owned by the key stakeholders.

Policy dialogue between donors and Government forms a complementary part of the process. This is going well, but needs persistence.

The second level of consensus building is with the population at large, all of whom are water users in some sense or another, all of whom are concerned citizens, all of whom will be required to bear the burden of adjustment. A public awareness program is the most appropriate way to engage this very broad constituency.

NWRA has begun to act on this, but results so far are disappointing. The program is urban based and focussed on themes that are not entirely thought through. Much of the awareness program should be aimed at rural users. The program should focus on specific target regions and populations and promote just a few essential themes, conveying simple but alarming truths about the categorical imperative of water conservation in Yemen. A major campaign on *qat* could be introduced.

NWRA should continue to take the lead in coordinating public awareness initiatives on water, but needs to bring in all concerned national institutions to support the programs (by joining a coordinating committee, working on message development, pooling resources and media etc.).

The expected outcome would be a sense of national crisis, and a willingness to participate in solutions that are understood to be essential and equitable.

NGOs and community groups should be encouraged to play a role

NWRA, and Government in general, have only limited capacity to influence minds and events. It is important to allow - and encourage - the development of non-governmental institutions, both technical support and action groups like the new NGO, and decentralized community groups. The chances of getting ownership of a reform program will be much greater if such groups are involved in the national debate, too. The process has started, with several NGOs regularly involved both in discussion and in implementation, but more can be done.

Develop donor coordination and partnership

NWRA has a key role in coordinating donor interventions in support of the national water strategy. The Technical Secretariat plays a similar role for the urban water reform agenda. The role of the donors is, first, catalytic, helping to develop the reform program through technical assistance, studies and dialogue. Second, the donors are backing up the adjustment dialogue with project conditionality. Finally, the donors are supporting capacity building and project investments within the public expenditure program, each investment addressing priority need and supporting the policy agenda. There is already a large degree of cooperation among donors for the water sector agenda, notably for water resources management, urban and rural supply, and irrigation.

Promote a top/bottom partnership

The objective is partnership between central or regional agencies and communities in the sustainable management of the resource for the common good. This, as has been elaborated at length above, is the key imperative in Yemen - bringing a national framework of rules and incentives into reconciliation with 45,000 autonomous well owners. The key requirements for success are that the **top** come with sound information about the problem, some technical options for change, some incentives, and some ability to facilitate community organization; and that the **bottom** prove ready to adopt communal management approaches and to work in partnership with Government (or regional agencies, or NGOs) on management plans that are efficient and equitable.

Make strategic investments

Lack of investment is a secondary problem: investments are productive only when a coherent sector strategy is in place. However, as that strategy emerges, investment plainly has a key role to play both in relieving supply problems and in advancing the policy agenda. In fact, based on recent decisive action in the water sector and in recognition of the importance of the sector, all of Yemen's major donors have retained water as an important area of investment (IDA, Netherlands, Germany, AFESD, IFAD). It is evident that donors wish to back the reform program with their investments, and in fact link the two to the extent that slackening of reform, e.g. in urban water, will raise the prospect of a sharp fall off in donor support.

Develop institutions and people

The water agenda places great demand on sector management capacity and tools, particularly the partnership approach. This will require capacity building and training, not only for NWRA and sector management agencies, but also for non-governmental associations and training institutions. The emphasis would be on resource monitoring and planning, public awareness and participation.

C. Risks and Scenarios

Will all this Help Yemen achieve its Three Objectives?

Return water use towards a sustainable basis

This is the toughest challenge. Few societies have been able to establish effective control over groundwater, and they are highly regulated and developed ones (some US states, Israel...). The conditions in Yemen are particularly difficult. Nonetheless, under the threat of impending loss of the resource, the nation has to act.

Government is having to take some key decisions on the macro solutions. There also has to be decentralization and partnership with communities, and a continuous process of dialogue and communication.

The outcome cannot be certain. In particular, the power of the community partnership approach to reverse the tragedy of the commons has yet to be demonstrated even on a pilot scale; and scaling up will pose huge institutional and financial problems. At best, even if the partnership approach succeeds, the impact of action can only be to slow the rate of resource depletion, to allow the nation time to develop economic activity less dependent on water mining.

Facilitate transfers of water from rural to urban areas

The quantum of water that has to be transferred to meet urban needs is small in relation to the overall availability. But lack of an institutional framework for transfers, and the excessive competing use in irrigation, represent formidable problems. The regional planning framework that NWRA is developing could provide the means for identifying water availability and its rational allocation, whilst the involvement of the private sector and the development of community partnership approaches can provide the means of negotiating and effecting actual transfers. However, uncertainty is high, as transfers of an already over-used resource will be dependent on contracts between town and country which may prove expensive or unworkable.

Increase coverage of clean water supply

As Government progressively implements the reform agenda for urban and rural water supply, public sector ability to supply clean water efficiently should markedly improve. But the development of private sector activity in urban supply - which is essential - is a more subtle agenda, that will need a lot of attention on the policy front. Donors have an important role to play in financing and guiding NWSA and GAREW, but also in supporting the development of a durable and efficient private sector that contributes to - rather than militates against - resource conservation.

Possible Scenarios

What would the nation do in the best of all possible worlds?

The "upside scenario" sketched out in the 1997 Strategy Report would have the Yemeni nation conduct a national debate on the water crisis under strong political leadership and with technical guidance from the NWRA. A strong reform program would be adopted by consensus. Donors would provide support to the policy dialogue, backing up the reform program with investment in institution building and conservation and supply projects, and possibly with balance of payments support. Strong sectoral reform programs would be implemented in urban water supply (decentralization, tariff adjustment, association of private management in major towns, promotion of private investment in smaller towns) and in rural water supply (community participation). Spate irrigation schemes would be progressively handed over to user groups, and communities and public agencies would work together on sustainable groundwater management at the local level. A long-term plan would be adopted to diversify the economy away from water intensity, to sustain rural incomes, and to site future growth near to available water, particularly in the Hadramawt. The result would be slower depletion, improved urban and rural potable supply, and prospects of more sustainable growth.

And what would happen if the nation does nothing?

The 1997 Note also speculated on the corresponding "downside scenario" - if nothing changed from the present situation. Under this scenario, there would be continued rapid mining of groundwater; there would be some relief of the urban water supply problem, if only because modern cities cannot simply die of thirst, but rural/urban antagonism would worsen, costs would increase sharply and water would become the dominant constraint to economic growth. The nation would have little prospect of meeting growth targets. The poor would suffer particularly as supply costs rose and conflict over water intensified.

It is evident that the outcome will lie somewhere between these two scenarios. On balance, the “upside” scenario is emerging into reality. The very real risks to this scenario are: lack of sustained political commitment, lack of national consensus on solutions, and inability of Yemeni institutions to forge the top/bottom partnerships. But if the current trend can continue for the next two decades, Yemen stands a good chance of solving the water crisis.

The challenge is to continue to push towards the upside end of the continuum. This will require sustained and consistent application.

Conclusion

The agenda in this report can fairly be described as high risk; there is virtually no track record in any country to show how likely it is to work. However, the reforms have got off to a fair start, and the key now is to hold steady.

The focus should be kept on the four key innovations in the way of doing water business in Yemen. First, **national debate and consensus** - this is like mobilizing a nation for war, which in a sense it is. Second, **prioritization**, which requires a definite rigor in identifying the *real* problems and the *realistic* solutions. Third, the reliance on the **indigenous private sector and local water markets**: the scale is very different from the challenge of a Buenos Aires, but there is nonetheless a tough policy agenda to ensure that local business can improve quality and price and conserve the resource. Finally, **partnership...participation...** the hoped for coincidence of national and local interests in self-management of groundwater. This is the most attractive of all solutions - building on the nation's traditions and common sense to brake the runaway mining of the last three decades and return resource management towards the age-old balance reflected in that luminous *hadith*:

*Cultivate your world as if you would live forever
Prepare for the hereafter as if you would die tomorrow*