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AN ANALYSIS OF DEVELOPMENT APPROACHES IN THE RURAL WATER SECTOR IN SUDAN: CASE STUDIES OF RURAL WATER SUPPLY PROGRAMS AND PROJECTS IN DARFUR AND KORDOFAN DURING THE INTERNATIONAL DRINKING WATER SUPPLY AND SANITATION DECADE

by

ANDREW JOHN LIVINGSTONE

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled AN ANALYSIS OF DEVELOPMENT APPROACHES IN THE RURAL WATER SECTOR IN SUDAN: CASE STUDIES OF RURAL WATER SUPPLY PROGRAMS AND PROJECTS IN DARFUR AND KORDOFAN DURING THE INTERNATIONAL DRINKING WATER SUPPLY AND SANITATION DECADE submitted by ANDREW JOHN LIVINGSTONE in partial fulfilment of the requirements for the degree of DOCTOR OF PHILOSOPHY.

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Date 8 November 1991

Abstract

Rural development initiatives in the Third World, largely sponsored, designed and managed by ESAs, have generally been ineffective. Within the rural water sector, despite unprecedented attention paid to the sector during the 1981 to 1990 IDWSSD, development efforts have in general failed to significantly improve conditions in many rural areas of the Third World. Large numbers of inappropriate and non-sustainable schemes have been constructed, and in many cases, scheme construction has not kept pace with rural population growth. Sub-Saharan Africa in particular has the lowest rural water and sanitation coverage levels in this world, and is the site of many inoperative and failed ESA sponsored schemes.

Researchers in rural development (for example Chambers, 1974, 1983; Korten, 1980; Johnston and Clark, 1982; Rondinelli, 1983) have suggested a more participatory and adaptive approach to development planning and implementation. Within the rural water sector, Feachem et al, 1978; Cairncross et al, 1980; Therkildsen, 1988; and Andersson, 1990, for example, have endorsed the principle of a change in approach to sector development towards a more flexible and community-based model.

The main objective of this study is to analyze sector development planning and implementation in a comprehensive way, to identify and evaluate the effectiveness of various management approaches, and to evaluate the effectiveness of the current sector conceptual framework regarding appropriateness and sustainability. Effective approaches to sector development management are identified, and guidelines for appropriateness and sustainability are prepared, with the goal of contributing to the theoretical knowledge of sector development management by suggesting an effective and workable strategy for sector planning and implementation.

Dafur and Kordofan Regions in northern Sudan provide an excellent case study location for the analysis of sector

development activities during the IDWSSD. Major ESAs active globally in the sector planned and implemented programs and projects in these regions, and a wide variety of approaches, concepts and technologies were employed. While Sudan is typical of sub-Saharan African countries in many ways, it represents one of the worst-case scenarios for sector development, being the largest country in Africa with virtually non-existent internal infrastructure, being one of the world's poorest nations, and being affected with political instability and internal strife for most of the last 35 years since independence.

A representative sample of five sector programs and projects conducted during the IDWSSD was selected for detailed analysis. The author was active at a senior level in the sector for three years, with access to key sector personnel and documents within the Government of Sudan, multilateral, bilateral and non-government ESAs. Extensive fieldwork included meetings with rural communities who were the recipients of the sector development. This long period of data collection allowed insights into problems and issues, and for extensive data collection and validation, which would not have been possible with short or discontinuous periods.

By means of direct observation, data were collected by interviews with key sector personnel, interviews with community beneficiaries, a comprehensive document and literature search, and by field observation of program and project implementation and outcomes. Comprehensive descriptions of the five programs and projects are presented, detailing the management strategies, conceptual and institutional frameworks, program and project components, constraints and outcomes. Data analysis consists of the use of an evaluation model modified from one initially developed by Cairncross et al (1980), and subsequently utilized by Therkildsen (1988), for the evaluation of sector planning and implementation. The data analysis is at three levels: the evaluation of ESA approaches to planning and implementation;

the evaluation of program and project appropriateness; the evaluation of program and project sustainability. Combined, the evaluations yield results that gauge sector development effectiveness, and identify strategies and concepts that enhance the appropriateness and sustainability of outcomes.

Given that there is general agreement among all players in the sector that while coverage levels must be increased, sustainability must be improved (see for example, UNDP, 1991), the results of this study indicate that:

i) effective management approaches can combine flexibility and adaptiveness, with control and efficiency, to yield optimal outcomes. Participatory planning should be encouraged, but pragmatic limits are necessary in developing planning options. Guided by long term objectives, implementation can commence without detailed pre-planning, if information gained during implementation is used to build upon or modify future plans and activities. While some degree of ESA control during implementation is desirable for reasons of efficiency and economy, management flexibility is required to allow implementation activities to evolve as the project proceeds and experience is gained. Implementation should be institutonalized as early and as much as possible, emphasizing community direction and leadership. The planning and implementation of technological activities involves a different timeframe than that of non-technological activities, and restraint is required to resist the temptation to allow construction of systems to set and control the project pace.

ii) sector development can be made more appropriate primarily by proper consideration of human and environmental resources in the design and management of activities. Specifically:

- water, sanitation and hygiene education activities must be fully-integrated into all sector programs and projects.

- training, especially of women, at the community level is essential. Training encompasses extension, administrative, financial and technical training.
- training of local government sector institutions, especially in planning, management, operations and maintenance is essential.
- local government sector policy should encourage and support community management of completed schemes.
- technology choice should be made on the basis of least-cost and VLOM capabilities.
- installed schemes must be appropriate to prevailing water resource and environmenial conditions in the program or project area.
- environmental impact, assessments, planning for impact mitigation, and environmental enhancement and rehabilitation activities should be integrated into all sector programs and projects.

iii) sector development can be made more sustainable primarily by paying adequate attention to human resource development and operations and maintenance of completed schemes. Specifically:

- sector activities must proceed with collaboration between ESAs and local government institutions, with active cooperation and the establishment of effective linkages between all sector groups.
- training of local government sector institutions should concentrate upon capacity-building and linkage development.
- technology choices made based upon least-cost and VLOM capabilities should emphasize the utilization and improvement of indigenous technology wherever possible.
- training at both the local government sector institution and at the beneficiary community level is essential for effective operation and

maintenance, and should encompass administrative, financial and technical training.

- least-cost technology, full or partial capital cost-recovery, and full recurrent cost-recovery are the financial base for sustainability.

This study makes an important contribution to theoretical knowledge in the field of rural water sector development design and management by first comprehensively analyzing representative examples of sector planning and implementation conducted during the IDWSSD, and then by identifying a more effective and workable management approach and philosophy for sector development. This study is based upon conditions, activities and outcomes in one of the least developed countries of the world, making the results generally applicable to a wide range of Third World situations.

A contribution is also made by this study to the evolution of an appropriate and sustainable sector conceptual framework, by identifying the most important contributing concepts and examining them in detail.

Other researchers have in the past analyzed some parts of sector development management, concentrating upon the design and planning of sector development, or upon the integration of specific components into the sector conceptual and philosophical framework. This study represents the first time that overall sector development management, encompassing planning and implementation, has been comprehensively analyzed, from the viewpoint of identifying an effective and workable management strategy that optimizes appropriateness and sustainability.

ACKNOWLEDGEMENTS

This work is dedicated to that "land ... which lies beyond the rivers of Ethiopia, ... a nation of tall and smooth-skinned people" (Isaiah 18:1,2), with the hope that the future of the children will hold more promise than the lives of the parents.

Without the help of my many friends in Sudan, who labor under the most difficult conditions imaginable, this work would not have been possible. Special thanks are due to Dr. Yagoub Abdullah Mohamed (Director, IES), Sayed Osman Mohamed Taha (Executive Director, NCDRWR) and Dr. Omer Abdel Salam (Head of Energy Section, MFEP) for their interest in and contributions to this study.

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The care and understanding provided by my wife and our children, both in Sudan and in Canada, has enabled me to complete what would otherwise have been an impossible task. The very real risks faced and sacrifices made during these past four years will not be forgotten.

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ACRONYMS

CIDA	Canadian International Development Agency
DANIDA	Danish International Development Agency
DGIS	Directorate General For International Cooperation (the Netherlands)
ESA	External Support Agency
FAI	Italian Fund Aid
GOS	Government of Sudan
IDWSSD	International Drinking Water Supply and Sanitation Decade
IES	Institute of Environmental Studies, University of Khartoum
IIED	International Institute of Environment and Development
KfW	Reconstruction Loan Corporation, Federal Republic of Germany
MFEP	Ministry of Finance and Economic Planning (Government of Sudan)
MOH	Ministry of Health (Government of Sudan)
MOSW	Ministry of Social Welfare (Government of Sudan)
NCDRWR	National Corporation For the Development of Rural Water Resources
NGO	Non-Government Organization
RWSG/EA	Regional Water and Sanitation Group/East Africa (UNDP/World Bank)
SCLURWPA	Soil Conservation, Land Use, and Rural Water Programming Administration
UNDP	United Nations Development Program
UNICEF	United Nations Children's Fund
UNHCR	United Nations High Commissioner For Refugees
USAID	United States Agency For International Development
VLOM	Village Level Operation and Maintenance
WADS	Water Resources Assessment and Development

	Programme in the Sudan
WASH	Water and Sanitation For Health Project
WCED	World Commission on Environment and Development
WHO	World Health Organization
WRI	World Resources Institute
WUSC	World University Service of Canada

1. Overview of the Rural Water Sector

International development, largely planned and implemented by multilateral and bilateral ESAs, has been conducted systematically in the Third World since the 1950s. Following the models of the Marshall and Colombo Plans for the redevelopment of Germany and Japan, international development in the Third World has relied largely upon comprehensive physical planning and technologically-based implementation. Programs and projects are the primary vehicle for the delivery of international development. It is widely recognized that there have been serious problems with the delivery of development, and that outcomes of programs and projects are often sub-optimal.

The rural water sector of international development is the sector where activities are concentrated upon the provision of safe water supplies and adequate sanitation facilities for the rural population of the developing world. The global rural population, estimated to be approximately 2.7 billion people in 1990 (WHO, 1991 (a)), are primarily subsistence cultivators and livestock herders, living in villages year-round, or migrating seasonally or year-round. Rural people represent some 67% of the total population of the developing world, and in general are the poorest and least educated members of society.

1.1 Global Situation

Rural water sector development activities were initiated by European governments in their colonial possessions, and by religious missionaries in their areas of activity. The United States of America formed the first external support agency (ESA) for sector development in 1940, to protect the health of local populations in Central and Latin America (Grover and Howarth, 1991). The World Health Organization (WHO) was created as a United Nations agency in 1948, to provide technical assistance and training of sector personnel, and to

be a continuous advocate for health improvements in the developing world through the provision of safe water supplies and adequate sanitation facilities.

In 1970, WHO made a global assessment of rural water supply conditions (WHO, 1972), indicating that (excluding China) only 12% of the rural population in 90 developing countries had adequate access to safe water supplies. By 1980, WHO estimated that of a global rural population of approximately 2.3 billion people, only 690 million (30%) had access to safe water supplies (WHO, 1991 (a)). Sanitation coverage was slightly better at 37% (860 million rural people with access to adequate facilities). Table 1 indicates the global distribution of water and sanitation coverage in 1980. It should be noted that the 1980 global coverage levels tend to over-represent the true picture, due to a large number of installations present in China (WHO, 1991, (b)).

WHO estimate that 80 percent of illnesses in the developing world stem from a lack of safe water and adequate sanitation (UNDP, 1989(b)). Water-related diseases are normally classified into three main categories: water-borne; water-washed; water vector-borne. UNDP estimates for 1989 indicate that annual deaths in the developing world from water-borne diseases were nearly 5 million, of which diarrhoea claimed the lives of approximately 4.3 million (primarily children under age 5). Water-washed and water vector-borne diseases caused an additional 2 million deaths in 1989, primarily from malaria (75%). Schistosomiasis, Onchocerciasis and Dracunculiasis are estimated to affect some 225 million people in the developing world (WHO, 1991(b). UNDP, 1989(b)), representing a huge loss of productive capacity of the population due to these debilitating diseases. In the early 1970s, WHO estimated, although reliable statistics were not available, that diarrhoea directly killed at least 6 million children annually, and that parasitic worms infected nearly 50% of the developing world population (WHO, 1991(b)).

Table 1 Global Rural Water and Sanitation Coverage (1980).

Region	Coverage (%)	Population Covered (millions)
Africa: Water	33	109.83
Sanitation	18	59.91
Central/Latin America:		
Water	47	58.71
Sanitation	22	27.48
Asia/Oceania: Water	28	510.52
Sanitation	42	765.79
Western Asia/Middle:		
Water	51	11.19
Sanitation	34	7.46
Global: Water	30	690.25
Sanitation	37	860.64

Source: WHO, 1991; UNDP, 1990.

During the First and Second United Nations Development Program (UNDP) Development Decades of the 1960s and 1970s, it became evident that general development programs could not adequately meet the challenges posed by the health needs of the developing world. The 1976 United Nations conference on human settlements in Vancouver (HABITAT) and the 1977 conference on water resources in Mar del Plata both called for a global effort to achieve full water supply and sanitation coverage by 1990 (Grover and Howarth, 1991). Concurrently, the World Health Assembly were calling upon developing country governments to set their main social targets as being an adequate level of health for their populations by the year 2000 (WHO, 1991(b)). The 1978 conference on primary health care at Alma Ata identified primary sanitation as the key to health for all.

The United Nations General Assembly formally launched the International Drinking Water Supply and Sanitation Decade (IDWSSD) in November 1980. The primary goal of the IDWSSD for the 1981 to 1990 period was apparently to achieve full access to safe water supplies and adequate sanitation facilities for all inhabitants in the developing world. At the end of the IDWSSD it is clear that the primary goal had not been attained. While more than one billion rural people were provided with safe water supplies during the IDWSSD, and 450 million rural people received adequate sanitation facilities for the first time, there remained nearly one billion rural people without water service and nearly 1.4 billion without sanitation by 1990 (WHO, 1991(b)). Table 2 indicates the global distribution of rural water and sanitation coverage in 1990.

While significant gains in coverage have been made during the IDWSSD in Asia and Oceania (specifically China), and moderate gains made in Central and Latin America, very little improvement is evident in Africa or in West Asia and the Middle East. Gains in rural water coverage in all cases

Table 2 Global Rural Water and Sanitation Coverage (1990).

Region	Coverage (%)	Population Covered (millions)	Population Not Served (millions)
Africa:			
Water	42	172.06	237.59
Sanitation	26	106.51	303.13
Central/Latin America:			
Water	62	76.80	47.07
Sanitation	37	45.83	78.04
Asia/Oceania:			
Water	67	1406.60	692.80
Sanitation	54	1133.68	965.72
West Asia/Middle East:			
Water	56	14.34	11.26
Sanitation	34	8.70	16.90
Global:			
Water	63	1669.80	988.72
Sanitation	49	1294.72	1363.79

Source: WHO, 1991; UNDP, 1990.

significantly exceed gains in sanitation coverage. The 1990 developing world rural population of approximately 2.7 billion (WHO, 1991(b)) is projected to expand to nearly 3 billion by the year 2000 (UNICEF, 1991). This population increase, combined with the population not served at the end of the IDWSSD, will result in the need to provide 1.3 billion rural people with water and nearly 1.7 billion rural people with sanitation, if full coverage is to be attained by the year 2000. Based upon conservative per capita costs of $30 U.S. (water service) and $20 U.S. (sanitation), the United Nations Children's Fund (UNICEF, 1991) estimate the cost of providing full rural coverage by the year 2000 to be approximately $73 billion U.S. UNDP (1991) estimate that approximately $500 billion U.S. is required for full rural and urban coverage by the year 2000. Sector (urban and rural) financing during the IDWSSD totalled approximately $117 billion U.S. (McGarry, 1991): an increase in sector financing by nearly 500% in the 1991 to 2000 decade is not likely.

1.2 Sub-Saharan Africa Situation

Coverage

Prior to the IDWSSD, rural water coverage in Sub-Saharan Africa averaged 26% (see Table 3). Comparable figures for sanitation coverage are not available, but in 1980 WHO estimated rural water and sanitation coverage for the whole continent to be 33% and 18% respectively. While low, these coverage levels were comparable to rural water coverage levels in Asia, and to rural sanitation coverage levels in Central and Latin America. Currently (WHO, 1991(a)), coverage levels in Africa for rural water (42%) and rural sanitation (26%) are the lowest for any region in the developing world. There is every reason to believe that in Sub-Saharan Africa, coverage levels are even lower than continental averages given by WHO, and are probably in the range of 30% for rural water and 25% for rural sanitation. Effective coverage is further reduced,

by 50% or more in some cases, by inoperative or failed systems (Mohamed, 1989(a)).

Some countries in Sub-Saharan Africa have made gains in rural water coverage in the last 10 or more years, such as Cote d'Ivoire, Lesotho and possibly Botswana. Other countries report relatively high levels of rural sanitation coverage at present, including Malawi, Rwanda and Tanzania.
Unfortunately, it is evident that rural water coverage levels have actually declined in some countries (such as Sudan, Uganda and Zambia), and have remained relatively static in most other countries since 1975. Rural sanitation coverage is apparently low, except as noted above.

Population Growth

A major reason for the poor performance of the rural water sector in sub-Saharan Africa is population growth. Population growth rates in Africa ranged from 2.63%/year in 1965 to 1970 to 3.00%/year in 1985 to 1990 (WRI, 1990), compared to growth rates in the range of 2.06% to 1.73%/year globally for the same time periods. Both Cote d'Ivoire and Kenya have population growth rates currently exceeding 4%/year. The total population of Africa in 1950 was approximately 224 million: by 1990 the population had increased to 648 million, and is projected to reach 1.58 billion by the year 2025 (WRI, 1990). In 1950, Africans constituted about 9% of the world's population. By 2025, Africans will constitute nearly 19% of global population and about 22% of the developing world population: more than any other region or continent except Southern Asia.

Demographic and health indicators shown in Table 4 reveal that Africa has the highest crude birth rate of any region, but by far the highest death rates too, resulting in low life expectancies at birth for Africa's population. Water-related diseases are the primary cause of death in Africa (UNDP, 1989(b)), a result of the lack of safe water supplies and

Table 3 **Rural Water and Sanitation Situation, Selected Sub-Saharan African Countries**

Country	1989 Population (millions) (a)	Water % coverage 1975 (b)	Water % coverage (Year) (c)	Sanitation % coverage (Year) (c)
Cote d'Ivoire	11.1	19	40 (1989)	10 (1989)
Ghana	13.6	35	39 (1985)	16 (1985)
Guinea	6.5	10	12 (1985)	N/A
Mali	7.8	9	10 (1985)	3 (1985)
Nigeria	106.6	N/A	20 (1985)	N/A
Zaire	32.6	16	21 (1985)	9 (1985)
Botswana	1.1	N/A	46 (1985)	28 (1985)
Ethiopia	44.8	6	10 (1989)	2 (1989)
Kenya	22.1	17	20 (1989)	20 (1989)
Lesotho	1.6	17	30 (1985)	14 (1985)
Malawi	8.0	33	40 (1989)	50 (1989)
Rwanda	6.4	35	48 (1985)	55 (1985)
Sudan	23.1	46	30 (1989)	15 (1989)
Tanzania	23.9	39	46 (1988)	70 (1988)
Uganda	15.7	35	20 (1989)	25 (1989)
Zambia	7.2	42	41 (1985)	34 (1985)
Zimbabwe	9.0	N/A	40 (1989)	25 (1989)
Average	N/A	26(d)	42 (1990) (e) 30 (f)	26 (1990) (e) 25 (f)

Sources:
(a) 1989 populations from World Bank, 1990(a).
(b) 1975 water coverage from World Bank, 1982.
(c) 1985 coverage from WHO, 1988/89 coverage from World Bank. All data contained in World Bank, 1990(a).
(d) average of countries listed.
(e) 1990 water and sanitation coverage from WHO, 1991(a).
(f) average of countries listed.

Table 4 Selected Demographic and Health Statistics

Region	Population (millions) 1990	Population (millions) 2025	1985 to 1990 Crude Birth Rate (per 1000)	1985 to 1990 Crude Death Rate (per 1000)	1985 to 1990 Life Expectancy at Birth (years)	1985 to 1990 Infant Death Rate (per (1000)	1985 to 1990 Child Death Rate* (per 1000)
Africa	647.5	1581.0	44.7	15	51.9	106	163
North & Central America	427.2	594.9	20.1	9	72.6	29	34
Latin America	296.8	498.4	28.8	8	65.5	58	78
Asia	3108.5	4889.5	27.6	9	61.1	73	108
Europe	497.7	512.3	13.0	11	74.0	13	15
USSR	288.0	351.5	18.4	11	72.1	24	27
Oceania	26.5	39.0	20.1	9	69.1	26	33
Global	5292.2	8466.5	27.1	10	61.5	71	105

Source: WRI, 1990.

* age <5 years

inadequate sanitation. The provision of improved rural water supplies has little beneficial impact upon health without concurrent improvement in sanitation facilities, and most importantly, effective hygiene education (Cairncross, 1990). Low levels of primary and preventive health care in Africa are also a major contributor to the population's poor health. Sudan for example has a population comparable in size to Canada's, but in 1990 had just over 2,000 physicians and about 13,000 trained nurses and midwives to serve them, compared to more than 48,000 physicians and 85,000 nurses and midwives in Canada (WRI, 1990).

Economic Decline

Another reason for the poor performance of the rural water sector in Sub-Saharan Africa is economic. Financing for the sector declined mid-way through the IDWSSD. This has been explained as being the result of generally lower rates of economic growth during the mid to late 1980s period (McGarry, 1991). Also, it has been noted by Grover and Howarth (1991) that "systemic inefficiencies" in sector investments, caused primarily by lack of collaboration between ESAs, have resulted in large numbers of people not receiving water and sanitation service.

In 1989, 325 million people in Sub-Saharan Africa lived in absolute poverty, 62 percent of the region's population (Worldwatch, 1990).

Without a doubt, aid flows to the developing world remained static or declined during the 1980s. Bilateral aid and development loans in 1990 totalled approximately $70 billion U.S. (Worldwatch, 1991), while capital flows from the developing world mostly in the form of debt principal and interest repayments was nearly $162 billion U.S.: a net capital drain of over $90 billion U.S. Despite loan forgiveness to sub-Saharan Africa in excess of $5 billion U.S. to date (Worldwatch, 1991), sub-Saharan Africa's external debt exceeds $125 billion U.S., increased from $28 billion U.S. in

1977 (WRI, 1990). This is approximately equal to the region's gross national product (GNP). Some countries within sub-Saharan Africa have crippling debt loads: Sudan, where debt equals 140% of GNP; Zaire, where debt equals 175% of GNP.

Economic performance in sub-Saharan Africa has declined during the 1980s. During the 1977 to 1987 period, GNP per capita growth did not exceed population growth rates in the least developed sub-Saharan African countries (WRI, 1990). In some countries, GNP contracted by up to 5.7 percent per year (Mozambique) during the decade. GNP per capita in 1987 ranged from $1,059 U.S. (Botswana) to $126 U.S. (Ethiopia) (WRI, 1990). While in other developing regions exports grew modestly during the 1980s, exports from African countries during the period stagnated or declined (World Bank, 1989(a)). In most sub-Saharan African countries, fuel and manufacture imports exceeded total exports by factors of 10 or more (WRI, 1990). Agriculture, both traditional and mechanized, contributes more to the sub-Saharan African economy than any other activity. Grain production per capita, peaking at 169 kg/person in 1967 has steadily declined and was 121 kg/person in 1990 (Worldwatch, 1991). As environmental degradation continues unchecked in most parts of the region, it is apparent that in the immediate future grain production per capita will continue to decline (Harrison, 1987).

Environmental Degradation

Rural water development activities frequently have contributed to environmental degradation, particularly increased desertification. It is essential that environmental considerations be incorporated into sector development planning and implementation, since increasing environmental degradation severely impacts the viability of life in many areas of the developing world.

Environmental degradation in sub-Saharan Africa is continuing at an alarming rate. The United States Department of Agriculture (1989) estimate that 17 percent of agricultural

land in Africa is severely degraded (more than 50 percent yield reduction), and an additional 23 percent is moderately degraded (10 to 50 percent yield reduction). It is estimated that since the 1920s, more than 650,000 km² of land in the Sahelian zone of Africa has been completely desertified (UNEP, 1977).

Concurrently, livestock populations have increased, with cattle numbers increasing 11 percent, sheep and goats 15 percent, and buffaloes and camels 16 percent in the last decade. The current population of these animals in sub-Saharan Africa is approximately 500 million head (WRI, 1990). Ethiopia and Sudan have the largest cattle populations in sub-Saharan Africa (30 million and 22 million head respectively) and Ethiopia, Nigeria, Somalia and Sudan each have in excess of 30 million head of sheep and goats.

During the 1980s, more than 1.3 million ha of closed forest and more than 2.4 million ha of open (savanna) forest were being destroyed annually (WRI, 1990) with only marginal reforestation efforts. Much of the wood was used as fuel for cooking in sub-Saharan Africa. Ethiopia for example, once 40 percent forested now has approximately 3 percent forest cover (Mungall, 1990). Apparent increased frequencies and severities of droughts have compounded the problems of environmental degradation (Glantz and Wigley, 1987; Dregne, 1987; Glantz and Katz, 1987; Mensching, 1986; Ibrahim, 1984). Climate is affected: rainfall amounts are reduced and rainfall variability is increased by the higher albedo of desertified land areas, by the reduced evapotranspiration and the increased atmospheric dust.

The World Commission on Environment and Development commented upon the interconnections between population growth, declining economic growth and environmental degradation in their report, Our Common Future (WCED, 1987). Certainly within sub-Saharan Africa, these interconnections are a tangled web that have led to stagnation and a deteriorating

quality of life for the majority of the region's population. Improving the appropriateness and sustainability of development activities in the rural water sector, together with increasing the level of such activities, would make a substantive contribution to improving the population's quality of life and economic well-being.

1.3 Multilateral ESAs

External Support Agencies (ESAs) in the rural water sector can be classified as being multilateral, bilateral or non-government organizations.

Multilateral ESAs are principally agencies within the United Nations System, formed as either United Nations Organizations (eg: UNDP, UNICEF, UNHCR), or as specialized agencies or autonomous organizations (eg: The World Bank, WHO, IFAD). Most multilateral ESAs within the United Nations system fall under the Economic and Social Council of the General Assembly (Kindred et al, 1987). Some multilateral ESAs are relatively active in the rural water sector, and the provision of safe water supplies and adequate sanitation facilities forms a major part of their activities. Other multilateral ESAs are involved in the rural water sector more peripherally.

The major multilateral ESA in the rural water sector is the World Bank, which consists of the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA). The IBRD was formed in 1945 following the United Nations Monetary and Financial Conference held in Bretton Woods, New Hampshire. The International Monetary Fund (IMF) was established at the same time. While the goal of the IMF was to promote international currency stability, the role of the IBRD was to help finance reconstruction and development in its member countries (World Bank, 1987). The IBRD is currently owned by the governments of more than 150 countries who have subscribed capital. Only

members of the IMF are eligible for membership in the IBRD, and the size of capital stock holdings in the IBRD is related to each member country's relative economic strength. The IDA was established in 1960, with the role of providing financial assistance to the poorest developing countries on easier terms. The IBRD and the IDA share the same management and staff, and IDA-assisted projects have to meet the same criteria as IBRD-assisted projects.

The World Bank's first water sector loan was made in 1961 (Grover and Howarth, 1991). In 1987, total World Bank funding to all sectors was approximately $17.7 billion U.S., of which $14.2 billion U.S. was through IBRD and $3.5 billion U.S. was through IDA. Average World Bank lending to the urban and rural water sectors during the latter part of the IDWSSD was 5 percent of total lending (approximately $785 million U.S. per year). Sub-Saharan Africa received approximately 12 percent of total lending during the mid to late 1980s (World Bank, 1987).

Although the primary goals of the World Bank are to promote foreign investment and promote long-term balanced growth in international trade (Jaycox, 1988), the provision of technical assistance is a significant World Bank activity. A technical assistance program in low cost water supply and sanitation was established in 1978, initially to conduct research, development and information dissemination on appropriate technology. The program currently exists as the UNDP-World Bank Water and Sanitation Program, with emphasis on human resources development and service delivery systems. The Program operates five Regional Water and Sanitation Groups (RWSGs) in Latin America, East and South Asia, East and West Africa, employing some 50 sector professionals world-wide. The Program is active in 40 developing countries and has the operational objective "to achieve increased and sustained coverage of the poor with water, sanitation and waste disposal services" (UNDP/World Bank, 1990(a), page 2).

Funding for the UNDP-World Bank Water and Sanitation Program has been provided by the UNDP (69 percent) and bilaterally (28 percent), with the remainder originating from some developing countries themselves. Program disbursements in 1989 totalled $9.1 million U.S. approximately. Projects in the rural water sector undertaken by the Program typically include water and sanitation scheme construction, institutional strengthening and human resource development projects, and sector policy formulation and strengthening projects (UNDP/World Bank, 1990(a)). Major bilateral supporters of the Program during the IDWSSD have been Norway, Switzerland, Canada, the Netherlands, and the Federal Republic of Germany.

The United Nations Development Program (UNDP) is the central funding and coordinating agency for the United Nations development system, and works with more than 30 separate executing agencies, 11 participating organizations and administers more than 5,900 on-going development projects. Fourth Cycle (1987 to 1991) allocations to developing countries will total nearly $3.7 billion U.S., of which some $1.2 billion U.S. (32 percent) is for sub-Saharan Africa. In 1988, UNDP project expenditures totalled $810 million U.S., of which 4 percent ($33.2 million U.S.) was directed to the health sector, which includes rural water and sanitation (UNDP, 1989). An allocation of some $6.9 million U.S. was utilized by the UNDP-World Bank Water and Sanitation Program in 1989 (UNDP/World Bank, 1990(a)). In addition, UNDP-directed sector projects in water, sanitation and hygiene education are undertaken. A special program PROWWESS (Promotion of the Role of Women in Water and Environmental Sanitation Services) is UNDP financed and managed.

Major contributors to the UNDP in 1988 included the United States (9.3 percent), Sweden (8.6 percent), the Netherlands (8.0 percent), Norway (7.4 percent) and Japan (7.3 percent). Total contributions in that year were approximately

$1.24 billion U.S. (UNDP, 1989(b)).

The World Health Organization (WHO) was created in 1948 as a United Nations agency, and has continuously emphasized safe water supplies and adequate sanitation facilities as being essential for good health. By collecting data on water supply, sanitation and health conditions in developing countries from the 1960s onwards, WHO advocated more attention be paid by ESAs to the urban and rural water sectors. This advocacy was instrumental in the United Nations General Assembly declaring 1981 to 1990 the IDWSSD (Grover and Howarth, 1991. WHO, 1991(b)). WHO played a leading role in monitoring and documenting sector activities during the IDWSSD, and operate the Country External Support Information System (CESI) to serve as an information exchange between ESAs and developing country governments. WHO's major current interests are in human resources development as it relates to environmental health and to water system operation and maintenance (WHO, 1989, 1990). Although it neither funds nor implements sector projects directly, WHO provides a strong technical assistance role and has a staff of some 80 sanitary engineers primarily in the field. In Geneva headquarters is based the Community Water Supply and Sanitation Group.

The United Nations Children's Fund (UNICEF) has the operational objective of enhancing child survival and development, and views control of diarrheal disease through primary health care and the provision of safe water supplies and adequate sanitation facilities as a major means of achieving this objective. UNICEF's annual contribution to the urban and rural water sectors is approximately $70 million U.S. which represents about 10 percent of the agency's annual budget (UNICEF, 1990(a)). UNICEF is active currently in about 80 developing countries, concentrated in sub-Saharan Africa, and has nearly 150 professional staff dedicated to the water sectors. UNICEF's main emphasis in the rural water sector has been the drilling of boreholes and installation of India Mark

2 handpumps, and UNICEF has developed recognized expertise in this technology (Grover and Howarth, 1991).

International development banks in addition to the World Bank have provided funding to the rural water sector, and include the Inter-American Development Bank, the Asian Development Bank, the African Development Bank, and regional banks and funds in the Caribbean and Middle East. Other United Nations organs, organizations and agencies involved to some significant extent in the rural water sector include the United Nations High Commissioner for Refugees (UNHCR) who provide water and sanitation services for refugees in rural areas, and the International Fund for Agricultural Development (IFAD) who implement rural water projects related to livestock production, soil conservation and crop cultivation.

1.4 Bilateral ESAs

Bilateral ESAs usually take the form of either specialized agencies of developed country governments (eg: Canadian International Development Agency (CIDA); or as divisions of developed country government line ministries (eg: Directorate General for International Cooperation (DGIS), the Netherlands Ministry of Foreign Affairs. Tables 5 and 6 show the relative development aid contributions for major bilateral ESAs.

Total development aid in 1990 was estimated to be approximately $70 billion U.S. (grants plus loans) (Worldwatch, 1991). Funding to the urban and rural water sectors the same year was approximately $3 billion U.S. (McGarry, 1991), which represents about 4 percent of all development aid. Bilateral aid to the water sectors range from 3 to 15 percent of bilateral development aid, with the Scandinavian countries and Germany usually supporting the water sectors more strongly than other bilateral ESAs (DANIDA, 1988(a)).

Bilateral ESAs also balance their development aid between

Table 5 **Development Aid 1985 to 1987: Major Bilateral ESAs**

Country	Annual Average (millions U.S. Dollars)	Percent of GNP	1987 per capita contribution (U.S. Dollars)
Canada	1,737	0.5	73
United States	9,304	0.2	37
Japan	5,628	0.3	61
Saudi Arabia	2,990	N/A	230
Austria	214	0.2	26
Belgium	559	0.5	70
Denmark	665	0.9	168
Finland	319	0.5	88
France	5,208	0.7	117
F.R. Germany	3,722	0.4	72
Italy	2,039	0.3	46
Netherlands	1,657	1.0	143
Norway	754	1.1	213
Sweden	1,102	0.9	165
Switzerland	424	0.3	84
U.K.	1,711	0.3	33
USSR	3,804	N/A	15
Australia	709	0.4	39
Global	42,546	0.5	93

Source: World Resources Institute, 1991.

Table 6 **Development Aid 1990: Selected Major Bilateral ESAs**

Country	1990 Aid (millions U.S. Dollars)	percent of GNP
Canada	2,320	0.44
United States	7,660	0.15
Japan	8,950	0.32
France	7,450	0.78
Germany	4,950	0.41
Netherlands	2,090	0.94
Norway	920	1.04
Italy	3,610	0.42
UK	2,590	0.31
Australia	1,020	0.38
Total	41,560	0.52

Source: Worldwatch Institute, 1991.

multilateral and bilateral channels. CIDA for example distributed their development aid 42 percent multilaterally in 1987/1988 (CIDA, 1987(b)); DANIDA 43 percent multilaterally in 1987 (DANIDA, 1988(a)). Bilateral aid channelled bilaterally is often focused on selected countries of choice. CIDA for example has directed approximately 60 percent of its water sector aid to seven developing countries (CIDA, 1987(b)), with Ghana and Tanzania in sub-Saharan Africa being the major beneficiaries. Scandinavian ESAs have a marked preference for water and sanitation development in Tanzania (Therkildsen, 1988).

1.5 Non-government ESAs

International non-government ESAs are private, primarily voluntary organizations that specialize in implementing relief and/or development projects in the developing world. These agencies are sometimes contracted to implement all or part of bilaterally or multilaterally planned and funded sector projects. The comparative advantages of non-government ESAs include their innovative and flexible operational approaches, their ability to work closely with beneficiary communities, and their relative independence from national governments (World Bank, 1985). Also, many non-government ESAs have developed considerable expertise in areas such as training, promotion of appropriate technologies, and community organization (Leger, 1990; Durning, 1989). Some non-government ESAs have considerable domestic fund-raising capabilities, particularly religious-based agencies, and are able to plan and implement sector projects relatively independently.

While non-government ESAs tend to be fragmented along lines of special interest or special audience (WCED, 1987), there is a trend towards more coordination and cooperation between agencies (Richardson, 1989). Linkages with international and indigenous non-government organizations

(NGOs) are being developed. Most multilateral and bilateral ESAs are actively seeking greater collaboration with international non-government ESAs (CIDA, 1987(b); 1988(b); UNDP/World Bank, 1990(a); UNDP, 1989(b)).

1.6 Objectives of This Study

It is the purpose of this analysis to evaluate the approaches to planning and implementation used by ESAs during the IDWSSD; to supplement this evaluation with evaluations of their program's appropriateness and sustainability; to identify alternative strategies and approaches to program planning and implementation that can contribute to the development of an appropriate and sustainable sector philosophical framework.

The main theme of this study is, by detailed evaluation of completed programs and projects, to improve the management of sector implementation, and therefore to improve the quality of future sector efforts.

The overall goal of the analysis is to contribute to development research in the rural water sector by analyzing and evaluating ESA approaches in planning and implementing programs and projects, using Sudan as a representative case study of a least-developed African country.

The specific objectives of the analysis are:

1. To evaluate the approaches used by ESAs in planning and implementing sector programs and projects in Sudan during the IDWSSD.
2. To evaluate the appropriateness of the ESA programs and projects.
3. To evaluate the sustainability of the ESA programs and projects.
4. To outline an alternative strategy and approach to rural water sector program and project planning and implementation.
5. To evaluate Government of Sudan (GOS) contributions and

abilities to effectively contribute to and manage these projects in long terms.

During the last 50 years of systematic sector development, a large number of ESAs have expended vast sums of money to plan and implement water and sanitation programs in the Third World. Despite this, and despite unprecedented attention focussed upon the sector during the 1981 to 1990 IDWSSD, rural water and sanitation coverage levels in the Third World remain low. The problem is particularly acute in sub-Saharan Africa, where coverage levels are the lowest in the world.

2. Sector Development Context

Rural water development is one important sector of international development. Recognizing that general development programs could not meet the health needs of the Third World, and that most illness and many deaths were the direct result of inadequate water and sanitation facilities, an IDWSSD was declared for 1981 to 1990. Unprecedented attention was focussed upon the sector during the decade, and ESAs experimented with a wide variety of approaches, technologies, and conceptual and institutional frameworks. By most accounts, the decade was a failure however, not only failing to meet coverage objectives, but resulting in the construction of many ineffective and non-sustainable water systems.

The purpose of this study is to contribute to the theoretical body of knowledge in rural water development management. The objectives of this study are to analyze the various approaches used by ESAs in planning and implementing sector programs and projects; to determine the appropriateness and sustainability of the conceptual frameworks used by ESAs in formulating and delivering programs and projects; and to evaluate the overall effectiveness of the ESA's sector efforts in Sudan during the IDWSSD.

The effectiveness of the various management approaches followed by ESAs in the rural water sector is probably similar in other development sectors. Lessons learned from this analysis may be applicable in the broader development context.

Future development activities in the rural water sector must address a number of main issues, and be cognizant of several major constraints, if these activities are to be more appropriate and sustainable than those of the past. Considerable progress has been made, particularly during the IDWSSD, in identifying an adequate conceptual framework for sector activities. Little progress has been made however in adopting an appropriate and sustainable philosophical

framework for sector development. Emphasis remains upon getting all the "right" components into a sector program, rather than upon approaching the planning and implementation of the program in the "right" way.

2.1 Summary of IDWSSD Activities

The IDWSSD (1981 to 1990) did not achieve its primary goal of providing full access to safe water supplies and adequate sanitation facilities for all inhabitants in the developing world. As of 1990, WHO estimates some one billion rural people lack safe water and 1.4 billion lack adequate sanitation facilities. Coverage levels in 1990 for rural water were 63 percent, and 49% for rural sanitation (WHO, 1991(a)). In Africa, the coverage levels are 42 and 26 percent respectively, indicating that water service in 1990 had not reached some 240 million rural people, and that over 300 million rural people had not received sanitation (see Table 2). Provision of water and sanitation services barely kept pace with population growth in Africa.

Numerous individuals and organizations (for example, see UNDP, 1991 and IWRA, 1991) have analyzed their activities, and the activities of others, during the IDWSSD. These analyses have revealed that essentially a two-track approach to the IDWSSD was followed: a hardware-based approach and a software-based approach.

Water supply and sanitation development has traditionally been within the domain of engineering and technical personnel, viewed primarily as a public works or construction activity (Sewell, 1971. WHO, 1991(b)). Given the large number of rural systems needed at the outset of the IDWSSD, it is not surprising that the overwhelming emphasis was upon increasing coverage levels. Engineering considerations such as technical design, equipment selection, and construction scheduling were uppermost, with developing country public works agencies cooperating with technically-dominated ESAs. Vast amounts of

time and effort were expended upon refining equipment design and construction techniques, with the World Bank leading the way in handpump, water treatment and excreta disposal research and development (World Bank, 1981, 1984(a,b), etc.). Incomplete understanding of the complex linkages between the provision of water and improvements in health resulted in their typical exclusion from project design and planning (WHO, 1991(b)).

The software-based approach emphasised a central role for the community in sector development: emphasising the role of women in the community since they are the primary drawers and users of domestic water; expanding hygiene education to promote the health benefits of new water and sanitation services; encouraging community operation and maintenance of completed services to enhance sustainability.

Gradually during the IDWSSD, sector activities began to move away from a hardware-based to a software-based approach. Some observers (McGarry, 1991) feel that this perceptive shift occurred early in the IDWSSD with the widespread realization among ESAs that community participation was needed in development activities. Others (Grover and Howarth, 1991) feel that increased collaboration and sharing of information during the IDWSSD led to the shift towards a software-based approach. A more realistic view is that with IDWSSD funding constrained significantly, such that it was apparent quite early on that the primary goal of full coverage could not be met, ESAs and developing country governments sought to reduce unit coverage costs by obtaining contributions from the communities served.

For whatever reasons, there was a noticeable shift in approach during the IDWSSD from hardware to software-based. In pre-IDWSSD times, the term community development was synonymous with "cash or labour contribution": during the IDWSSD, community participation was emphasised and became local involvement in the development activity. With the

current need to enhance the sustainability of completed systems, the emphasis is now upon community management. McGarry (1991), Kalbermatten (1991) and others feel that the shift has been from a provision approach towards a promotion approach to rural water and sanitation development.

Specific achievements of the IDWSSD rather than being quantitative, tend to be qualitative and perceptual. Most ESAs agree that about ten major lessons were learned from IDWSSD activities, which were summarized by Margaret Catley-Carlson, president of the Canadian International Development Agency (CIDA), in her 1988 keynote address to the Sixth World Congress on Water Resources, Ottawa (CIDA, 1988(a)). She indicated that sector programs should be community-based and actively involve the beneficiaries, especially in operation and maintenance; emphasis should be upon helping the rural poor, where the need for improvements in health are greatest; implementation can often best be achieved by involving local non-government and private groups; regional and international cooperation in sector activities should be promoted water resources supply and management research should be expanded; women's involvement in sector activities is vital; project and program planning is a crucial component of sector activities; technology utilized should be affordable and appropriate; environmental concerns should be central to all sector programs; and human resources development through training and institutional strengthening is essential to enhance sustainability.

Most policy documents and position papers prepared by bilateral and multilateral ESAs in the last few years endorse these concepts (For example: DGIS, 1989(a); DANIDA, 1988(a); CIDA, 1988(b)). While progress was made towards adoption of these concepts into sector development during the latter part of the IDWSSD, it was at best haphazard and inconsistent (UNICEF, 1991). The concepts are largely viewed as components to be incorporated into program planning and implementation to

improve success, rather like ingredients in a recipe. The overall philosophical and psychological approach to sector development and management changed little during the IDWSSD.

There is an urgent need to evaluate completed programs and projects, and to examine the need for changes in management approaches in light of the lessons learned from these evaluations.

2.2 Current Status

At the end of the IDWSSD the current status of the rural water sector can conveniently be summarized by a number of general observations:

(1) coverage achieved during the IDWSSD was impressive and unprecedented. However, vast and ever-increasing numbers of poor rural people in the developing world remain without access to safe water supplies and adequate sanitation facilities.

(2) sustainability of systems completed during the IDWSSD (and before) is very poor, with nearly half of the completed systems not functioning.

(3) recognizing the above two facts, sector ESAs individually and through recently created formal collaborative mechanisms have called for more sector funding, lower service costs and levels for the rural poor, and improved sustainability of sector activities.

(4) with significantly increased sector funding unlikely in the current global economic climate, financial emphasis is tending to be "some for all" as opposed to presumably "all for some" (UNDP, 1991). With considerable caution and numerous qualifications, most ESAs are indicating that full rural coverage by the year 2000 may be within their grasp (for example, UNICEF, 1991; UNDP, 1991).

(5) the problem of lack of sustainability has been addressed supposedly by the development of and agreement upon a conceptual framework for sector programming. These 10 or

so key principles for future sector activity are assumed to virtually guarantee sustainable water supplies and sanitation facilities.

(6) little progress has been made in the development of an appropriate sector philosophical and management framework, within which planning and implementation of sector programs should be conducted. Despite some vague mention of the need for "new approaches to program formulation" (Andersson, 1990), the approaches used by ESAs in planning and implementing sector programs remains one of the main obstacles to sustainability.

2.3 Main Issues and Constraints

With the IDWSSD recently concluding, the United Nations General Assembly is "Deeply concerned that, notwithstanding the achievements attained during the [IDWSSD] the current rate of progress remains slow, owing to the economic problems facing developing countries, and would leave a very significant number of poor people in urban and rural areas without suitable services in water and sanitation by the year 2000," (United Nations General Assembly Resolution: A/RES/45/181).

The main issue identified by the General Assembly then is to increase coverage levels, the same main issue present at the beginning of the IDWSSD. Increasing coverage levels implies substantially increasing funding to the sector, and the General Assembly urges governments "to assign greater priority to the allocation of development financing to water supply and sanitation" and "to mobilize additional funds from existing and new sources" (United Nations General Assembly Resolution: A/RES/45/181). The General Assembly recognizes that national efforts and international cooperation must be intensified to achieve full coverage by the year 2000.

The UNDP sponsored New Delhi Global Consultation (September, 1990) of donor and national governments identified

four main sector issues for future development, subsequently endorsed by the General Assembly:

1. To protect the environment and safeguard health by integrating water, sanitation and solid waste management.
2. To achieve reforms in sector institutions to promote an integrated approach and to enhance the full participation of women.
3. To strive for community management of services, with strengthening of local institutions.
4. To manage financial resources in the sector more soundly, and to promote low-cost technology.

(UNDP, 1991).

The UNDP/World Bank Water and Sanitation Program in their Annual Report 1989-90 state that "solutions to hardware design [problems] are essential, but long-term success requires a greater regard for the numerous non-technological aspects of providing water and sanitation services" (page 7). The report identifies five main issues for the decade of the 1990s: the development of institutional options within the sector, such as community management, a promotional role for national governments, increased privatization, and an increased role for non-government organizations (NGOs); improved financing of the sector, including the aspects of increased ESA and national government funding, better utilization of available funding, and cost-recovery for system operation and maintenance; addressing the needs of women and ensuring that their needs and concerns are incorporated into sector development, both at the community level and at the institutional level; integrated environmental management, including the appropriate disposal of human wastes and wastewater, solid waste collection, and waste resource recovery; and human resource development, primarily through the sensitizing and training of sector professionals in appropriate sector concepts.

The UNDP/World Bank Water and Sanitation Program has provided leadership in international collaboration (Grover and Howarth, 1991), which remains a key issue for the future. The collaborative council of ESAs, formed in The Hague in 1988, is intended to maintain IDWSSD momentum in the 1990s by providing a framework for coordination of sector programming.

The major challenge within the rural water sector will be to reconcile the need to increase coverage with the need to enhance sustainability. The main issues identified are encouraging in this regard, in that they focus upon both technological and non-technological aspects, with emphasis upon the latter. However, several major constraints are present, only partially related to the sector, that must be recognized and considered.

Sector funding will continue to be a major constraint. How realistic is it to expect a three to five-fold increase in sector funding during the 1990s? (UNICEF, 1991). The Organization for Economic Cooperation and Development (OECD) has called for development aid levels of 0.7% of each member's GNP, but as of 1989, only four members had reached or exceeded this level of aid (Worldwatch, 1991; DANIDA, 1988(a)). Most members including Canada, Japan and the United States contributed a considerably lesser percentage. Funding to the urban and rural water sectors remained static during the IDWSSD (McGarry, 1991). Given global economic conditions, it is doubtful that sector funding will increase significantly in the near future. Proposals to expand coverage levels in the 1990s must hinge therefore upon reducing unit service costs, encouraging capital contributions from beneficiaries, or both.

Regarding unit service costs, it is estimated that $100 U.S. per person served was expended during the IDWSSD, and that, given current levels of funding, only $20 U.S. per person is available if full coverage is to be reached by the end of the century (McGarry, 1991). Low-cost technology, generally applicable in rural areas, costs in the range of $20

to 30 U.S. per person served at present (UNICEF, 1991), while intermediate and higher-cost technology for urban areas ranges from $25 to 350 U.S. per person served. Political choices will need to be made regarding where service is provided and at what level of technology.

Willingness to make a capital contribution will depend upon service level to a great extent. More affluent people are in a better position to contribute, but will probably demand a higher technology and higher cost level of service. Numerous studies have shown that as socio-economic levels in a community rise, the demand for yard or house connections also rises. The very poor seem content to walk to the village handpump or standpipe (example: Feachem et al, 1978).

Compounding the problem of inadequate sector funding is the problem of overwhelming indebtedness. During the IDWSSD, developing country governments on a global basis provided about two-thirds of sector funding, although in sub-Saharan Africa the portion provided in-country was only about one quarter (World Bank, 1989). These local contributions to sector funding are very significant, and in the case of Africa were derived primarily from export-earnings and from development loans. Declining exports and increasing import costs (of fuel especially) during the 1980s led most African nations deeply into debt, such that debt service payments now equal or exceed the value of development aid received in many African nations (George, 1988), and in many cases exceed GNP (World Bank, 1989(a)). Short-term crisis management has resulted, as national governments turn away from longer-term development planning and financing to concentrate upon pressing issues caused by indebtedness. Observers are now concluding that, without significant debt-forgiveness, meaningful development in sub-Saharan Africa will be impossible (example: Berg and Whitaker, 1986).

Another major constraint to sector development is population growth and rural to urban migration. Rapidly

expanding populations in sub-Saharan Africa put tremendous pressure upon national governments to keep pace with the demand for water and sanitation services (World Bank, 1989). Compounding this problem is the fact that improving health conditions brought about by the provision of safe water supplies and adequate sanitation may result in ever greater population increases. Political leadership is required to address the population growth problem of the developing world. Some ESAs suggest that future development aid be made conditional upon addressing this problem among others (Berg and Whitaker, 1986).

Another dimension to the population problem is the migration of people from rural to urban areas on a massive scale. Besides placing tremendous environmental health pressures on urban and peri-urban areas, this out-migration from rural areas has contributed to the declining viability of many villages (IIED, 1989; Demeny, 1987). This has contributed to a general decline in rural food production and to increasing rural poverty (Worldwatch, 1989).

Lack of sustainability of rural water and sanitation services will continue to be a main constraint. It is estimated that 40 to 60 percent of rural water systems may be out of order at any one time (WHO, 1990). With current approaches, an improvement in the level of sustainability of completed systems is not likely. Experiences in Lesotho (Lesaoana, 1990), Malawi (Glennie, 1983; Nyumbu, 1990), and Sudan (McPherson and Livingstone, 1990) have shown that a combination of effective human resources development (through training and institutional strengthening), combined with meaningful community management, and supportive government legislation and policies are needed for system sustainability. These non-technical activities take time to implement successfully, and require considerable institutional flexibility on the part of the ESA and the national government. Inflexible attitudes and an emphasis on

construction schedules will severely constrain sector activities intended to contribute to system sustainability.

Overall, developing country sector institutions lack the capability and capacity to effectively plan and implement sector development. ESAs have been known to distort host country capabilities and capacities for their own ends (MFEP, 1990). There is a need to address the issue of capacity-building within local sector institutions.

2.4 Sectoral Concepts

A conceptual framework has evolved within the rural water sector that has been adopted by most ESAs active in the sector. Within recent years, various policy statements have been issued by major ESAs, emphasising various elements of this conceptual framework. Also, the World Commission on Environment and Development in their 1987 report Our Common Future dealt with similar concepts, but on a broader scale. The conceptual framework reflects to some extent the lessons learned during past activities and represents the "state-of-the-art" in sector programming. These key elements in this conceptual framework are as follows:

Full and effective community participation, leading to community management of services, is the cornerstone of sustainability. Although it has been evident for a long time that communities must take a lead role if water supply and sanitation development is to be effective (IDRC, 1988), moving from a provision approach (where the community are passive recipients) to a promotion approach (embodying community management) has not proceeded very far (McGarry, 1991). The main factors that have worked against effective community participation include control-oriented approaches to planning and implementation (Korten, 1980), political and bureaucratic prejudices and biases against rural people (Therkildsen, 1988), and inadequate budgeting and resource allocation to community development activities within sector programs.

The use of appropriate and low-cost (least-cost) technology is essential. Much emphasis was placed upon developing appropriate technology during the IDWSSD, especially reliable handpumps and adequate latrines. The India Mark 2 and 3 handpumps are now widely used by UNICEF, and the World Bank promotes the use of the Afridev handpumps in its programs. Local manufacture of these handpumps is encouraged where considered feasible, to reduce the need for imported manufactured equipment (UNDP/World Bank, 1990(a)). The Ventilated Improved Pit (VIP) Latrine was developed in Zimbabwe, subsequently modified, and is now widely used with success in Africa and elsewhere (Blair Research Institute, 1990). The catchphrase of the IDWSSD regarding appropriate technology remains today Village Level Operation and Maintenance (VLOM), implying simple, robust and inexpensive equipment.

Women should play a full and effective role in sector planning, implementation and system management. In most developing countries women, and to some extent younger children, are responsible for finding, collecting, transporting and storing household water. Household water use, hygiene and sanitation practices are normally managed by women (Melchior-Tellier, 1991). Women typically spend one third of their time in water-related labour, in addition to performing demanding agricultural work (Harrison, 1987), yet women in general have less access to financial, educational and technological resources than men, and have limited access to decision-making positions (Leonard, 1989). Despite a United Nations General Assembly Convention in 1979 to eliminate all forms of discrimination against women, and focused activities involving women during the 1975 to 1984 Decade For Women, many developing country governments lack the political will to promote equality for women (Stichter, 1984). The goal of community management of water and sanitation services will not be reached until the contribution of women

is optimized.

The concept that users should pay for services received, and that the operation and maintenance of rural water systems should be on a cost-recovery basis. This concept is considered a key to sustainability by the WHO, and increasingly by other ESAs (WHO, 1989, 1990). The essential elements in cost-recovery are the setting of water rates or service charges that cover the full cost of operation and maintenance, and provide additional funds for future rehabilitation or expansion of the system. Community management of water revenues in revolving-type accounts is considered most effective and appropriate (Mohamed, 1989(a)). It is generally accepted that the maximum amount which a family can pay for potable water is about 3 to 4 percent of their disposable income (CIDA, 1988(c)), therefore the questions of socially-affordable water rates with government subsidization, or inter-community or inter-regional subsidization need to be addressed. Government sector policy must incorporate realistic water and sanitation tariff mechanisms.

Sector development should occur within a sound and coherent government sector policy framework. Led by the UNDP/World Bank Water and Sanitation Program, specific sector activities are now underway in a number of developing countries to either rationalize existing sector policies, or to create new policies (World Bank, 1990(a)). With the overall goal of community management of services, the World Bank and other ESAs are working with national governments to develop sector policies that embody decentralization of activities, support of local initiatives, provision of grants and loans and extension services to rural communities (UNDP/World Bank, 1990(a)).

Operation and maintenance of completed water and sanitation systems should be incorporated more fully into program planning and implementation. WHO have indicated that

the lack of balance between the allocation of sector resources for new construction versus operation and maintenance has been a major constraint to the efficient use of facilities (WHO, 1989). National governments are being encouraged to move away from the central-utility models for operation and maintenance, originally adopted from developed country models, towards an individual community managed model (Kalbermatten, 1990).

Environmental issues must be of central concern in all sector activities. The central issue of environmental sustainability, where the global resource base is conserved and enhanced, has been raised by the World Commission on Environment and Development (WCED, 1987). The United Nations Environment Program cautions that the development of water resources should not contribute to their destruction (UNEP, 1988), as evidenced for example by severe desertification adjacent to rural water supply systems (Timberlake, 1985; Sandford, 1983). Increasing water scarcity is a problem in many areas of the developing world, such as the Middle East and the Sahel (Falkenmark, 1989; Speidel et al, 1988; White, 1983). Some ESAs have formally incorporated guidelines to strengthen environmental considerations in development activities (example: DANIDA, 1988(b)), while most lack a "clearly articulated sustainable development strategy" (Worldwatch, 1991).

Human Resources Development, encompassing training, institutional strengthening and sector linkage establishment, is essential to ensure program sustainability. Human Resources Development has been defined in a variety of ways which has resulted in considerable confusion and apparent different emphasis among ESAs (Livingstone and McPherson, 1991). CIDA for example view human resources development as the central focus for their development priorities of poverty alleviation, increased participation of women, and environmentally sound development (Grover, 1989; CIDA, 1987(b)). Others define human resources development more

narrowly: as training programs (JICA, 1990); as institutional strengthening (Commins (Ed), 1988); as community development (UNDP, 1989(a)).

Sector programs should be fully integrated. Calls to integrate water provision with sanitation have been made since the 1840s (World Bank, 1990(c)), but in rural areas of developing countries sanitation provision still lags far behind water provision activities. Increasingly, awareness of the importance of hygiene education to maximize health benefits has arisen (Cairncross, 1990). Major ESAs in the recent New Delhi Statement (UNDP, 1991) call for the integration of solid waste and wastewater management with water supply and sanitation provision. Although agricultural development is widely seen as the most pressing need in sub-Saharan Africa, attempts to integrate water provision with agricultural development (integrated rural development programs) have been largely unsuccessful (Berg and Whitaker, 1986).

Coordination of sector development efforts and improved cooperation between ESAs and national sector agencies is essential to improve efficiency. It is generally agreed that country-level collaboration yields the best results, but the means to achieve effective collaboration vary from one country situation to another (Grover and Howarth, 1991). The key to effective collaboration is good communications, which the major sector consultations at Interlaken (1987) and The Hague (1988) promoted by the preparation of a Framework For Global Cooperation Beyond the Decade, and the establishment of a sector collaborative council (Rotival, 1989). Sector groups such as the International Training Network (World Bank, 1990(b)), the International Development Research Centre and the International Reference Centre (Grover and Howarth, 1991) provide foci for sector research and development information exchange.

2.5 Sectoral Approaches

Planners may decide the feasibility of a development program, but it is usually politicians who decide upon the implementation, often regardless of the feasibility (Biswas, 1980). Although ESA sectoral approaches to planning and implementation determine to a large extent the relative success or failure of the program, the political influence upon sectoral approaches cannot be ignored. Sectoral approaches are subject to development guidelines established politically, which frequently include a preference towards bilateral programs, which are more visible and direct than multilateral programs; the requirement that most aid be tied to purchases of equipment and services in the donor country, often up to the 95% level; the desire to establish long-term economic trading linkages with specific developing countries; foreign policy and security considerations; donor country public opinion; political leadership and orientation in specific developing countries; social and moral values held by specific developing countries; and domestic economic conditions in the donor country.

These political guidelines can change rapidly and unpredictably, causing confusion for ESA managers and planners. Also, changing and conflicting signals and demands from ESAs causes confusion among developing country governments, and places additional burdens upon already weak government institutions (Berg and Whitaker, 1986).

Another influence affecting the sectoral approaches of ESAs are the structural constraints of the management process within the ESA. The following constraints have been identified as effecting the approaches of most ESAs (Garcia-Zamor, 1985; Waterbury, 1979): planning is usually limited to a narrow base, fragmented, with short time horizons; development planning often proceeds on a program by program basis; sector programs are not necessarily related to each other, and may lack a coherent rationale; planning often

relies upon information provided by others, not collected by the planners themselves; monitoring and evaluation are fragmented processes, often done by outside individuals or groups; and planning is sometimes undertaken when the decision to provide program funding has already been made.

Planning and implementation approaches favoured by ESAs tend to be comprehensive, with detailed pre-planning. This is essentially the western physical planning model. In their book Evaluation For Village Water Supply Planning, Cairncross et al (1980) state that "the public planning process will have a major part to play in rectifying the unsatisfactory condition of many rural communities" (page 1), but further state that in the case of rural water supplies, planners use "weak theory, hypothetical propositions, and casual empiricism to support investment ... programmes for public water supply" (page 1).

Despite this cautionary notation, comprehensive, and detailed planning has been followed faithfully in the sector. In a technical paper prepared for the World Bank (Water Supply and Sanitation Project Preparation Handbook, Volume 1: Guidelines) Grover (1983) lists 266 items to be analyzed as part of a standard pre-feasibility study for sector programs. While noting that the guidelines "may appear too detailed and demand too much information", Grover asserts that "such detail is considered necessary and useful to the planner" (page 1). Grover recommends the use of his guidelines for the preparation of both ESA and locally-funded programs. In a study also prepared for the World Bank (Appropriate Sanitation Alternatives: A Planning and Design Manual) Kalbermatten et al (1982) present three complex algorithms for the selection of sanitation technology. "Critical information needed for selection and design of sanitation systems" includes: full and comprehensive data on climate, topography, geology, hydrogeology, and flooding vulnerability; a complete socio-economic and demographic survey; an existing environmental

sanitation survey; a complete socio-cultural survey including perception and attitudinal measurement; and an institutional analysis (page 50). This is all to be done to make a "tentative selection" (page 51).

While comprehensive and detailed planning has remained the method of choice among ESAs in the rural water sector, program emphasis during the IDWSSD began a slow shift from technological to non-technological aspects. With increasing attention being paid to simpler services for the poor, some ESAs have adopted a less demanding planning approach in program preparation. DANIDA for example commenced in 1987 to allow greater flexibility in procedures, but cautioned that the "complexity of development assistance calls for stepped-up analysis and planning" (DANIDA, 1988(a), pages 27, 29). CIDA identify improving program planning and implementation as a major objective of their 1988 Water and Sanitation Sector Development Issues Paper (CIDA, 1988(b)), but reiterate that programs are to be formulated within a "comprehensive planning framework" (page 13). DGIS in their 1989 Water: A Policy Memorandum (DGIS, 1989(a)) call for a comprehensive description of "objectives, activities, actors and the financial, material and professional input of the various parties concerned" before a program is commenced (page 15). However, some reduction in the rigor of planning programs that are "technically uncomplicated ... in sparsely populated rural areas" is offered (page 17).

Additional dimensions to the sector planning approaches followed by ESAs include (Faludi, 1973):

Rational-Comprehensive versus Disjoint-Incremental Planning.

Rational-Comprehensive planning, in seeking the most efficient and appropriate means to reach a desired outcome, will employ various analyses of alternatives to identify the desired means. Disjoint-incremental planning relies less upon analysis of alternatives, and more upon negotiation and consensus upon means, and tends to be more reactive rather

than proactive.

Blueprint versus Process Planning.

Blueprint planning emphasises pre-implementation information collection to prepare an exhaustive and complete program plan. Monitoring during implementation is done to ensure compliance with the plan. Process planning is guided by a long-term strategy or policy, and an initial program plan is prepared, but monitoring during implementation is used to provide feedback to planners so that modifications or changes can be made as required during the program.

Functional versus Normative Planning.

Functional planning accepts goals and objectives as given, and analyzes the various means by which these goals and objectives may be achieved. Normative planning involves both the identification of goals and objectives, and the analyses of various means to achieve them.

Other dimensions to the sector planning and implementation approaches include:

Participatory versus Non-Participatory Planning and Implementation.

Participatory planning is less concerned with analytical methods and concentrates more upon organizational processes (Korten, 1980). The central goal is to effectively obtain community participation in the program, and this relies upon an effective interface between the community and the program staff (Garcia-Zamor, 1985). The process can be formal, through the establishment of local committees, or informal by encouraging suggestions without institutionalizing participation.

Non-participatory planning and implementation is followed implicity by many ESAs (Chambers, 1973; Therkildsen, 1988), and by national governments, despite policy statements to the contrary. Essentially, it is top-down development where national goals such as modernization justify the imposition of

various development programs upon the rural population. The process assumes that ESAs and national governments know what is best for rural people, and that these people will readily accept whatever services are provided.

Bypassing versus Institutionalization in Planning and Implementation.

Bypassing refers to the separation of ESA sector programs from national government sector institutions. This separation normally occurs in both planning and during implementation, and is often characterized by the establishment of an independent management unit for the specific ESA program (Honadle et al, 1983). One common feature of these program management units is the presence of significant numbers of expatriate technical assistance staff, despite the widespread recognition that "unless technical assistance is carefully integrated ... it [is] likely to increase dependence and vulnerability" (Forss et al, 1988, page 31).

Institutionalization attempts to plan and implement through national government sector institutions. Institutional strengthening and training of national sector personnel are emphasised, with expatriate technical assistance personnel in an advisory or motivational role rather than formal or quasi line positions (Honadle et al, 1983). By nature, institutionalization is a slower process than bypassing, and therefore is often perceived as being inefficient by ESAs. However, long-term sustainability of program activities depends to a great extent upon the degree to which institutionalization was pursued (Johnston and Clark, 1982).

The fundamental distinction between the various ESA approaches to sector planning and implementation is whether they tend to be control-oriented or adaptive (Therkildsen, 1988). These classifications assume various combinations of the dimensions to planning and implementation discussed above, and the major characteristics and assumptions of control-

oriented and adaptive approaches to planning and implementation have been well-summarized by Pfeffer (1981) and Therkildsen (1988):

Control-oriented approaches

(a) long-term objectives
- commonly agreed, clear and reasonably consistent.
- often expressed as detailed work schedules and production targets.

(b) decision-making context
- planning and implementation authority centralized within one or a few agencies.
- within agencies, normative planning usually followed with planners making most decisions.

(c) analytical context
- comprehensive pre-implementation data collection to reduce uncertainty regarding cause-effect and environmental relationships.
- information obtained assumed to be reliable.
- monitoring information used to ensure adherence to plan.

(d) participatory aspects
- top-down planning and control of implementation
- community non-participation, or community mobilization to meet specified, restricted objectives considered acceptable.

(e) institutionalization aspects
- program-oriented approach characterized by bypassing and an independent program management unit
- technical assistance personnel often in line or quasi line positions to rectify perceived deficiencies in national institutions.
- institutional strengthening and human resources development often defined as formal training, scholarships, etc.

Adaptive approaches

(a) long-term objectives
- commonly ambiguous and unclear, sometimes inconsistent.
- subject to negotiated change, both in the short and long term.

(b) decision-making context
- planning and implementation authority decentralized between a number of agencies, and frequently outside groups.
- within agencies, decision-making often jointly made by planners, implementors and researchers.

(c) analytical context
- uncertainty regarding cause-effect and environmental relationships can be reduced by a learning process during implementation.
- information that can be obtained will be unreliable, therefore a limited amount of selective information is normally used during planning.
- monitoring information obtained is very useful and generally reliable, and is used for learning and to modify plans and implementation activities.

(d) participatory aspects
- participatory planning and evolution of the program through a learning process established by effective communications with the community.
- community mobilization and empowerment emphasised.

(e) institutionalization aspects
- emphasis upon full and effective human resources development, with planning and implementation through national government sector institutions.
- technical assistance personnel provided to advise and motivate national personnel.
- emphasis upon program and policy development issues.

Sector development has had a strong technological, control-oriented bias, which has resulted in the construction of numerous inappropriate and non-sustainable schemes, and only in recent years have some ESAs begun to place emphasis on non-technological aspects of rural water and sanitation development. Community participation and human resources development are being recognized as the most important elements in sector planning and implementation, but confusion exists in the literature and among ESAs as to the optimal approach to managing this different style of development. Results obtained from this analysis in the rural water sector may aid development management in other sectors, where similar problems exist.

3. Sector Development Context of Sudan

Sudan, being one of the least-developed countries in the Third World, presents the full range of constraints to development encountered globally. Conclusions obtained from this study may assist ESAs in the management of development in most other Third World countries.

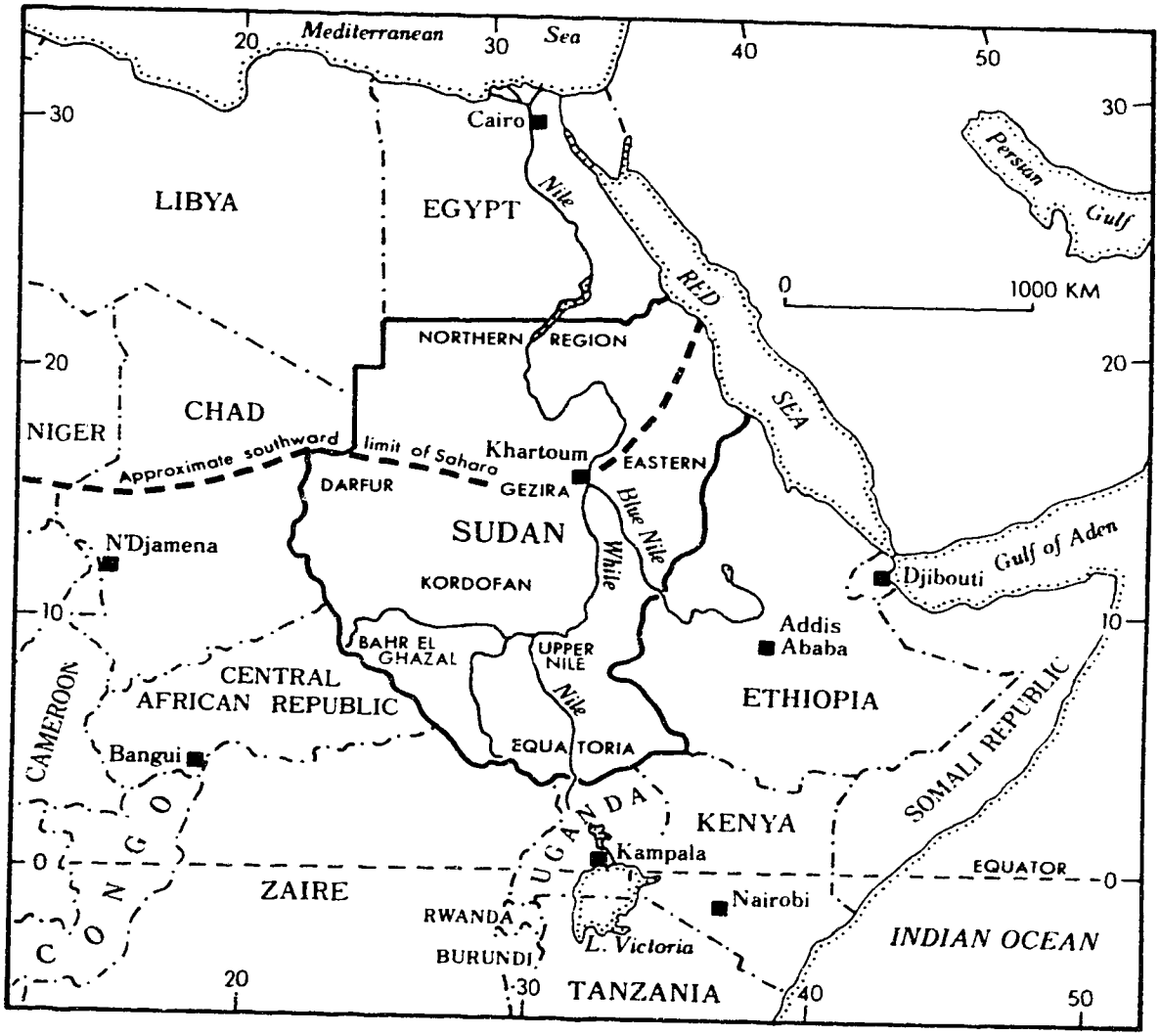
Sudan, located partially in North Africa and partially in sub-Saharan Africa (see Figure #1), is the largest country on the continent, with an area of approximately 2.5 million square kilometres. The current estimated population is 25.2 million people, with an annual population growth rate of 2.8 percent (WRI, 1990).

Sudan is composed of three distinct zones: the northern zone (comprising Khartoum, Northern, Eastern and Central Regions) where more than 50 percent of the population live; the southern zone (comprising Upper Nile, Bahr el Ghazal and Equatoria Regions) where about 25 percent of the population live; and the western zone (comprising Darfur and Kordofan Regions) where the remaining 25 percent of the population live.

The western zone (see Figure #2) of Darfur and Kordofan Regions has an area of approximately 876,000 square kilometres, and a population of approximately 7.3 million (Darfur 2.7 million, Kordofan 4.6 million). The rural population comprises about 75 percent of the total, for a rural population density of about 6 persons per square kilometre: less in Darfur than Kordofan, and less in northern parts of the zone than southern parts (IES, 1987, 1982). Major urban settlements are Nyala and El Fasher (Darfur), and El Obeid and En Nahud (Kordofan).

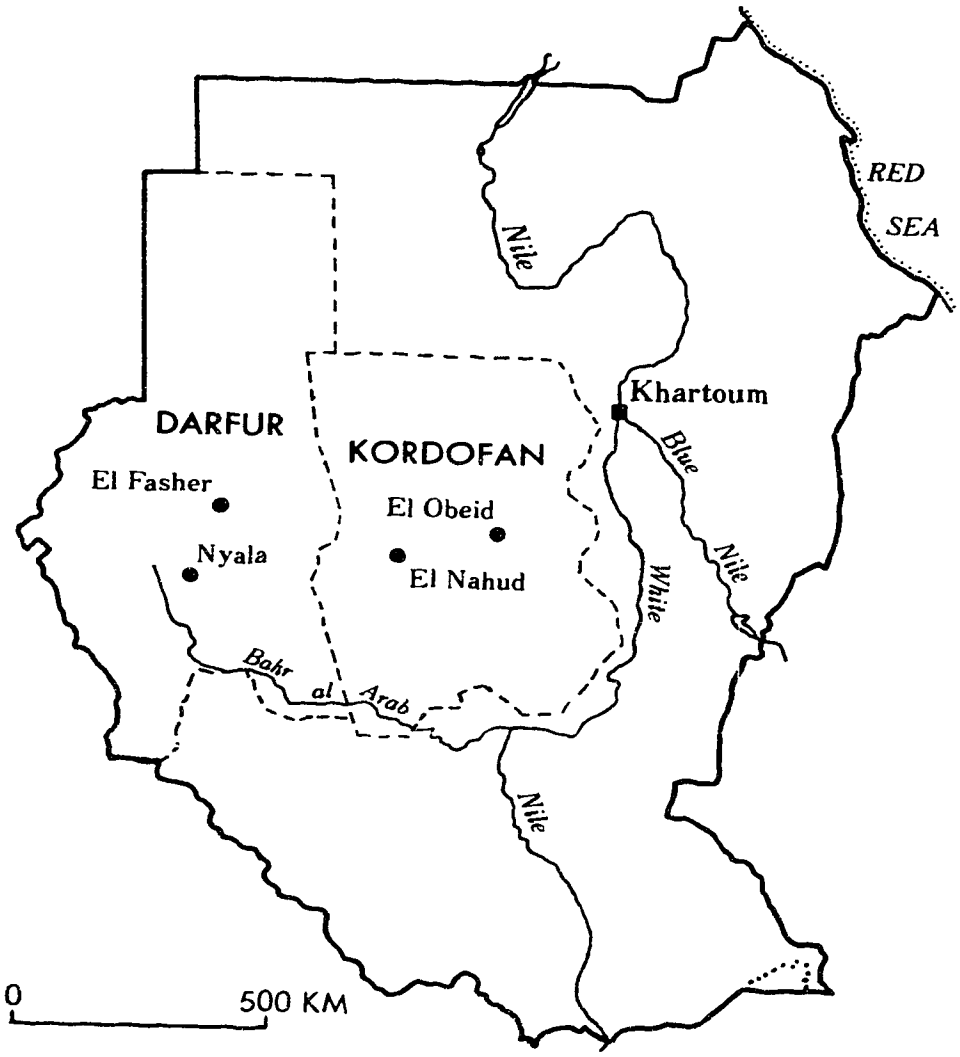
Most of Darfur and Kordofan can be classified as arid or semi-arid, with desert, semi-desert or sahel, and low rainfall savannah woodland zones from north to south (Ibrahim, 1984). Physiographically, the area is generally of low relief with mean elevations not exceeding 1,000 metres above sea level.

Figure #1 Sudan



Source: De Waal, 1989.

Figure #2 Sudan: Darfur and Kordofan



Source: Geoprojects/Oxford University Press, 1980. The Oxford Map of Sudan.

Significant topographic highs caused by igneous outcrops exist in Darfur (Jebel Marra Plateau, Meidob Hills) and Kordofan (Nuba Mountains). The predominant soil (Goz) is derived from the extensive sand sheet cover; also there are significant areas of clay pediplain and clay alluvial soils (IES, 1987, 1982). Average annual precipitation ranges from near zero in the northern parts to more than 800mm in the southern parts, with a distinct rainy season (Mountjoy and Hilling, 1988).

There is a complex mix of ethnic groups and sub-groups in the western zone. Most tribal groups are Arabized, with Arabic being the common language of inter-tribal communication. There are numerous dialects spoken, with Fur, Nuba and Masalit being common. Tribal groups are usually classified as being either sedentary or nomadic, although in reality many sedentary groups are semi-nomadic and many nomadic groups are partially sedentary, at least during certain seasons. Subsistence cultivation and livestock raising are the major economic activities of the rural people. Continuing severe drought has severely impacted the lives of both cultivators and livestock raisers, causing increased dislocation and marginalization of the rural population (Ibrahim, 1984; DeWaal, 1989). Small-scale irrigation agriculture is practised on alluvial soils in wadi (intermittent stream) channels and valleys, which are dispersed across the western zone. Traditional agroforestry in the form of gum arabic (hashab) production is widely practised, especially in Darfur.

Livestock are a very significant component of the agricultural economy of Darfur and Kordofan. Estimates of livestock populations are notoriously inaccurate (IES, 1987; Ibrahim, 1984) but total livestock numbers in both Regions combined are in the range of 20 million head (cattle 35%, camels 10%, sheep and goats 55% approximately). This corresponds roughly with estimates made by Adams (1981), IES (1982 and 1987) and the World Resources Institute (1990).

Basic demographic, health and economic indicators shown in Tables 7 and 8 reveal that Sudan is a "least developed country" (LDC), typical of many in sub-Saharan Africa (World Bank, 1989). Previous vigorous growth in gross national product, primarily from an agriculturally-based and export-oriented economy, has stagnated following the global economic dislocations of the 1980s. External debt has grown to unmanageable levels, equal to or exceeding Sudan's gross national product currently. This has resulted in the curtailment of most rural development activities in the country, despite increasing amounts of ODA (overseas development assistance) received. Health conditions are poor, typical of other LDCs in sub-Saharan Africa. Infant and child mortality, resulting from the lack of safe water supplies and inadequate sanitation facilities primarily (UNICEF, 1991; DeWaal, 1989), is unacceptably high.

Politically, Sudan cannot be considered stable. Since independence in 1956, a variety of democratic and autocratic (primarily military) governments have been in power. Regional government was enacted in Sudan in 1979 and legislated in 1981, with each Region having an appointed governor. Regional governments oversee appointed district and village (local) councils, although traditional tribal councils remain influential at the village and district levels in many areas. Most government departments are officially decentralized along regional lines. Considerable autonomy in decision-making is permitted regionally, but implementation is usually subject to the provisions of a centralized budget formulation and allocation system. The key players in the rural water sector, the Ministry of Finance and Economic Planning (MFEP) and the National Corporation for the Development of Rural Water Resources (NCDRWR), are not effectively decentralized. Although regional offices exist, planning and implementation decision-making is centralized in Khartoum.

Table 7 **Sudan: Basic Demographic and Health Indicators (1985 to 1990)**

	Sudan	Global
Crude Birth Rate (per 1,000 population)	44.6	27.1
Life Expectancy at Birth (years)	50.3	61.5
Crude Death Rate (per 1,000 population)	16	10
Infant Death Rate (per 1,000 live births)	108	71
Child Death rate (<5 years, per 1,000 live births)	175	105

Source: World Resources Institute, 1990.

Table 8 Sudan: Basic Economic Indicators

GNP (1987)	
Total (million U.S. $)	7,647
Per Capita (U.S. $)	331
Annual Average Change in Real GNP (%)	
1967 to 1977	4.6
1977 to 1987	(1.4)
Annual Average ODA (million U.S. $)	
1980 to 1982	652
1985 to 1987	992
ODA as a % of GNP	
1980 to 1982	8.4
1985 to 1987	13.9
Total External Debt (million U.S. $)	
1977	2,534
1982	6,641
1987	10,754
Long-Term Public Debt as a % of GNP	
1977	29
1982	76
1987	97

Source: World Resources Institute, 1990.

Significant political changes have occurred in Sudan during the IDWSSD. The National Reconciliation Government of President Nimeiri was overthrown by the military in 1985, and a transitional military council under General Swared Dahaab was established. In 1986, a coalition government was formed, headed by Prime Minister Sadiq El Mahdi. This coalition lasted until mid-1989, when the military again intervened and established the current National Salvation Revolution Command Council under Lieutenant-General Omar Hassan Ahmad al-Bashir. The on-going Civil War, essentially dormant from the 1972 Addis Ababa peace agreement, flared up again in 1983 with Colonel John Garang as chairman of the SPLM (Sudanese Peoples Liberation Movement) and commander of the SPLA (Sudanese Peoples Liberation Army). The civil war was proceeding with ferocity at the end of the IDWSSD.

3.1 Water Development in Darfur and Kordofan

Surface water sources in Darfur and Kordofan consist of rainfall catchment in either natural depressions (rahads) or in constructed reservoirs (haffirs) and earth dams. Rainfall is generally unreliable, increasingly so (Ibrahim, 1984), and traditional rahads and constructed haffirs and earth dams are subject to considerable fluctuation in volumes of water stored. At present there are approximately 1,100 haffirs and earth dams in existence. Average haffir capacity ranges from 5,000 to 60,000 cubic meters, although siltation has reduced capacity by about 70% (Muktar, 1989). Earth dam capacity ranges from 300,000 to 2 million cubic meters, but has similarly been affected by siltation. Although intake structures and treatment systems were installed on most haffirs and earth dams initially, they have since become inoperative, and human and livestock generally water directly from the reservoir (MFEP, 1989(a)).

Groundwater is a significant source for rural water supply in much of western Sudan. Shallow groundwater found in

small aquifers in Goz sand areas and in alluvial wadi deposits is traditionally developed using shallow large-diameter wells, often equipped with skin bags or buckets with ropes. There is no reliable estimate of the number of shallow large-diameter wells in northern Sudan, probably more than 2,000. Deeper groundwater occurs in both fractured metamorphic Basement Complex, and Nubian Sandstone and Um Ruwaba sedimentary formations, and locally in less extensive fractured metamorphic and sedimentary series. Boreholes drilled into these deeper aquifers have been equipped with hand pumps (approximately 5,000) and with motorized pumps supplying wateryards (approximately 3,600). A wateryard is a rural water supply and distribution complex, generally consisting of one or more boreholes and pumps, storage tanks, and outlets for container filling, tank filling and livestock watering.

The development of rural water supplies in Sudan has had a complex and contradictory history. This has been well documented for the 1920 to 1979 period by Shepherd et al in Water Planning in Arid Sudan (1987). In summary, until 1945 rural water supplies were constructed by the central government primarily to open up new areas for settlement, grazing and other potentially economic development activities. Sudan was viewed as having great agricultural potential, with adequate water supplies the main constraint to the development of this potential.

In 1945 the Rural Water Supplies and Conservation Board was established, and was responsible specifically for rural water development management. The Board lasted until 1954, when the Land Use and Rural Water Development Department was created to concentrate upon area planning, of which rural water development was an integral part. The period 1945 to 1954 has been called the "Haffir Decade", during which time some 500 haffirs were constructed, primarily in the western zone.

In 1966 the Rural Water Development Corporation was

created, consisting of the Rural Development Department (responsible for planning) and the Water Development Department (responsible for implementation). The Corporation oversaw the planning and implementation of the 1966 to 1974 Anti-Thirst Campaign, during which some 2,000 rural wateryards were constructed in the northern and western zones.

The Corporation was part of the Ministry of Cooperatives and Rural Development initially, and later moved to the Ministry of Agriculture. In 1975 the Water Development Department of the Corporation (renamed the Rural Water Corporation) remained with the Ministry of Agriculture, but the Rural Development Department was reorganized as the Soil Conservation, Land Use and Rural Water Programming Administration (SCLURWPA), which was to advise the Rural Water Corporation on supply siting. By 1979, the Rural Water Corporation, having moved again to the Ministry of Energy and Natural Resources, had ceased any effective cooperation with the SCLURWPA (MFEP, 1989(a)). In 1979 the Rural Water Corporation embarked upon an intensive borehole and handpump installation program in various regions of the country.

3.2 Development During the IDWSSD

Entering the IDWSSD in 1981, the implementation-oriented Rural Water Corporation was the de facto lead agency in the rural water sector. In 1985, the National Administration for Water (NAW) was created to oversee the decentralization of rural water construction into a regional network. The National Corporation for the Development of Rural Water Resources (NCDRWR) was created, with a director general in Khartoum and 6 regional directors, including one in El Fasher (Darfur) and one in El Obeid (Kordofan). In 1987, the NCDRWR moved to the Ministry of Irrigation and Water Resources, where it remained until 1989, when the NCDRWR was moved back to the Ministry of Energy and Mining.

Within the rural water sector during the IDWSSD, from

1981 to 1990, the following bilateral and multilateral ESA supported programs and projects were undertaken:

- UNICEF borehole drilling, handpump installation, sanitation and hygiene education program in Kordofan, Eastern, Bahr el Ghazal and Equatoria Regions.
- The USAID funded and CARE implemented water supply and management project in Kordofan Region.
- The DGIS funded water resources assessment and development program, including a water resources management component, and a village water supply component in Southern Darfur Region.
- The Italy/Sudan Rehabilitation and Development Program for Darfur, which included a UNDP managed wateryard construction component (UNDP/FAI Program).
- The CIDA funded and WUSC implemented Northern Darfur Water, Sanitation and Hygiene Education Project.
- Various UNHCR emergency water supply and sanitation projects for Ethiopian refugees in the Kassala Region.
- Various NGO funded or NGO implemented, ESA funded small water projects.
- The UNDP-World Bank Sector Review and Action Plan Program, to strengthen the sector and assist in sector policy development.

By the end of the IDWSSD, nearly 10,000 modern systems were in place (MFEP, 1989(a)), representing a rural water coverage level of approximately 30 percent (World Bank, 1990(a)). Rural sanitation coverage is estimated as 10 to 20 percent (see Tables 9 and 10). During the IDWSSD itself, emphasis in the western zone was upon construction of boreholes and handpumps, wateryard rehabilitation and construction, and some promotion of sanitation.

Financial support to the rural water sector has been significant, ranging from approximately $5 million U.S./year in the mid-1960s to the equivalent of nearly $30 million U.S./year in the latter part of the IDWSSD (UNICEF, 1990(b);

Table 9 Rural Water Systems (1989)	
Handpumps on boreholes	5,000
Boreholes in wateryards	3,600
Haffirs and earth dams	1,100
River and wadi intakes	170
Total	9,870

Source: MFEP, 1989(a).

Table 10 Sector Coverage (1989)	
Urban Water	40%
Urban Sanitation	N/A
Rural Water	30%
Rural Sanitation	10-20%

Source: MFEP, 1989(a). World Bank, 1990(a).

MFEP, 1989(b)). The Government of Sudan's current four year development budget commits a total of $288 million U.S. equivalent to the water sectors: 52% for urban and 48% for rural water supplies and sanitation facilities (MFEP, 1989(b)). ESAs provided a significant portion of financing to the water sectors during the IDWSSD. From providing about 19 percent of sector budgets in 1980/81, ESAs provided an estimated 55 percent of sector budgets in fiscal year 1989/90 (MFEP, 1989(b)).

3.3 Trends and Constraints to Development

The World Bank, MFEP and others have identified the following main constraints to development in the rural water sector in Sudan (World Bank, 1990(a); MFEP, 1989(a)): the lack of a coherent and effective sector policy; generally weak and ineffective sector institutions; low levels of existing coverage, and large numbers of inoperative systems; lack of community involvement in sector development; inadequate sector capital and recurrent financing mechanisms; and sporadic and generally ineffective ESA assistance projects.

Major sector policy issues identified as being essential to the improved planning and implementation of rural water programs and projects include (Baldwin, 1988; MFEP, 1989(a)): to create an inter-agency coordinating body to overcome the organizational instability, competition and conflicting responsibilities between groups within the sector; to resume planning on a regional level, and implementation regionally through NCDRWR; to encourage community participation in planning and operations and maintenance of rural water supplies; to introduce cost recovery systems for system operations, maintenance and minor improvements; to encourage the use of low-cost appropriate technologies, emphasizing renewable energy sources where applicable; to encourage local manufacture of water system inputs where appropriate; to promote the use of national consulting and expertise in

planning and implementing programs and projects; and to upgrade training and retrain redundant personnel within the sector.

The major sector objectives of the Government of Sudan as expressed in the current four year (1988/89 to 1991/92) Development Program are to develop water resources within a long term framework of integrated and sustainable rural development; in the short and medium term, to serve the areas of greatest need with low-cost solutions; to reconcile the development of water resources with ecological balance and ecosystem protection and enhancement; and to integrate water supply development with hygiene education and improvement in sanitation.

The rural water sector in Sudan is at present in a state of flux, and an effective sector policy has yet to be established. The UNDP-World Bank Sector Review and Action Plan Program which is currently underway has made some progress toward addressing the major sector policy issues previously identified. Emphasis is to be placed upon improving the efficiency of sector institutions through organizational and human resources development, and upon introducing better financial and operational systems and procedures (World Bank, 1990(a)).

3.4 Sector Organization and Financing

The NCDRWR is responsible for providing a safe water supply to all rural consumers. Furthermore, the NCDRWR is responsible for the operations and maintenance of rural water supplies, including the provision of spare parts, equipment and materials. The NCDRWR does not manage the development of Nile Waters for rural water supplies: this resource is controlled directly by the Ministry of Irrigation.

The NCDRWR Act (April 1986) specifies that SCLURWPA will conduct socio-economic studies to aid NCDRWR in the appropriate development of rural water resources. Also, the

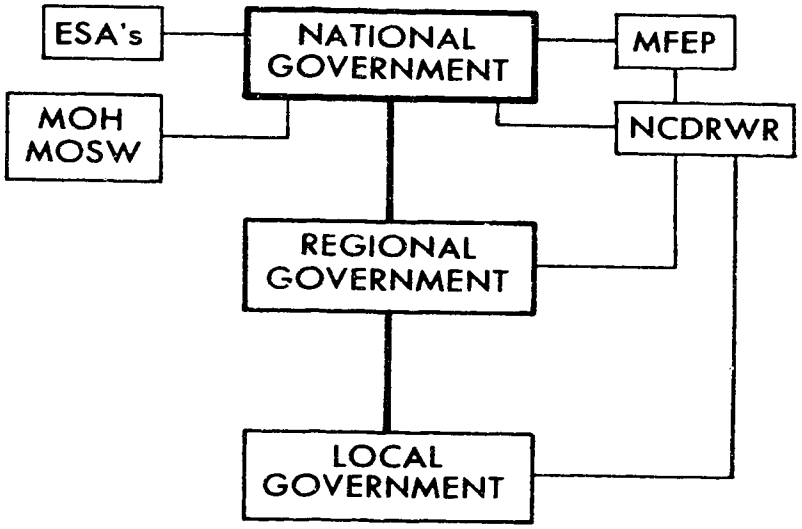
National Corporation for Geological Research (NCGR) is to provide NCDRWR with appropriate hydrogeological information to permit optimal development of the resource. In practice, NCDRWR proceeds with project implementation with little input from either organization (MFEP, 1989(a); MFEP, 1990).

The MFEP performs a leading role in rural water programming and implementation by various means (see Figure #3). The Project Planning Unit (PPU) is responsible for the identification and preparation of suitable projects, drawing upon input from various political and bureaucratic sources. The Foreign Loans and Technical Assistance (FLTA) Section is responsible for negotiations for, and administration of, foreign aid directed to the sector, including grants, loans and counterpart funds. The FLTA Section monitors and reviews all sector projects being implemented, and approves project budget disbursements in conjunction with the local counterpart agency, usually the NCDRWR or National Urban Water Corporation (NUWC). In addition, the Energy Section of MFEP is responsible for providing input to program and project formulation, and monitoring and review of implementation. In early 1990, a separate Water Section was created from within the Energy Section of MFEP, primarily at the suggestion of UNDP and the World Bank who are currently conducting a water sector review in Sudan.

The Water Section approves both NCDRWR and NUWC annual capital and recurrent budgets. On average, annual NCDRWR budgets in recent years have been capital project or development intensive (75% of total budget), with the remainder allocated for salaries and overhead (17%) and operations and maintenance (8%) (NCDRWR, 1988; MFEP, 1988).

NCDRWR headquarters is responsible for policy, planning and design, and construction of major projects. Regional offices undertake planning and design for regional works, and provide support for provincial activities. NCDRWR provincial offices are responsible for implementation of projects,

Figure #3 Organization of the Rural Water Sector in Sudan



Source: Schematic simplification of information in World Bank, 1990(a); MFEP, 1989(a); Shepherd et al, 1987

rehabilitation, and operation and maintenance of existingfacilities (NCDRWR, 1988). With a total of some 15,000 personnel, 50 percent are classified as unskilled which appears excessive (UNDP, 1988(c)). Only 12 percent of the NCDRWR's employees are professional or technical, considerably below the desireable level of about 25 percent (UNDP, 1988(c)). NCDRWR's institutional capacity is therefore lacking and will require considerable building before an effective sector capability can be expected.

Table 11 indicates the total water sector budgets since 1961. Prior to 1961, data for water sector budgets is unobtainable since portions are included in both the agriculture and the services sectors (Beshir, 1984). Also, some data for certain periods are amalgamated, since specific fiscal year water sector budget data are not available.

As can be seen, foreign aid to the water sector increased significantly in fiscal year 1981/1982, and in fiscal year 1986/1987. Local allocations to the water sector increased significantly in 1986/1987, in response to a government commitment to respond to the prevailing drought conditions throughout northern Sudan. Table #12 indicates the relative importance of the water sector budget within the total energy and mining sector budget allocation since 1978. Local budget commitments to the water sector averaged 31% of total energy and mining sector budget up until 1985/1986, increasing since then to an average of 63% of total budget. Foreign aid contributions to the water sector as a percentage of contributions to the total energy and mining sector have increased from an average of 13% before 1985/86 to an average of 43% currently. Overall, total (local plus foreign) allocations to the water sector have increased from 11% of total budget (1978/1979) to 55% currently.

Within the context of the current overall development budget, allocations to the energy and mining sector are approximately 17% of total allocations (see Table #13).

Table 11 Sudan Water Sector Budgets 1961 to 1991 (millions of Sudanese Pounds)

Fiscal Period	Local Budget	Foreign Budget	Total
61/62 - 70/71	N/A	N/A	14.643
71/72	2.219	3.118	5.337
72/73	1.660	1.874	3.534
73/74 - 77/78	N/A	N/A	N/A
78/79	1.053	0.950	2.003
79/80	3.568	1.985	5.553
80/81	4.620	1.050	5.670
81/82	6.600	10.500	17.100
82/83	8.727	12.900	21.627
83/84	6.950	17.570	24.520
84/85	7.857	15.000	22.857
85/86	6.150	11.107	17.257
86/87	90.212	66.378	156.590
87/88	53.048	52.626	105.674
88/89*	114.400	124.400	238.800
89/90	134.600	149.400	284.000
90/91	152.600	194.300	346.900
91/92	156.700	271.600	428.300

Source: MFEP 1989(b).
* Devaluation of Sudanese Pound by approximately 55% occurred.

Table 12 Percentage of Total Energy and Mining Sector Budget Allocated to the Water Sector (1978 to 1990)

Fiscal Year	%
78/79	11
79/80	16
80/81	13
81/82	14
82/83	21
83/84	20
84/85	24
85/86	19
86/87	54
87/88	48
88/89	48
89/90	55

Source: MFEP, 1989(b).

Table 13 **Sectoral Allocations, Sudan Development Budget (1988 to 1992)**

Sector	Percentage Allocation
Services	28.5
Agriculture	26.9
Transport/Communications	17.2
Energy/Mining	16.9
Industry	10.5
Total	100.0

Source: MFEP, 1989.

Within the water sector, current and projected allocations to the rural and the urban sub-sectors are approximately equal in the current four year development plan (see Table #14).

Sudan presents the full range of constraints to sector development that are encountered by ESAs throughout the Third World. Therefore results obtained from this analysis of case studies in Sudan may assist ESAs manage sector development in many other countries.

Table 14 **Rural/Urban Sub-Sector Allocations (1988 to 1992). (Millions of Sudanese Pounds)**

Fiscal Year	Rural Allocation (%)	Urban Allocation (%)	Total Budget
88/89	148.2 (62)	90.6 (38)	238.8
89/90	155.7 (55)	128.3 (45)	284.0
90/91	154.0 (44)	192.9 (56)	346.9
91/92	168.1 (39)	260.2 (61)	428.3
Total	626.0 (48)	672.0 (52)	1,298.0

Source: MFEP, 1989(b).

4. Methodology

Five case studies were prepared representing all applicable and comparable sector programs and projects conducted in Dafur and Kordofan during the IDWSSD. Data for the preparation of case study descriptions was collected by means of direct observation, key-person and beneficiary interviews, and a comprehensive document and literature search. Data was collected while resident in Sudan for three years, active in the sector at a senior level. Management strategies, conceptual and institutional frameworks, program and project components, constraints and outcomes were detailed.

Data analysis involved the development and use of an evaluation model that provides analysis at three levels:

1. the evaluation of ESA management approaches;
2. the evaluation of program or project apropriateness;
3. the evaluation of program or project sustainability.

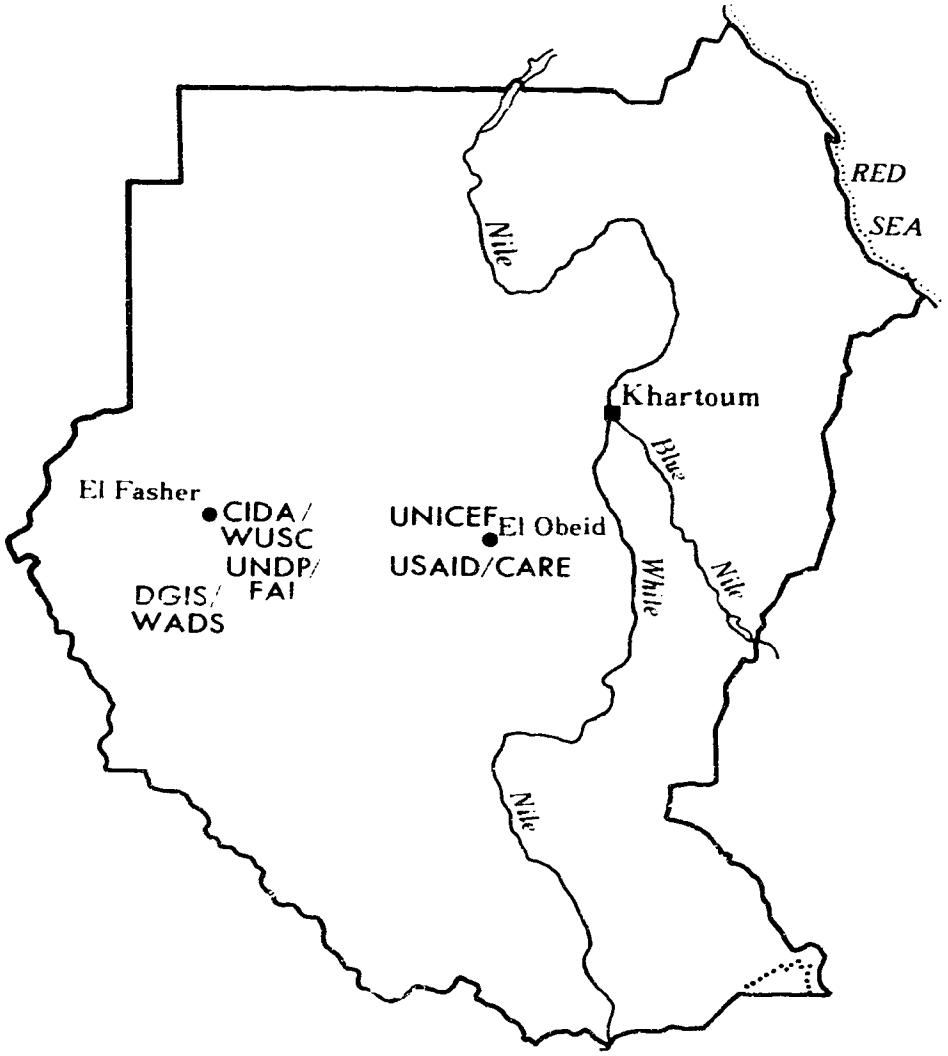
Combined, the evaluations yield results that indicate the relative effectiveness of the various sector activities and identifies strategies and concepts that will enhance appropriateness and sustainability. The model is substantially modified from ones initially developed by Cairncross (1980) and Therkildsen (1988), for the analysis of some components of sector management.

4.1 Case Study Selection

The five case studies selected for analyses are the UNICEF (Kordofan) Program; USAID/CARE Project; DGIS Project; UNDP/FAI Program (water component); and the CIDA/WUSC Project. The case study areas are shown in Figure #4.

The case studies selected represent major programs and projects planned and supported by important ESAs during the IDWSSD. All were undertaken in western Sudan, where geographic and logistic constraints during the IDWSSD were similar for each program and project.

Figure #4 Case Study Locations



Reasons for not including all sector programs and projects in the analysis include: significant logistical differences between programs in western Sudan compared to other areas of Sudan; the structural differences of emergency relief-oriented programs; the small-scale and non-replicability of many NGO projects.

Obtaining information on planning and implementation was a key problem. For some of the programs and projects, ESAs were unwilling to open their files for study or to make information available, and so these programs and projects had to be ruled out. For each of the case studies the ESA proved very cooperative and made their files available and were extremely helpful in discussing the programs and projects.

4.2 Data Collection Methods

Direct observation by means of the participant observer approach was utilized, since the author was active at a senior level in the rural water sector in Sudan from 1987 to 1990.

In general, most authors agree that the increased breadth and enhanced detail of data obtained via participant observation outweighs the loss of objectivity inherent to the technique. Direct observation for data collection is described in general by Rutman (1984) and Bowles (1981), and comprehensively by Rossi and Freeman (1989). Cairncross et al (1980) describe in detail the approach as it relates to rural water program evaluation, and an excellent example is given by Aziz, Cairncross et al in the Report of a Health Impact Study in Mirzapur, Bangladesh (World Bank, 1990(b)). Supplemental information on participant observation is found in McCracken et al An Introduction to Rapid Rural Appraisal for Agricultural Development (IIED, 1989).

The author was in Sudan for three years and this long period of data collection allowed insights into problems and issues and for extensive data collection and validation which would not have been possible with short or discontinuous

periods.

Data collection was by means of four main technologies, as detailed in Appendix 11.2, and included key person interviews, beneficiary interviews, a comprehensive document and literature search, and field observation of programs and projects.

4.3 Evaluation Models

Data analysis consists of evaluation of the case studies at three levels:

1. An evaluation of the ESA approaches to planning and implementation.
2. An evaluation of the appropriateness of the programs and projects.
3. An evaluation of the sustainability of the programs and projects.

The latter two evaluations are intended to supplement the first or primary evaluation, and are performed separately for reasons of clarity.

Each evaluation utilizes a modified version of a model initially developed by Cairncross et al (1980) for the evaluation of village water supply planning, and subsequently utilized by Therkildsen (1988) for the qualitative evaluation of sector program planning and implementation. The modified evaluation model to be used is a matrix where the programs and projects are assessed against a set of normative criteria established to allow quantification of program characteristics.

The evaluation of ESA approaches to planning and implementation employs a set of questions based upon normative criteria that reveal whether the approaches at various stages in the planning and implementation cycle tend to be control-oriented or adaptive. Although many combinations are possible of various planning modes and implementation strategies, the fundamental distinction between these various combinations is

whether they are adaptive or control-oriented (Therkildsen, 1988, page 67). These criteria have been summarized succinctly by Therkildsen (1988) and include long-term goals and objectives, shorter term plans and schedules,decision-making structure and procedures, information gathering and utilization procedures, beneficiary consultation and participation, and integration with local institutional framework.

The matrix is structured such that each program or project is scored against the set of 20 questions, each with a score range of 1 (control-oriented approach) to 5 (adaptive approach). An ESA program or project receiving a low overall score within the possible range of 20 to 100 will display a generally control-oriented approach to planning and implementation. Conversely, a high scoring ESA program or project will tend towards a more adaptive approach to planning and implementation.

The evaluation of program or project appropriateness employs a set of questions based upon normative criteria of appropriateness, as currently defined by sector ESAs. As evidenced by the 1990 New Delhi Statement and subsequent United Nations General Assembly Resolution, and as identified by most ESAs in various IDWSSD policy and planning documents, these appropriateness criteria include integration of water, sanitation and hygiene education activities, human resources development, institutional capacity strengthening, community participation, low-cost technology, operations and maintenance strategy, enhanced role of women, and water resources considerations.

Ten questions are utilized, each with a score range of 1 (inappropriate) to 5 (appropriate). Program or project overall scores will fall within a range from 10 to 50, depending upon appropriateness.

The evaluation of program or project sustainability employs a set of questions based upon normative criteria of

technical, administrative and financial sustainability, as described in Cairncross et al (1980), and supplemented by sustainability criteria established by WHO (1989) and the UNDP/World Bank Water and Sanitation Program (1990). These criteria include choice of technology including operating requirements, local manufacture of equipment and spares, training and institutional strengthening activities, community organization, training and empowerment activities, contribution to sector policy reform and sector linkage establishment, coordination and cooperation, capital and recurrent cost financial management, environmental compatibility, commitment of local government, and human, financial and management resources to continue the program or project.

Seventeen questions are utilized, each with a score range of 1 (non-sustainable) to 5 (sustainable). Program or project overall scores will fall within the range from 17 to 85, depending upon sustainability.

Program or project effectiveness is guaged by calculating the composite scores of the three separate evaluations. Programs and projects are then ranked from most to least effective.

5. Description of Case Studies

Case studies of sector programs and projects planned and implemented in Sudan, one of the least-developed countries in the Third World, may assist ESAs in the management of sector development in most other Third World countries, since Sudan presents the full range of constraints to develoment encountered globally by ESAs.

5.1 Format

Comprehensive qualitative and quantitative descriptions of each case study are presented following the format:

- descriptive summary of the program or project.
- program or project objectives.
- program or project development/evolution.
- planning undertaken.
- institutional framework.
- sector context.
- technology choice.
- sanitation/hygiene education aspec
- community involvement.
- operation/maintenance aspects.
- financial/cost-recovery aspects.
- implementation/construction.
- coordination.
- monitoring/evaluation.
- outcomes.
- major issues.
- major constraints.
- future constraints.
- sector implications.

Information presented in each category of the descriptive format will subsequently be compared with criteria in the evaluation of ESA approaches, and the evaluations of program or project apropriateness and sustainability.

The primary sources of information for each description

are interviews with ESA, GOS and other personnel and beneficiaries and from field visits to each program or project made by the author. Documents obtained from ESA, GOS and other sources are supplemented by documentary information on related sector programs, planning and financing in Sudan and on baseline studies for Kordofan and Darfur.

5.2 UNICEF (Kordofan) Program

Description of the Program

UNICEF's Child Survival Programme in the Sudan hinges upon primary health care improvements, and upon the provision of adequate supplies of potable water and sanitary facilities (UNICEF, 1987). The Water and Environmental Sanitation Division of UNICEF's Sudan County Office has been very active in water supply and sanitation in Red Sea, Bahr el Ghazal, Equatoria and Kordofan Regions for the past 10 years or more (UNICEF, 1989(b)).

In Kordofan Region, UNICEF's involvement began in 1978 in South Kordofan with a $1.9 million U.S. rural water supply project. The original six-year plan of action called for the installation of water treatment plants, rehabilitation and upgrading of haffirs, and borehole drilling with handpump installation (IES, 1983). UNICEF's sector activities were expanded into North Kordofan in 1985, primarily in response to the severe drought and the resultant impact upon the population in and around the regional capital El Obeid. Haffir and wateryard rehabilitation, and borehole drilling with handpump installation were the major activities in North Kordofan (Dodge and Zelenika, 1987).

A health education and sanitation component was incorporated into sector activities in 1984, which emphasized the construction of ventilated improved pit (VIP) latrines in both South and North Kordofan (UNICEF, 1989).

Initially, emphasis was placed upon the installation of water treatment plants and the rehabilitation of haffirs.

Targets called for the installation of 16 plants and the rehabilitation of 140 haffirs during the 1981 to 1985 five-year period covered by the revised plan of operation (May, 1981). Work did not proceed according to plan however, and by the beginning of 1986 only 7 plants had been installed and 74 haffirs rehabilitated: a sucess rate of some 50 percent (UNICEF, 1989, page 9). By the time the plan of operation for activities in North Kordofan was prepared in late 1985, water treatment plant installation had been dropped as an activity. Haffir rehabilitation remained scheduled for both South and North Kordofan, by mechanical and manual means (Dodge and Zelenika, 1987). High costs and technical difficulties plagued this activity, and by 1987 the plan of operations for Kordofan (1987 to 1991) no longer emphasized haffir rehabilitation, but had redefined it as "rehabilitation of existing sources where considered feasible and environmentally sound" (UNICEF, 1987, page 74).

What UNICEF had found "impressive and encouraging" was the drilling of boreholes and installation of handpumps. Commencing with the drilling of just 11 boreholes in 1979 (target 170), production gradually increased and peaked at nearly 2,500 drilled in 1988 (target 1,116) (Dodge, 1989). The 1989 plan of action called for the drilling and installation of an additional 600 boreholes and handpumps in Kordofan Region, plus 2,700 VIP latrines, for a budget of approximately $2.4 million U.S. No mention is made of water treatment plants or haffirs. The combination of borehole drilling and handpump installation was seen to "improve cost efficiency and increase the area of coverage" (UNICEF, 1988(a), page 1).

At the end of the IDWSSD, UNICEF's water supply and sanitation program in Kordofan Region is on-going. Emphasis is upon drilling large numbers of boreholes and installing equally large numbers of handpumps "in record time" (Dodge, 1989, page 6). Water committees are formed to take care of

handpump operation and maintenance, and to serve as a vehicle for VIP latrine promotion, primary health care interventions, and other UNICEF-scheduled activities. Currently, tree seedling nurseries for village wood lot planting are considered de riguer (UNICEF, 1989(b).

Objectives

The general objectives of the UNICEF Kordofan Program are to reduce the incidence of child mortality and morbidity through the provision of adequate supplies of potable water; to reduce the drudgery and time spent in the collection of water through the provision of new sources as nearby the users as possible; to promote sanitary facilities and the protection of water supplies against contamination; and to ensure the largest possible participation of rural communities and strengthen awareness and motivation of beneficiaries about the correct use of water and improved personal hygiene and environmental sanitation practices. (UNICEF, 1987, page 77). These general objectives from the 1987-1991 plan of operation and plans for action are clear, and represent a significant refinement over earlier program objectives. In addition, eleven specific objectives are identified that define program activities quite carefully, including for example:

> "to develop maintenance systems ... in order to ensure constant availability of a minimum of 20 litres of water per person per day..."
>
> "to increase the efficiency and cost-effectiveness of the program ... in order to reduce the cost of each installation..."
>
> "to promote behavioural changes ... through the establishment of 1,120 village health committees..." (all page 78).

Development/Evolution

Commencing in South Kordofan in 1978, UNICEF's water program initially sought to enhance child survival by

providing adequate water supplies. Various means were tried, and by the mid 1980s, borehole drilling with handpump installation had emerged as the major activity of the program. In response to changing times and concerns, first sanitation and hygiene education, and later environmental conservation components, were added onto the water provision work. A sub-program in North Kordofan, initially started on an emergency basis in 1985, was later merged with South Kordofan work to become a Kordofan Region water and environmental sanitation program. By the end of the IDWSSD, this on-going program was considered "state of the art" by the UNICEF Sudan Country Office. Emphasis remains upon the rapid implementation of large numbers of handpump and latrine installations throughout the Region.

Planning Undertaken

UNICEF have stated that within three Regions of Sudan including Kordofan Region, their goal is to provide "convergent services" to attain acceptable child survival and development levels (UNICEF, 1987, page 132). This is to be accomplished by zonal development planning, where the optimal use of limited financial and manpower resources is ensured.

Zonal development is claimed to be compatible with Government of Sudan planning policies and procedures, which emphasize decentralization and planning at a sub-national level. Zonal development planning conducted by UNICEF for its 1987 to 1991 Child Survival Programme included the objectives of promoting the capacity for planning and implementation at the regional, provincial and district levels, and improving the planning capabilities (at various levels) to ensure improved delivery of basic services.

In the early 1980s, the UNICEF Zonal Development officers were working with Regional Government, assisting in the establishment of district-level planning units and the formulation of Regional plans of action for various health-

related activities (UNICEF, 1987, page 135). By the mid 1980s however, the Government of Sudan's attention drifted away from decentralization to more centralized planning and administration, and UNICEF became increasingly involved in emergency activities (due to drought and civil war). As a result, Zonal Development apparently lost its former appeal and planning became more sectorally-based again. By 1989, Kordofan Program plans of action were authored by the UNICEF Water and Environmental Sanitation Division, co-signed by MFEP and NCDRWR (at the national level only).

Institutional Framework

UNICEF annual plans of action are prepared with NCDRWR in Kordofan Region (NCDRWR, 1987(a)). An executive manager is provided by NCDRWR to work with the UNICEF project coordinator: NCDRWR provide an additional 114 seconded staff (drillers, technicians, artisans, training and health education workers, support staff); UNICEF provide 5 specialist or support staff. In addition, UNICEF provide a production bonus to NCDRWR personnel and training incentives, which in 1989 for example amounted to $196,000 U.S. (about $1,700 U.S. per seconded NCDRWR employee, or from 50 to 150 percent of their average base government salary depending upon exchange rate used) (UNICEF(a), 1988, page 4).

Under a typical operational agreement, UNICEF provide imported equipment and supplies (vehicles, pumps, borehole casing, drilling tools, etc.), and NCDRWR provide locally-available equipment and supplies (cement, some vehicle spare parts and vehicle and equipment lubricants). The operational budget for 1989 is shown in Table #14. The approximate budget share indicated is UNICEF 66 percent, NCDRWR 34 percent.

Although not specifically mentioned, the program existed as an entity separate from NCDRWR Kordofan, and was operated as such (UNICEF, 1988(b)). Seconded staff were considerably better paid and were far better equipped than regular NCDRWR

personnel. The UNICEF project coordinator and UNICEF Water and Environmental Sanitation Division Chief (Khartoum) wielded considerable influence within NCDRWR and MFEP nationally. Also, UNICEF's emphasis on production and coverage was politically beneficial to both Regional and National governments (UNICEF, 1989(b)).

Sector Context

Within the rural water sector in Sudan during the IDWSSD, UNICEF was a major player especially with regard to implementation. Virtually single-handedly, UNICEF with their seconded NCDRWR staff installed nearly 5,000 borehole handpump schemes, almost half in Kordofan Region alone. Also, nearly 4,000 VIP latrines were constructed or were nearing completion in Kordofan Region by the end of the IDWSSD.

UNICEF felt quite confident that their approach was the right one, having been tested on a large scale in the field, modified and improved upon (Dodge, 1989). UNICEF became increasingly vocal in advocating the adoption of their borehole/handpump/VIP latrine approach by other ESAs in other areas of Sudan (for example, see UNICEF 1990(b)). While their approach certainly had merit, and with further modifications could have applicability in other regions of Sudan, it was hardly the panacea they purported it to be. Major institutional, political and economic difficulties in Sudan constrained the wide-spread application of any technology-based solutions.

Technology Choice

UNICEF's early experiments with rapid and slow gravity and pressure sand filtration, chlorination, flocculation and clarification, etc., in South Kordofan make for interesting but depressingly familiar reading (IES, 1983, pages 70 to 100). As noted previously, these efforts were abandoned by mid 1980s. In a similar way, UNICEF's experimentation with

haffir rehabilitation technology was disappointing. Mechanical means were employed primarily, but the cost per haffir using scrapers, graders and caterpillar tractors was nearly $30,000 U.S. (Dodge and Zelenika, 1987). It was decided to try manual rehabilitation using village labor, described by Dodge and Zelenika: "community participation in [haffir] rehabilitation was seen by UNICEF to be the best way to enable users to become involved and eventually take control of their own water supply" (1987, page 25). Evidently, although the cost of manual rehabilitation was considerably less than mechanical rehabilitation (about $3,600 U.S. per haffir), the prospect of three month's hard labor was not generally appealing to most villagers and the technique was quietly dropped from UNICEF's promotional agenda. Compounding the "haffir problem" was the fact that a newly-rehabilitated haffir did not contain significantly better quality water than before, just more of it.

The choice of technology in UNICEF's program with regard to handpumps is of significantly more importance than the foregoing. From the beginning of the program, the India Mark II (Hayati) handpump was installed, based upon UNICEF's favorable experience with this pump elsewhere (Dodge, 1989). Despite this pump's known deficiencies, it is robust and relatively easily repairable. Field trials and testing of selected UNICEF Kordofan handpump installations were conducted by World Bank personnel and were rated as "performing well" (World Bank, 1984(b), page 23), despite harsh climatic conditions and very intensive use. Several uniquely Sudanese problems have emerged regarding the use of handpumps in particular, as reported by the IES (1989, pages iv, v):

- the standard water container, a jerry can with a 50mm diameter mouth, is difficult to fill from a handpump without wasteage.
- vast numbers of livestock, often exceeding the human population in many villages, cannot be watered by

handpumps. Water supplies for livestock must be considered when planning borehole and handpump installations.

Little progress has been made by UNICEF in localizing the manufacture of the India Mark II handpumps (UNICEF, 1990(c)). In cooperation with UNDP and the World Bank, the latter's Water and Sanitation Program has attempted to interest both the NCDRWR and a local metal foundry in manufacturing the handpump on a trial basis, but with little success to date (World Bank, 1990(a)). Concerns expressed by NCDRWR include the reluctance of UNICEF to consider upgrading a handpump already locally produced and widely installed in northern Sudan, rather than introducing what is considered a new model. Until this rather circular argument is resolved, UNICEF's handpump installations rely upon imported spare parts.

Sanitation/Hygiene Education Aspects

As previously indicated, a sanitation and hygiene education component was incorporated by UNICEF into the Kordofan Program in 1984: some six years after the start of the program in South Kordofan. The sanitation aspect has focused upon the installation of VIP latrines, some 3,900 constructed or under construction to the end of 1989 (UNICEF, 1987, 1988(a)). Initially started as a demonstration project, with selected community members participating to provide an "example in improved excreta disposal practice" (UNICEF 1987, page 76), the sanitation activities have expanded to obtain wider coverage in each community. The latrine design is essentially that developed by the Blair Research Institute in Zimbabwe (Blair Research Institute, 1990), with a superstructure modified for local conditions (mud bricks, or in some cases straw). UNICEF provide the latrine slab and vent pipe, plus technical assistance and community development. In some villages, coverage levels approach 90 percent, but these are exceptional at present. In general

however, UNICEF's efforts in sanitation promotion have been "executed with great efficiency, and the performance of the constructed units if it is not good it is absolutely satisfactory" (UNICEF, 1989(a), page v).

UNICEF's health or hygiene education activities are conducted by a team of 6 people seconded from the Ministry of Health, but with 100 village health committees to form and train in 1989 alone (UNICEF, 1988(a), page 1), their effectiveness is questionable. The principal aim of the village training included not only the improvement of personal hygiene practices, but preventive health measures (immunization and oral rehydration therapy), water handling and storage, and latrine construction. Two pump mechanics were also included in each 10 member village health committee, to address the operation and maintenance of the village handpumps. While the committee structure is well integrated and the training proposed comprehensive, with the meagre resources devoted to these activities by UNICEF, their success is doubtful. In their 1988 evaluation of UNICEF's activities in sanitation and hygiene education, the IES found data on hygiene education "unfortunately ... rather scattered in different reports" (UNICEF, 1989(a), page 15), and found the program health workers inadequately trained, with communications between UNICEF, village health committees and government in need of improvement. The IES also questioned the institutional and financial sustainability of the village health committees formed (Ibid, page ix).

Community Involvement

Specific objectives of UNICEF's Kordofan Program related to community involvement revolve around the concepts of the provision of services to communities, the motivation and stimulation of communities to accept program activities, and full participation in operation and maintenance of completed works (UNICEF, 1987, page 77). It is further mentioned (Ibid,

page 79) that in order to attain the goal of safe water in all communities "an enormous effort by the government is required". The only mention made of community involvement in guiding program activities is a vague reference to the increased need for water due to population and livestock herd increases (Dodge and Zelenika, 1987), and very general references to the poor health and high infant mortality rates in the area (UNICEF, 1987, pages 2, 3). While these generalities cannot be seriously argued against at this level, specific identified community needs, aspirations and preferences are totally lacking in program plan formulation. The approach by UNICEF is paternalistic and altruistic: the communities assumed to be willing and thankful recipients.

Operation and Maintenance Aspects

Two pump mechanics (male or female) are required by UNICEF to be part of each village health committee. Training is provided to the mechanics and "rarely does the village ... system fail due to the mechanic's inability to perform the repair" (Wahadan et al., 1989, page 134). Managerial, administrative and organizational problems are the most frequent causes of system failure, indicating that village health committees need more effective training and strengthening in these areas. In a survey of two districts in South Kordofan in 1988, it was found that 30 percent of the village handpumps were out of order, including 5 percent permanently inoperative due to collapse of the borehole (UNICEF, 1989, page 11).

The strategy employed by UNICEF for operation and maintenance places emphasis upon community responsibility and NCDRWR support to the community. Spare parts can be purchased from the program or NCDRWR, and NCDRWR can be hired to perform more complex maintenance services (such as cleaning the borehole). Ownership of the system unofficially (or by default) rests with the community, although the Government of

Sudan has yet to pass enabling legislation to rescind NCDRWR's ownership of all rural water supplies. Funds for spare parts are collected within the village as required: it has been recommended that a revolving fund or water fee be established to cover the cost of spare parts, pay the pump mechanics and cover the expenses of the village health committee (UNICEF, 1989(a)). In addition, the IES caution that appropriate institutional and accounting arrangements would be necessary to administer village water fees, and that community regulatory procedures regarding water system use should be established (Ibid, page ix).

Standardization of designs and technology has aided in operation and maintenance by simplifying training and repair procedures, reducing the complexity of spare parts stocking, and achieving some savings in economies of scale. However, with the exception of the choice of handpump, standard designs are modified by actual field conditions that require changes in approaches and solutions (Wahadan et al., 1989, page 131). One obvious example where standard designs can cause problems are VIP latrine pits and superstructures.

Financial and Cost-Recovery Aspects

Cost-recovery related to operation and maintenance has been discussed in the previous section, with the noted need to improve financial management and revenue collection at the village level. Communities are also expected to contribute 50 percent of the capital cost of the handpump and tools, with an average of 2 pumps per village (at approximately $500 U.S. per pump).

UNICEF Kordofan Program budgets have remained relatively even during the past decade: from $1.9 million U.S. (1978) to $3.6 million U.S. (1988), decreasing to $2.4 million U.S. in 1989. With an overall target cost of $25 U.S. per capita for water, sanitation and hygiene education, UNICEF has with success improved the cost effectiveness of its program's

activities. This has been achieved primarily by drilling more boreholes per year, using smaller more appropriate drilling rigs, and by paying staff production bonuses, commencing in 1986. Claims of doubling or tripling work output since the introduction of production bonuses have been made (Wahadan et al, 1989, page 125). Certainly from a budget perspective, cost effectiveness has improved: in 1984 some 325 successful boreholes were drilled with overall expenditures of $3 million U.S. approximately ($9,230 U.S. per borehole); in 1988, 1,200 successful boreholes had a unit cost of $3,000 U.S. per borehole (overall expenditures $3.6 million U.S.) (Wahadan et al, 1989).

It is interesting to note that the above unit cost data, as provided by UNICEF, equates all program activities (overall expenditures) on a per borehole basis. This quantitative bias pervades most of the program documents and plans prepared by UNICEF.

Implementation/Construction

From the beginning emphasis during implementation was upon construction; drilling boreholes and installing handpumps. UNICEF and others recognized later that other aspects of implementation (ie: sanitation, hygiene education) lagged far behind construction of water systems (UNICEF, 1988, 1989). Some attempt was made effective 1988 onwards to implement more sanitation and hygiene education activities, but these efforts displayed a fundamental lack of comprehension of the inherent differences between construction and community development work.

Implementation is controlled by a five year master plan with annual reviews. One principle "followed religiously to maintain efficiency is that each geographic area [district] must be fully covered before drilling is moved to a new area" (Wahadan et al., 1989, page 129). In addition, implementation plans must be "technically precise ... to achieve cost

effective implementation" (Ibid, page 132).

Coordination

Relationships between UNICEF and UNDP, the other major U.N. sector presence in Sudan, are strained (UNICEF, 1990(c)). One case in point revolves around the issue of local manufacture of handpumps. UNDP, desiring to promote sustainability of handpump schemes, has an on-going project with the World Bank to encourage local manufacture. UNICEF, desiring to increase coverage levels as quickly as possible, would rather import ever increasing quantities of handpumps than delay their activities waiting for local manufacturing capabilities to be established (UNICEF, 1990(c)).

Similarly, UNICEF's relationships with other sector ESAs are less than ideal. UNICEF's position as champion of the handpump has polarized them from other ESAs who take a broader view of technological options. Likewise, their relationship with NCDRWR is effected by their discounting of other options. The issue of what to do with nearly 3,600 wateryards in Sudan that the NCDRWR is responsible for is a complex one, but UNICEF's apparent answer of replacing them with handpumps (UNICEF, 1990 (b)) is considered unrealistic.

Monitoring/Evaluation

Annual reviews are conducted in-house, to review construction progress and modify future work plans. Monitoring has emphasized the identification of means to improve cost effectiveness, primarily by increasing both the number and success rate of boreholes drilled. Monitoring has also identified the need to address the environmental aspects of program activities (UNICEF, 1989(a)), and has resulted in some significant initiatives in water conservation and tree planting.

Formal evaluations of the Kordofan Program have been conducted by IES (UNICEF, 1983, 1989), the latter containing

a substantial number of recommendations for program improvement. In addition, the UNICEF Red Sea Province Progam was evaluated by IES in 1989, and some of the findings there are applicable to the Kordofan Program.

No health impact evaluation has been conducted in Kordofan Region, so claims of improved health through program activities (although likely) cannot be substantiated. Concern has been expressed by IES and others that some program boreholes contain excess nitrates or fluorides (UNICEF, 1989(a)), page vii), but in the absence of effective water quality testing, this has not been confirmed. Health awareness levels have been observed as being high in the program area, subsequent to program activities (Ibid, page 15).

Outcomes

Specific outcomes of the UNICEF Kordofan Program include the provision of an estimated 2,200 boreholes equipped with handpumps, serving approximately 440,000 people; the construction of 3,900 VIP latrines, on a demonstration basis primarily, in the villages served by boreholes and handpumps; the formation and training of about 150 village health committees, whose responsibilities include handpump operation and maintenance; and the establishment of low-cost handpump and VIP latrine technology as a viable option for the rural water sector in Sudan.

Major Issues

The major issues addressed by the UNICEF Kordofan Program included the feasibility of integrating sanitation and hygiene education activities with water provision on a wide scale, the feasibility of village level operation and maintenance of handpumps, with partial community management, incorporating women actively in sector activities, and addressing environmental concerns partially related to the provision of

new water supplies.

Major Constraints

General constraints faced by the program included logistical delays, procurement procedural difficulties technical supervision, including lack of proper borehole siting, poor communications, and deteriorating economic conditions in Sudan.

Specific constraints that effected the UNICEF Kordofan Program, identified the Wahadan et al (1989, pages 121 to 123) include:

- reluctance of NCDRWR to accept the viability of handpump technology.
- sector policy constraints that do not allow the provision of new facilities to keep pace with population growth.
- working in too large of a geographical area.

Future Constraints

Considering that the UNICEF Kordofan Program is on-going, future constraints that are program-specific include: continuing severe drought conditions in Kordofan Region that will impact system sustainability at the community level;economic and political deterioration in Sudan that will impact upon UNICEF's high-rate, complete-coverage implementation style; the continued reliance of the program upon imported handpump technology and spare parts; the relatively superficial community involvement in all aspects except the responsibility for operation and maintenance, not necessarily leading to a sense of community ownership; and insufficient institutional capacity within NCDRWR to independently implement such a program.

Sector Implications

The major positive contribution of the UNICEF Kordofan Program to the rural water sector in Sudan is the

demonstration of the viability and utility of handpump technology, where formerly it was unknown or untried. It is apparent that the handpump option is now viewed relatively favorably by NCDRWR and MFEP, with the implication that this represents a perceptible shift away from the previous high-technology bias that pervaded sector thinking. At a sector conference held in Khartoum in May 1989, the then Minister of Irrigation and Water Resources Sayed Mahmoud Bashir Gamaa identified the utilization of simple and appropriate technology as one of the keys to solving Sudan's rural water supply problems (WHO, 1989, page 5). He cautioned however against placing the greatest emphasis upon construction of new water supplies.

5.3 USAID/CARE Project

Description of the Project

USAID has been involved in the rural water sector in Sudan since 1979, and has shown a particular interest in Kordofan Region. In 1982, USAID funded the North Kordofan Rural Water Supply Baseline Survey (IES, 1982), and the Kordofan Baseline Survey in 1985 (IES, 1985), as well as co-funding several other surveys. The USAID/CARE Interim Water Supply and Management Project, intended as a pilot project, was implemented in villages north and west around El Obeid in North Kordofan during the 1986 to 1988 period. CARE had been active in North Kordofan since 1983 conducting various relief efforts including emergency (drought-relief) water supply provision.

The project plans called for the rehabilitation of 15 wateryards, the rehabilitation of some shallow wells and construction of new shallow wells for a total of 13, and the rehabilitation of two haffirs. In total, 30 communities were to be involved in project activities, which also included some training and hygiene education sessions. Funding for the project was provided by USAID (66 percent), CARE USA, Italy

and France (24 percent), and USA for Africa funds (10 percent), for a total project budget of $1.24 million U.S. dollars (WASH, 1988).

Project implementation by means of a CARE/NCDRWR agreement commenced in October 1986 and concluded 18 months later in March 1988. By that time, improved water supplies had been provided to 22 communities, about 73 percent of those originally planned. Specific implementation activities varied considerably from those planned, with more emphasis on wateryard rehabilitation and less on shallow well rehabilitation/construction. A process evaluation of the project was conducted by WASH and CARE (Nairobi office) in November 1987, at the request of both USAID and CARE, with the major purpose of evaluating proposed plans for an extension to the project beyond the pilot phase (WASH, 1988, page xi). Major problems with sustainability of project activities were identified, and to date USAID/CARE have not proceeded beyond the pilot phase with this project (WHO, 1989), although CARE have remained active in the rural water sector in Kordofan.

Objectives

The general objectives of the USAID/CARE Project were: to assure the reliable provision of potable water to project communities (about 90,000 people); to establish village water committees, and to assist those committees in planning, managing and maintaining their water systems; to provide health and sanitary education at each village; and to provide training and assistance to local private workshops in simple handpump maintenance and repair. (WASH, 1988, pages 5, 6)

The specific objectives are rather less clear, since separate and somewhat divergent project agreements exist between USAID and CARE on the one hand, and between CARE and NCDRWR on the other. The major differences between the two agreements are shown in Table #16.

The major reason for the differences in specific

objectives is that the original plan (30 communities) and subsequently approved budget was prepared before actual site selection visits had been made, when it was discovered that some of the wateryards had more than one borehole. This necessitated reducing the number of wateryards to be rehabilitated to stay within the (already approved) budget.

Development/Evolution

As previously mentioned, CARE had been active in North Kordofan since 1983, involved in drought relief activities including emergency water provision. During the dry season, wateryards are used by about 30 percent of the population in North Kordofan, but shallow wells are also important sources (27 percent) and haffirs nearly equally so (21 percent) (IES, 1982). In North Kordofan, there were about 400 wateryards, compared to only 130 in South Kordofan (NCDRWR, 1987), but all tended to be in poor condition and in need of rehabilitation (MFEP, 1989). Shallow wells and haffirs, more directly impacted by drought conditions, also were in general contaminated or polluted (NCDRWR, 1987, page 6).

In 1985, CARE had drafted a proposal for a shallow well and haffir rehabilitation project. Following discussions with USAID, and their offer of funding, a wateryard rehabilitation component, and the training and hygiene education components were added. Following this revised proposal, NCDRWR took an active interest in the project and site selection and implementation specifics were negotiated.

Planning Undertaken

Project planning was undertaken by a troika consisting of USAID, CARE and NCDRWR, each with apparently different goals and agendas. USAID, keen on working in Kordofan where UNICEF was already very active, were interested in exploring means of enhancing the sustainability of wateryards (USAID, 1989). CARE wished to maintain an active presence in the rural water

sector and in North Kordofan (WASH, 1988, page 7). NCDRWR wished to upgrade their existing infrastructure in the area and to meet "increasing water demands" (NCDRWR, 1987, page 6).

It is difficult to determine whose goals were met by the project, but CARE's and NCDRWR's goals being more immediate were probably partially realized. The beneficiary communities were not consulted during the planning process: in fact actual project communities were not finalized until after the USAID/CARE agreement was signed in March 1986. A site selection trip was made in July 1986, when CARE, NCDRWR and MFEP visited potential "sites" and evaluated each one for inclusion in the project. Villages fortunate enough to show social and economic stability as determined by the MFEP representatives (along with a water source suitable for rehabilitation) were selected by the planners.

Institutional Framework

An implementation agreement was drawn up between CARE and NCDRWR and signed in October 1986 for an 18 month period to March 1988. Under the terms of this agreement, NCDRWR was to provide an engineer and two extension workers, construction crews and workshop facilities, and equipment and materials on hand from the previous CARE emergency water provision work in Kordofan. CARE was to provide a project manager, extension coordinator and 6 extension workers (WASH, 1988, pages 15, 16) and additional equipment and materials. Administrative backup was provided to the project by the CARE country office located in Khartoum. Technical backup was provided via monitoring by the USAID office of engineering.

Community participation in the forms of the provision of volunteer unskilled labor, and food and lodging for project construction crews, was formalized with each community prior to the commencement of project activities in that community.

The project existed as a separate entity from NCDRWR Kordofan Regional Office. In a rather complex organizational

structure, the project manager reported directly to CARE (Khartoum), while the project engineer reported directly both to the project manager and the NCDRWR Regional Office. Extension activities were supervised by the extension coordinator, who reported to the project manager. Construction work crews reported to the project engineer, who was not organizationally linked to the extension coordinator (WASH, 1988, page 17).

Sector Context

The USAID/CARE project represents one of several sector efforts during the IDWSSD in Sudan concentrated upon the rehabilitation of existing water sources, rather than upon the construction of new water sources. Since the mid 1970s, the continuous breakdown of wateryards in Kordofan Region had become a major cause for concern (IES, 1982), and in part this project addressed the need to put some of these wateryards back into operation.

Also, the USAID/CARE project included the rehabilitation of alternative, equally important water sources in Kordofan Region, namely shallow wells and haffirs. These two types of sources had likewise suffered neglect from the mid 1960s onwards (IES, 1982). Such a multi-source approach had been attempted and essentially abandoned previously by UNICEF in Kordofan Region.

Attempts were made by the USAID/CARE project to integrate their water provision activities with hygiene education and community development. Curiously, no further attempt to promote the adoption of improved sanitation facilities was made, and establishing community management of rehabilitated water sources was not seriously attempted.

Technology Choice

Wateryard rehabilitation concentrated upon the rehabilitation of existing or construction of new boreholes to

provide approximately 1.5 L/S or 100 m^3/d at each site. In some cases, up to 4 boreholes were utilized at each site, although in most cases 2 boreholes were adequate. Existing Lister diesel engines (single cylinder, 8 horsepower) and Edeco reciprocating piston pumps were rehabilitated and re-installed. Elevated sectional steel water storage tanks (nominal capacity 55 m^3) were welded as necessary and repainted. The water distribution system at each wateryard was replaced and improved, with separate areas of tap stands for human consumption and troughs for livestock watering. Perimeter and internal cross fencing was erected from barbed wire and thorn bush.

Shallow wells (both originally lined and unlined) were deepened as necessary to improve yield, and lined if required using concrete rings. Well collars and drainage aprons were constructed to improve sanitary conditions around the well head. In a number of communities, new shallow wells were constructed. Most completed shallow wells were left open so that traditional rope and bucket water withdrawal could continue to be practiced. India Mark 2 handpumps were installed on capped shallow wells in only 2 communities.

Haffir rehabilitation included desiltation of the reservoir and expansion of the catchment area, with reconstruction of any civil works in the catchment area (WASH, 1988, page 62). Where previously installed, water pumping and water treatment equipment was rehabilitated, and the haffir fencing replaced.

Several problems are immediately apparent with the technology choices of the USAID/CARE project:

- wateryard rehabilitation without improving the pump installation significantly does not contribute to sustainability. Several other projects in Sudan had chosen to use the Mono helical rotor pump to replace existing Edeco pumps, with good success (WHO, 1989; NCDRWR, 1988). The Mono pump is extremely adaptable to

fluctuations in head, is very fuel efficient and robust, and considerably less expensive than the Edeco pump.

- wateryard rehabilitation without replacing the elevated sectional steel water storage tanks, most of which had already exceeded their original service life of 10 years (NCDRWR, 1988), is shortsighted.
- shallow well rehabilitation and construction paid little attention to improvement of the traditional water lifting technology. Some advances had been made in this regard by other projects (see for example Negenman, 1989). The installation of 2 India Mark 2 handpumps seems a rather isolated, futile effort.
- haffir rehabilitation by means of mechanical equipment, with the installation of water treatment equipment had already been demonstrated by UNICEF in Kordofan as being an expensive and marginally useful exercise (IES, 1983, Dodge and Zelenka, 1987).

Sanitation/Hygiene Education Aspects

One general objective of the USAID/CARE project was to develop and implement a "health and sanitation extension curricula" at each community (WASH, 1988, page 4). These hygiene education activities consisted of a series of 10 lessons presented by 3 female extension workers to groups of 20 to 30 women in each community. The topics included in the series of lessons were disease transmission and illness, disease and personal hygiene, careful use of water, water in the kitchen, other domestic uses of water, water as medicine, traditional water purification methods, water and diarrhea, and water and malaria. Extensive use was made of locally-produced posters and other visual aids, reinforced by a community-wide audio-visual "Gala Day" held when the water source rehabilitation was complete. On this day, puppet shows, drama, poetry readings and demonstrations were presented by women of the community, integrating the theme of

water and hygiene with local cultural and sporting events (WASH, 1988, page 34). Residents of satellite communities were invited to attend these Gala Days, thus spreading the extension message further. Unfortunately, no formal impact survey was conducted on the hygiene education activities, although observations made during the process evaluation in November 1987 indicated a positive impact by improvements in home hygiene and cleanliness (WASH, 1988, page 33).

Beyond the exhortation to improve sanitation practices contained in hygiene education lessons, no effort was made to promote improved sanitation technology. Considering that UNICEF had commenced large-scale VIP latrine demonstration activities in adjacent areas in 1984 (some 2 years prior to the start of the USAID/CARE project) the absence of an effective sanitation component in project plans is notable.

Community Involvement

The USAID/CARE project had 3 male extension workers charged with the responsibility of establishing village water committees at each project community. Each village water committee consisted of all-male members, who were given training by the project in committee procedures, water source regulation, routine maintenance and repair, financial administration (wateryards), village health and sanitation, and desertification control and village tree planting.

The village training sessions were conducted after rehabilitation of the water source was completed, and consisted of a 10 lesson series in each community, utilizing visual aids extensively. The village water committee participated with the village women's group in the "Gala Day" described in the Sanitation/Hygiene Education ; pects.

Unfortunately, CARE and NCDRWR were unable to reach agreement on community management of rehabilitated water sources. NCDRWR Kordofan remained adamant that they retain complete control over all technical and managerial decisions

regarding wateryards (WASH, 1988, page 71), although they were more flexible regarding other water sources. Therefore, village water committees trained at project wateryards were largely redundant, and relegated to a minor background role.

Due to various delays and difficulties, the project's community development activities did not commence until January 1987, and therefore lagged behind rehabilitation activities throughout the project. Initial contact with each community by project extension workers was usually to solicit volunteer labor, food and lodging for construction crews, and in the case of two villages cash contributions. Little or no community input into planning or design was solicited or obtained. Training in hygiene and water source operation and maintenance came after rehabilitation was substantially or fully complete as noted previously. More effective results may well have been achieved by a more phased approach, with community development work before, during and after construction, encouraging community participation in all project phases.

Operation and Maintenance Aspects

The operation and maintenance of rehabilitated or newly-constructed water sources was not seriously addressed by the USAID/CARE project, despite the stated objectives of assuring the reliable provision of water to project communities via community management and maintenance of their water systems (WASH, 1988, page 5).

Village water committees were established and trained at each community, but had neither the administrative or legal power to manage or maintain their water systems. Communities with shallow wells or haffirs would play a large role in system operation and maintenance, since this had traditionally been the situation, but communities with wateryards remained as customers of NCDRWR. Rehabilitated wateryards were handed over to NCDRWR for operation and maintenance, despite the

observed fact that NCDRWR had been unable to regularly and properly operate and maintain wateryards since "the 1950s and 60s" (WASH, 1988, page 40). Critical aspects of wateryard operation and maintenance such as officially sanctioned community management, recurrent cost-recovery, and the provision of spare parts and repair services, were not addressed by the project.

Only two India Mark 2 handpumps were installed on capped shallow wells, although initially 10 installations were planned. Community handpump operator training was provided for 10 communities by UNICEF on a sub-contract basis, but subsequently was only of use to 2 of the operators. The stated objective of developing "a nonformal curriculum for pump repair workshop management, finances and techniques" for local private workshops (WASH, 1988, page 6) was not met. In fact, no local private workshop training was undertaken. Similarly, no attempt was made to address the need of haffir operation and maintenance, specifically future periodic de-siltation.

Financial and Cost-Recovery Aspects

The USAID/CARE project expenditures are shown in Table #17. Total expenditures of approximately 1.10 million U.S. are less than the budget of $1.24 million U.S., and under-expenditure of aproximately 11 percent. While USAID and CARE(USA) covered the bulk of the project expenditures (86 percent), CARE (Italy), CARE (France) and USA for Africa provided specific amounts for specific expenditures such as materials, equipment and vehicles. It should be noted that the USAID contribution included the equivalent of $66,000 U.S. in local currency. The financial contribution of NCDRWR in the form of staff base salaries (as opposed to CARE provided bonuses), materials, equipment and supplies contributed towards project activities were not included in CARE's calculation of either the project budget or expenditures.

This curious ommission was not explained, nor commented upon during the process evaluation, and is probably indicative of the relative separateness of CARE and NCDRWR in most phases of this project.

Average unit costs per project activity were derived by CARE and are interesting from a comparative perspective (see Table 23). The unit costs for borehole drilling and for engine, pump and pipe installation are comparable to those incurred by NCDRWR elsewhere, and considerably cheaper than those of the private sector (NCDRWR, 1988). Wateryard rehabilitation total costs in 1987 were in the range of $70,000 U.S. per unit, and new construction costs approximately $80,000 U.S. per unit (based upon single borehole wateryards). Presumably, haffir rehabilitation costs were borne totally by NCDRWR since no mention of expenditures for haffir rehabilitation is contained in project reports.

Implementation/Construction

The USAID/CARE project agreement, signed in March 1986 was for an 18 month period until November 1987. An implementation agreement with NCDRWR was not reached by CARE until October 1986, therefore it became necessary to extend the original project agreement with USAID until March 1988 to allow 18 months of implementation.

Immediate emphasis was upon rehabilitation and construction activities, which were substantially completed by November 1987, only 13 months after the actual start of implementation. Community development activites did not commence until January 1987, and so lagged some months behind construction (WASH, 1988, pages 13, 20). CARE did not seem able to move from an "emergency relief response focus" to the project until the later stages. Emphasis was upon rehabilitation of water sources, "not necessarily ensuring the sustainability of such efforts in the long run" (WASH, 1988, page 40).

Construction plans remained relatively fluid during implementation. For example, 15 wateryards were originally planned to be rehabilitated based upon the assumption of one borehole per wateryard. When it was later discovered that some wateryards contained more than one borehole, the number of wateryard rehabilitations was reduced to 12. Ultimately, 12 wateryards were rehabilitated, which included the rehabilitation of 24 existing boreholes and the construction of 3 new boreholes. The fact that this was done without exceeding the original project budget is noteworthy (USAID, 1989). To partially compensate for this unexpected effort, the number of shallow wells rehabilitated or constructed was reduced from 13 to 8, and all of the workshop and technician operation and maintenance training was dropped.

Coordination

Relationships between CARE and NCDRWR were relatively distant and ineffective, both at the Regional (NCDRWR, 1987(a)) and at the National level (USAID, 1989). In the field, the project essentially operated as 2 streams: an engineering effort controlled by NCDRWR and a community development effort headed by CARE. Relationships between CARE and NCDRWR in Khartoum hedquarters, despite claims to the contrary, were superficial (NCDRWR, 1988). Little progress was made by CARE in persuading NCDRWR to adopt different positions regarding critical issues such as technology choice, community management, cost-recovery for operation and maintenance, etc. No more than necessary contact was maintained between CARE and MFEP (MFEP, 1988). USAID were satisfied with the project's reporting quality and frequency, but attempts by USAID to expose CARE to a fuller appreciation of sector issues were not successful (USAID, 1989). In fact, several important sector conferences held in Sudan in the late 1980s failed to attract CARE's attention despite personal invitations from several sources (IES, 1990).

USAID attempted to promote wateryard rehabilitation and sustainability by taking the results of the USAID/CARE project and using them to aid the planning of similar proposed projects in both Kordofan and Darfur. Subsequently, USAID was able to provide considerable input to the design of both the Save The Children (U.S.) and CIDA/WUSC projects, the latter one completed during the IDWSSD.

Monitoring/Evaluation

Periodic project monitoring was undertaken by the USAID country engineering office, by means of meetings and field trips. The project was also included under CARE Sudan's routine monitoring and reporting system, which has been described as providing good and complete documentation (WASH, 1988, page 16). Technical activities were reported to NCDRWR on a monthly basis (NCDRWR, 1988).

A process evaluation was undertaken in November 1987 at the request of both USAID and CARE. The evaluation was conducted by a member of the Water and Sanitation for Health Project (WASH) from Washington, D.C., and a member of CARE's East African Regional Technical Assistance Team from Nairobi, Kenya. Although intended to be an ex-post evaluation, the evaluation was conducted some 4 months before the project was complete. However, rehabilitation and construction activities were substantially complete at the time of evaluation.

The purposes of the evaluation were to evaluate the project from a technical perspective, to evaluate the project community development activities, and to review draft proposals for a continuation of the project beyond 1988.

The evaluation did not include a health impact assessment: hygiene education activities were on-going at the time of evaluation. The major conclusions of the WASH/CARE evaluation included the project community development model should be adopted by other organizations involved in similar sector activities; the rehabilitation or construction of

various types of water sources is a sound approach in Kordofan; more attention is needed to addressing the problem of long term sustainability; and better coordination and collaboration with other sector ESAs and organizations would enhance CARE's effectiveness. (WASH, 1988, pages xii, xiii)

Outcomes

Specific outcomes of the USAID/CARE project included the provision of potable water supplies in 22 communities by means of 12 wateryard rehabilitations, 8 shallow well rehabilitations/constructions, and 2 haffir rehabilitations, hygiene education training at 22 communities, and the formation of 22 village water committees.

Major Issues

The major issues addressed by the USAID/CARE project included the feasibility of integrating hygiene education with water provision on a pilot scale; incorporating women actively in sector activity; and demonstrating the feasibility of wateryard and shallow well rehabilitation at reasonable cost.

Major Constraints

Constraints faced by the project included considerable friction and difficulty in relationships with NCDRWR (Kordofan and National Headquarters); problems with technical supervision and lack of coordination between construction and community development staff; lack of sector coordination and collaboration; and "emergency" bias of project activities being detrimental to sustainability.

Future Constraints

CARE has yet to establish an effective working relationship with NCDRWR, and this will prove to be detrimental to their current and future efforts in the sector.

Community development activities, particularly with

regard to village water committee formation, were largely wasted due to the inability of the project to effect community management of completed water systems. This may serve as a disincentive to future organization and education in communities in the area.

Sector Implications

Within the overall context of the rural water sector in Sudan, the USAID/CARE project provides some relatively significant contributions. The project's emphasis on the rehabilitation of existing water sources of various types represents an interesting and potentially viable approach, when contrasted to the more usual "construction of one type of water source" approach.

Despite the poor timing of delivery, and the lack of a comprehensive impact survey, the hygiene education activities apparently made a positive contribution towards project water provision activities.

The focus upon the rehabilitation of existing wateryards, which was accomplished quickly and economically, provided the impetus for several other wateryard rehabilitation projects that came later in Kordofan and Darfur. Despite the tendency of NCDRWR to view wateryard rehabilitation as the ultimate form of operation and maintenance, there are positive financial and sociological aspects to putting a closed water source back into operation.

5.4 DGIS Project

Description of the Project

The WADS Programme (Water Resources Assessment and Development Programme in the Sudan) has been funded by the Netherlands Government since 1979. The overall WADS Programme has been implemented in 3 phases to date, the latest or third phase being from 1986 to 1989. Negotiations for a fourth phase (1989 to 1992) were proceeding at the end of the IDWSSD

and implementation of this phase commenced in late 1989 and early 1990 (WADS, 1989(a)).

The WADS Programme essentially consists of two main components: a water resources management project consisting of groundwater data collection, analysis and hydrogeological investigations in various basins in eastern and western Sudan; and a village water supply project centered around Nyala in South Darfur. It is the latter project, referred to as the DGIS project, that is examined as a case study. A training component identified in project documents has been essentially integrated into the foregoing two main components (DGIS, 1989(b)).

The DGIS village water supply project commenced implementation in 1986 and the initial phase ended in 1989. Project plans called for the construction of 24 shallow wells per year (for an approximate total of 72), the installation of VLOM handpumps or water-lifting mechanisms, the formation and training of village water committees, and hygiene education training in each project community (WADS, 1989(a); 1988(b)).

Project funding was provided by DGIS as part of the overall third phase funding of their WADS Programme, which averaged 2.5 million NFL per year during the DGIS project time period. Allocations to the DGIS project specifically, primarily for equipment and transportation, were approximately one half of the annual WADS Programme budget. Local budget contributions to WADS from the Government of Sudan for staff salaries, office and vehicle operation primarily, averaged 4 million Sudanese Pounds per year, with approximately one third going towards the DGIS project (DGIS, 1989(b)).

Project implementation was supe[illegible]ed by IWACO, a private Dutch consulting company, of sub-co[illegible]ct to TNO Institute of Applied Geosciences who held the prime contact with DGIS for the implementation of the overall WADS Programme (WADS, 1989(a)). An expatriate project coordinator was located at project headquarters in Nyala, with three to five other

expatriates providing technical assistance primarily in shallow well construction and mechanical engineering. During the 1986 to 1989 phase of the DGIS project, some 70 shallow wells were constructed in 6 rural councils in South Darfur. They were equipped with buckets and ropes or windlasses, and operated and maintained by the trained village water committees (WADS, 1990).

Project reviews in 1986 and 1988, and a formal evaluation by DGIS in 1988 concluded that the project had been an overall success. Plans were then prepared to essentially replicate the scale and style of the project for another phase (1989 to 1992).

Objectives

The general objectives of the DGIS project were to demonstrate the viability of the participatory approach to village water supply; to field test various water supply technologies to assess their appropriateness; and to create within NCDRWR the institutional capacity to implement the participatory approach to village water supply. (Negenman, 1989).

These objectives are clear and well-defined, and relate directly to the stated goal of enhancing the sustainability of rural water supplies (DGIS, 1989; WADS, 1989(a)).

Specific operational objectives for the three year project period included: the construction of 24 shallow, large-diameter, hand dug wells per year in villages in South Darfur; the installation of various traditional and improved-traditional water-lifting mechanisms; the formation of male village water committees at each community; the formation of female village health committees at each community; and training in operations and maintenance, and hygiene education training, to committees in each community.

(Negenman, 1989; WADS, 1990)

Specific objectives for institutional strengthening

within NCDRWR are lacking, and individual human resource development activities in this regard are not identified. However, it is later reported (WADS, 1990) that the "establishment of a hand-dug well construction unit" (Ibid, page 1) within NCDRWR Darfur Region was achieved, and that about 70 key NCDRWR staff received formal training under the overall WADS Programme in 1986 to 1989.

Development/Evolution

Initial DGIS sector involvement in Sudan began with the WAPS (Water Resources Assessment) Project in 1979. In 1985, the program was reformulated as the WADS (Water Resources Assessment and Develoment) Programme. As the WADS Programme, DGIS involvement in the sector in Sudan continues up until 1992 as currently formulated.

Within the WADS Programme, the water resources management component was started first in 1979 and by 1989 was in its third phase. This component was operational in Kassala Province in eastern Sudan, Khartoum NCDRWR headquarters, and in south Darfur. In Kassala, the main activities were the hydrogeological investigation of the Gash groundwater basin, and the establishment of a water board and well licencing system for that area (WADS, 1990). Work in Khartoum concentrated upon groundwater and well data collection, culminating in the establishment of a computerized data bank and the publication of hydrogeological maps (scales 1:1,000,000 and 1:2,000,000) of Sudan (WADS, 1990. DGIS, 1989(b)). Water resources management work in south Darfur consisted of several water resources studies, including the preparation of a master plan for groundwater development (WADS, 1989(b)).

Towards the end of the second phase of the WADS Programme in 1985, it was decided to design a village water supply component into the programme. Water resources studies in the area had previously inventoried existing water sources,

estimated present and future water demands, and had identified critical water supply areas, mostly southwest of Nyala and near Zalingei in the northwest of the area (WADS, 1989(b)). Also, livestock water demands in the areas far exceeded human domestic water demands (IES, 1987).

In south Darfur there are some 330 deep boreholes located in nearly 240 wateryards that have been constructed by NCDRWR. Despite official reports to the contrary, many wateryards were non-operational (NCDRWR, 1989). While deep boreholes are frequently needed in both south and north Darfur to tap deep aquifers, WADS identified considerable groundwater potential in shallow alluvial (wadi) aquifers in the area (WADS, 1988(b)). It was decided to proceed with a shallow well participatory project to develop these shallow aquifers in a sustainable manner.

Planning Undertaken

Considerable planning was undertaken in the DGIS project at 2 separate levels.

On a macro level, a groundwater masterplan and a comprehensive water demand study were prepared by expatriate personnel on the WADS programme. The masterplanning exercise was intended to "make it possible to plan all activities in the water sector in the short and long run, at a general level" (WADS, 1989(b), page 5). The masterplan was thought to be a functional contribution to sector and economic development on a regional and national scale (Ibid, page 7). Despite these rather grandiose intentions, the WADS programme did produce a comprehensive and relatively concise groundwater plan for south Darfur that contributed positively to the planning of the DGIS village water supply project. The water demand study produced by WADS (WADS, 1988(b)) with some editorial contributions by IES was considerably less concise. In addition to a comprehensive study of water supplies in south Darfur, the study included extensive data and

discussions on population and livestock of the area. In essence, it duplicated large parts of the previously conducted Baseline Survey for Darfur Region, published by IES in 1987.

On the operational level, project planning was considerably less detailed, but thorough none the less. With an annual capacity of about 24 village wells, the project worked through rural councils to solicit requests for service from individual villages. A short list of villages for consideration for the project's annual plan of operations was compiled, and these villages were then surveyed hydrogeologically and socio-economically (Negenman, 1989). Once a priority list of 20 or so villages had been prepared, extension meetings were held in each village. Normally, a contract between the village and the project covering operational and administrative arrangements for project activity in the village was signed.

On the micro level, planning for village well siting, choice of technology and construction was participatory. Although the approach to micro level planning varied little from village to village, individual communities had considerable input into the provision of the village water supply (WADS, 1989(a)).

Institutional Framework

The DGIS project was implemented through the NCDRWR: not the Darfur Regional Office, but rather the Groundwater Research Department. This somewhat curious institutional arrangement may have several explanations (WADS, 1989(a)):

- the overall WADS Programme, being initiated as a groundwater resources based exercise, was governed by an implementation agreement signed with the NCDRWR Groundwater Department, Khartoum. The DGIS project as part of the WADS Programme presumably could operate under the blanket programme agreement.
- NCDRWR Regional Offices were well known as having a bias

towards wateryards, higher-technology, and non-participatory development (Shepard et al, 1987). The Groundwater Department probably was less concerned with the ramifications of using simple technology with a high degree of community participation, and more interested in exploring the shallow groundwater potential of south Darfur (WADS, 1989(a); NCDRWR, 1990).

A project steering committee based in Nyala, comprising representatives from IWACO, NCDRWR Groundwater Department, Ministry of Health and Regional Government, did include a representative from the NCDRWR Regional Office (Nyala District). The steering committee reviewed and provided some input into annual plans of operation, specifically with regard to priorization of villages to be included in the project (WADS, 1989(a)).

The expatriate project coordinator had a counterpart manager (hydrogeologist) from NCDRWR Khartoum, who was posted to Nyala for the duration of the project. In addition, from three to five expatriate technical experts worked on the project at various times, primarily in shallow well construction and mechanical engineering. Well construction teams, community development and hygiene education workers were provided by the Government of Sudan (NCDRWR Groundwater Department, Ministry of Health). Administratively, the project had three sections: groundwater exploration; village activities; well construction (Negenman, 1989).

Sector Context

The DGIS project represents one of a very limited number of efforts during the IDWSSD in Sudan that utilized and improved indigenous technology, and established community management of completed water sources. As elsewhere in Darfur and Kordofan Regions, NCDRWR wateryards were unreliable and frequently broken down (IES, 1987, 1982), and surface and traditional groundwater sources were frequently contaminated

and generally unreliable (IES, 1982; WADS, 1988(b); NCDRWR, 1987(b)).

By developing relatively shallow groundwater sources, the project was able to employ manual labor to a great extent. Local water lifting devices, proven reliable through time, were utilized with minimal maintenance requirements. By improving well construction and finishing techniques, and by providing hygiene eduction training, the bacteriological quality of water sources was improved and protected. Partly by design and partly by default, the development and subsequent operation of water sources under the project was a community managed exercise, with NCDRWR acting in an uncharacteristic catalytic role (NCDRWR, 1990(a)).

Technology Choice

Traditional shallow wells constructed by hand into alluvial aquifers contained in wadi channels provide approximately 30 percent of the rural population in south Darfur with water (IES, 1987). Difficult to dig below the water table, these wells are frequently productive only during the rainy season (July to September). Also, inadequate or lack of lining material leads to frequent well collapse and contamination. The traditional water lifting mechanism, a leather bucket on a rope, while simple and reliable is often a source of well contamination.

The DGIS Project sought to improve shallow wells in the area by constructing them deeper into the aquifer and using concrete casing rings or blocks (either telescoped or single-shaft) to prevent well collapse during and after construction. The casing and well head finishing (slab/apron, lid) also prevented contaminated water from seeping down into the finished well (Negenman, 1989). While leather buckets on ropes were utilized on some completed wells, the project sought to introduce simple bucket and windlass systems whenever possible. Although requiring more maintenance than

the traditional system, the windlass system provided better sanitary protection of the well (WADS, 1989(a)). At least four different versions of a standard windlass were develoed and used on the project (Negenman, 1989)

Sanitation/Hygiene Education Aspects

A hygiene education program was conducted by the village activities section of the DGIS project; the section responsible for community development and other forms of village training also. The hygiene education program was developed by the project in consultation with the Ministry of Health, Darfur Region, and the majority of the health extension workers were obtained from that ministry (WADS, 1989(a)). The Ministry of Health also played an active role in project monitoring and was represented on the project steering committee.

The hygiene education program developed and delivered was considered as "practical and pragmatic as possible" (Negenman, 1989, page 181). The program concentrated on three topics: maintaining a clean well; transporting water in a clean manner; and storing water in a clean way. The program was delivered by means of group sessions involving the village water and village health committees, and other groups of village women. More than 60 such training sessions were held during the three year life of the project. A health impact survey was not conducted to measure the effect of the hygiene education program. Previous work in the area by Save the Children (United Kingdom) (SCF(UK), 1987) and DeWaal (1989) reiterated the commonly held concept that health conditions are better in villages which have adequate water supply systems in Darfur.

The project made no attempt to promote the use of improved sanitation practices or facilities. No doubt, health benefits that resulted from the delivery of the hygiene education program could have been enhanced by the inclusion of

a sanitation promotion component. In context however, unlike rural Kordofan where relatively significant advances have been made in the introduction of VIP latrine technology (see section 5.2 for example), rural Darfur has received an insignificant amount of development in rural sanitation (MOH, 1988). Urban sanitation in El Fasher and Nyala, the 2 main centres, also remains rudimentary. (MFEP, 1990(a); GOS, 1974).

Community Involvement

A primary objective of the DGIS project was to demonstrate the viability of the participatory approach to village water supply (Negenman, 1989, page 175). The goal was to include community members in all stages of project activity, and this was substantially achieved.

Initially, individual villages wanting a well had to contact the project, rather than vice-versa. Village councils requested service through the Rural Council Administrative Office, who compiled requests and aided the Rural Council in priorization or verification of requests. An initial short list was then forwarded to the DGIS project management. Initially, three Rural Councils were involved in the project, but later more became involved for a total of 6 (WADS, 1988(b)).

The DGIS project management then prepared another short list, and the top 20 villages on the list in each Rural Council were contacted. No explanation is provided regarding the criteria used for priorization by either the Rural Councils or by the DGIS project. South Darfur consists of 24 Rural Councils, and initial selection of the Rural Councils for project activity were based upon water demand and water supply differentials: the higher deficit areas receiving priority (WADS, 1989(b)). Within each Rural Council, priority appears to have been placed upon villages that are relatively populous (both in terms of humans and livestock), show a reasonable degree of internal organizaton and cohesion, and

are hydrogeologically suitable (WADS, 1989(a)).

Initial contact with each village by DGIS project staff was by means of three extension meetings. The purpose of these meetings was to organize a village water committee, organize a village health committee, and sign a contract between the village and the project to cover financial, labor and maintenance aspects of the village well construction.

(Negenman, 1989)

It was generally arranged that the all-male village water committee would be responsible for the collection of village contributions (capital and recurrent), and the organization of village labor for construction. Normally, 12 village men were selected to manually dig the village well under project supervision. Also, the village water committeee appointed 2 well caretakers, whose responsibility was to keep the well and well head area clean, and to perform routine maintenance and repairs as required. The well caretakers received a salary for their services.

The all-female village health committee were the focus of hygiene education training, but played an influential role tangential to the village water committee. For example, both committees had input into the selection of potential well sites within the village. Following test augering by the project, final site selection was made by all 3 parties (WADS, 1989(a)).

On-going monitoring and a formal evaluation (Boot et al, 1988. WADS, 1988(c)) indicated that the degree of community involvement in project activities was high. Allowing the community to select the well site addressed the very important need of considering village political and social arrangements, rather than relying upon technical criteria alone. As a result, sense of ownership of the well among villagers was high, and financial and labor contributions towards well construction were always forthcoming (Negenman, 1989, page 178).

Some problems were experienced with the use of village well caretakers, primarily the high salaries they demanded and their arrogant behaviour towards village women (WADS, 1988(c)). While individual villagers generally were willing to contribute to the recurrent cost of spare parts for well operation and maintenance, they were reluctant to pay more than a token amount for the caretaker's labor. While the project management began to question the value of village caretakers, they did not explore the possibility of asking women to assume this role in whole or in part (WADS, 1989(a)). Considerable success in using women as well caretakers in Kordofan by UNICEF (UNICEF, 1989) may be replicable in Darfur.

Operation and Maintenance Aspects

The DGIS project was able to institute community managed operation and maintenance, principally due to its low technology, participatory approach.

Routine maintenance and cleaning of the well head area is the responsibility of the well caretakers described in the previous section. Despite considerable friction between men and women at the village level, most wells were maintained in a sanitary condition (NCDRWR, 1990(a)). However, 3 areas of operation and maintenance were found to require a considerable degree of attention (WADS, 1988(c)):

1) Some wells were not initially constructed deep enough to be productive in the dry season, or suffered subsequent collapse, and needed to be deepened. This was undertaken by the project, and in fact was their responsibility under the terms of the village-project contracts (Negenman, 1989).
2) Most wells were equipped with buckets and windlasses manufactured in the project workshop. Four styles were available: with spokes; with handles; with spokes and handles; with ancilliary storage tanks. Regardless of type, the windlass bearing proved to be a high

maintenance item, and modification and field-testing of improved bearings was initiated but incomplete by 1989. Routine windlass maintenance (other than of the bearings) was relatively minor.

3) Not all wells were equipped with windlasses, at the option of the community served. Bacteriological water quality was found to be "bad in wells where no windlass was installed" (Negenman, 1989, page 180). The source of the contamination was the dirty containers used to abstract water from the well. Obviously, more hygiene education training was required in these villages to motivate the purchase of a windlass.

Financial and Cost-Recovery Aspects

The DGIS project prepared a financial forecast for the cost for well construction over a 3 phase, 9 year period, of which 1986 to 1989 was the first phase. This forecast is shown in Table 24.

This financial forecast, based obviously on a number of debateable assumptions, is useful nevertheless for some comparative analysis. The anticipated unit cost per well (not including community labor) is in the range of 127,000 Sudanese Pounds. This compares very favorably against the unit costs for wateryard rehabilitation reported by USAID/CARE (approximately $70,000 U.S. Dollars, or 800,000 Sudanese Pounds at 11.5:1 Shadow Price). As expected, unit costs per well are higher in the initial phase of the project (1986 to 1989) than they are projected to be in later phases. It should be noted that the 110 wells anticipated in 1986 to 1989 in reality were not constructed: the unit cost based upon the 70 wells actually constructed with a budget of nearly 25 million Sudanese Pounds is approximately 357,000 Sudanese Pounds per well.

The individual villages served in the project were required to make a capital contribution of 1,000 Sudanese

Pounds towards well construction. In addition, the village labor contribution based upon a 12 man crew working for 30 days is valued at approximately 3,000 Sudanese Pounds per well. The village also provided food and lodging free-of-charge to project staff. A capital contribution was also required for a windlass: 250 Sudanese Pounds or approximately 17 percent of the cost was charged (Negenman, 1989, page 177).

Recurrent operation and maintenance costs are the responsibility of the village. These expenditures have been monitored by the project and average 200 Sudanese Pounds per year per well for materials and 2,400 for caretaker salaries (2), for a total of 2,600 Sudanese Pounds per year per well (WADS, 1989(b)). No allowance has been made for windlass bearing replacement, which has been covered by the project so far. If it is assumed that a typical village well can produce 1,500 m^3/year (WADS, 1989(a)), then recurrent costs are in the range of 1.75 Sudanese Pounds per m^3. This compares favorably with the "official" NCDRWR water rate at wateryards of 5.56 Sudanese Pounds per m^3(NCDRWR, 1989).

Implementation/Construction

Coordination of the activities of the groundwater exploration, village activities (extension) and well construction sections was of a high calibre. Project output of about 24 wells per year, requiring 2 or 3 construction crews, was exceptional given the logistical constraints experienced. Excellent working relationships between the foreign contractor (IWACO) and the Groundwater Department of NCDRWR were a major contributor to the success of implementation (NCDRWR, 1990(a)). The participatory approach and the quality of community development activities was the other major contributor to success.

The basic steps involved in implementation were: request for service; community development; well site selection; construction; community development follow-up; and monitoring

and evaluation. (Negenman, 1989) By allowing community development to set the pace of project implementation, the problems associated with technology-driven implementation were largely avoided. By actively monitoring completed work, improvements in implementation could be made as the project progressed.

Coordination

As previously indicated, the relationship between the project and the Groundwater Department of NCDRWR was excellent. Unfortunately, the relationship between the project and NCDRWR Darfur Regional Office was less cordial (NCDRWR, 1989; WADS, 1989(a)). The root of the problem was that the Regional Office, officially responsible for all rural water supply provision in the Region, felt ignored by the project who had chosen to work with the specialized NCDRWR personnel from Khartoum. While this may have enhanced project success in the short term, this lack of building institutional capacity in the NCDRWR Regional Office is regrettable, and may negatively affect replication of project activities in the longer term (NCDRWR, 1988).

Sector coordination between IWACO, DGIS (through the Royal Netherlands Embassy in Khartoum) and other ESAs was inconsistent. The project on one hand did little to promote the adoption of its approach and technology in meetings with other ESAs. In fact, obtaining information on project implementation and financing proved to be very difficult. On the other hand, the project was an enthusiastic participant in a sector conference and workshop (1989 and 1990) to discuss the seemingly intractable issue of sustainable operation and maintenance of rural water supplies in the Sudan (WHO, 1989).

Monitoring/Evaluation

Systematic monitoring of completed village wells was undertaken by the project, and yielded valuable information

that was subsequently incorporated into improved annual plans of operation and procedures (Negenman, 1989). The community development staff designed and implemented the monitoring system, rated as excellent by independent experts (IES, 1990).

A project advisory committee with representation from MFEP, NCDRWR, DGIS and the project formally evaluated the project on a semi-annual basis (DGIS, 1989(b)). The Nyala-based steering committee performed more of a planning rather than an evaluative function. Independent review missions were conducted in 1986 and 1988, and a formal project evaluation by DGIS took place in September and October, 1988. The principal recommendation of this latter evaluation was to separate the WADS Programme into 2 independent projects, de-linking the village water supply activities of the DGIS project from the more research-oriented activities of the water resources management project. The major objective for future DGIS project activities beyond 1989 was to "integrate this [project] into the regional office of the NWC [sic] in Nyala" (DGIS, 1989(b)).

Outcomes

Specific outcomes of the DGIS project included the construction of 70 or more shallow wells equipped with traditional, or improved traditional water-lifting devices, in about 60 villages in south Darfur, hygiene education training in about 60 villages, the formation of 60 village health committees and 60 village water committees, and the development of an appropriate and generally reliable windlass for optimizing traditional well water withdrawal by means of buckets.

Major Issues

The major issues addressed by the DGIS project include: the feasibility of integrating hygiene education with water provision; the feasibility of following a participatory

approach to shallow well development, leading to community management of the source; incorporating women actively in sector activities; demonstrating the utility of simple improvements to local technology, with local manufacture; and contributing to the exploration of cost-recovery as a means to enhance construction, operation and maintenance.

Major Constraints

Constraints faced by the project included the lack of integration of activities with NCDRWR Regional Office, logistical and security problems currently endemic to Darfur Region, and isolation of project and generally inadquate dissemination of project results.

Future Constraints

Changes to the NCDRWR Act (April, 1986) are required to legalize the framework of community management upon which this project's achievements are based. Concurrent development of an effective and appropriate sector policy is required to legitimize the approach followed and techniques used by the project. While the existing NCDRWR Act and non-existing sector policy do not in practical terms threaten this project's accomplishments, future replication and the initial work will be in a legislative and administrative vacuum.

Sector Implications

The DGIS project is unique in the context of the rural water sector in Sudan during the IDWSSD in that it concentrated upon the improvement of local technology. This allowed the project to follow a participatory approach to implementation, with adequate emphasis on community development, that resulted in community management of completed water sources. Technical and community-level administrative sustainability is thus enhanced.

The isolated nature of the project, the general lack of

collaboration with other ESAs, and the selective bypassing of Regional NCDRWR may detract from the ability of DGIS to replicate this project on a wide scale.

5.5 UNDP/FAI Program (Water Component)

Following the severe drought and famine of 1984 and 1985 in western Sudan (see for example DeWaal, 1989), the Italian Government Fund for emergency assistance to developing countries stricken by natural disasters (FAI or Italian Fund Aid) was committed partially to a comprehensive rehabilitation and development program in northern Darfur. Within a 24 month period, it was proposed to mount an approximately $57 million U.S. multisectoral effort, including the provision of seeds and food grains (25 percent), the construction of roads (26 percent), and the provision of rural water supplies (25 percent) (FAI, 1985). The entire effort was to be managed by UNDP, who had an established presence in Sudan.

The resultant program plans in the rural water sector called for the drilling of 66 new deep boreholes, the construction of 198 new wateryards, the rehabilitation of 86 wateryards, and some minor haffir and earth dam rehabilitation (FAI, 1985). The estimated cost of implementing these works in the sector was approximately $14 million U.S. (19.6 billion Lira).

Implementation of the program was sub-contracted to UNDP and wateryard borehole drilling commenced in April 1987. Work on the program concluded in September 1989, an elapsed time of some 30 months, during which some 65 wateryards were constructed or rehabilitated in four areas of northern Darfur (UNDP, 1989(d)). The final water sector component budget was some $17.7 million U.S. (MFEP, 1990) about 26 percent more than anticipated. The number of wateryards constructed or rehabilitated was approximately one-quarter the number planned. Haffir and earth dam rehabilitation occurred at 6 sites (UNDP, 1989(e)).

Severe logistical and security problems dogged the program throughout implementation, and relationships with the Darfur Regional Government were fractious, adding to the program's difficulties (NCDRWR, 1989). Program planning and implementation was essentially without community participation and operation and maintenance considerations: the resultant wateryards were non-sustainable, some 40 percent being broken down by March, 1990 (NCDRWR, 1990(b)).

Objectives

FAI legislation enacted by the Government of Italy established the following general objectives for emergency assistance supported through the fund the assistance should directly benefit the "poorest of the poor", and contribute to their basic needs; the assistance should reduce mortality; and the assistance should bring about the rehabilitation and normalization of the effected area. (FAI, 1985, page 1) Cetainly on the surface, the widescale provision of water in northern Darfur through the construction and rehabilitation of wateryards would meet these objectives.

The water component of the UNDP/FAI program had various general objectives, which were identified by FAI (1985) as the improvement of rural living conditions, the increased use of available resources for rural development, support of the livestock sector, and reduction of "desert encroachment". (page 6)

Other water component objectives expressed by UNDP (1987, page 25) as part of their Area Development Scheme for north Darfur included controlling desertification, increasing agricultural and livestock production, and increasing availability of water. This was to be accomplished by means of "rational lifestock [sic] and range management and land use" (page 25).

Development/Evolution

Funding for the program became available as part of the general emergency response from donor countries to the devastating droughts and famines that afflicted the Sahel during the mid 1980s. In fact, FAI assistance was restricted to CILSS (Comité Interétats pour la Lutte contre la Secheresse dans le Sahel) and IGADD (Inter Governmental Authority for Drought and Desertification) countries only (FAI, 1985).

UNDP had been active in Sudan since 1970, and had undertaken three development plans within Sudan since that time, and was embarking on a fourth development plan in 1987 (see Table #25).

Most development assistance provided by UNDP to the Government of Sudan during the 1972 to 1986 (1987) Country Programmes was concentrated in the areas of agriculture (average 31 percent of aid), with aid to education and industrial development being initially significant but later declining, and aid to general development and planning becoming very significant in the later Country Programmes (example: 41 percent of aid in the 1983 to 1986 Programme). As of 1986, UNDP aid to Sudan was reoriented in light of the overall deterioration in the country, and the 1987 to 1991 Development Plan called for concentration "on fewer objectives, ... fewer economic sectors, ... fewer individual projects, and attempt to achieve tangible and lasting impact by working as closely as possible with the intended immediate beneficiaries". (UNDP, 1987, page 15).

Although UNDP development assistance was not included in the UNDP/FAI Program (water component), UNDP's development philosophy as expounded in the 1987 to 1991 Development Plan should have been. UNDP were contracted by FAI (for some $6 million U.S.) to manage the Italy/Sudan Rehabilitation and Development Programme - Darfur, of which the water component

was a very significant part. Concurrently in Sudan, UNDP played the leading role for other major sector projects including:

- Water and Sanitation Sector Program #SUD/88/040 (UNDP, 1989(c)).
- Economic Water Planning Model, project #SUD/86/096 (UNDP, 1988(b)).
- Rural Water Supply for the Nomads of the Eastern Region #SUD/88/014 (UNDP, 1988(d)).
- The U.N. Capital Development Fund, proposed to be partially used for water supply and sanitation projects in Darfur and Korofan Regions (UNDP, 1989(f)).

FAI felt that fragmented implementation of the Italy/Sudan Rehabilitation and Development Programme - Darfur through several U.N. executing agencies was "not practical" (FAI, 1985, page 2) and chose UNDP, office of Projects Execution, as the manager. There is no doubt that FAI felt that UNDP's sector experience and interests would contribute to the success of the UNDP/FAI Program, and in fact took a "hands off" approach during program implementation. However, evidence suggests that UNDP's Office of Execution and UNDP's Water Sector staff failed to cooperate and collaborate during subsequent program implementation, with the water sector having virtually no input to the program (UNDP, 1989(d)(f). NCDRWR, 1990(b)).

Planning Undertaken

Once FAI had satisfied itself that northern Darfur rehabilitation and development activities indeed were "suitable for FAI assistance" (FAI, 1985, page 2), program planning was given to UNDP who in turn sub-contracted it to Montedison Servizi Agricoltura S.p.A., an Italian consulting company with previous development experience in Sudan. A joint identification mission was conducted in July 1985, composed of representatives of FAI, UNDP, and experts in a

variety of sectors. The two week mission identified a 24 month $57 million U.S. program including roads, seed and food grain security, water, agriculture, health, livestock, forestry, education, and energy conservation. Roads, seed and food grain security, and water were to receive the bulk of the funding: some $39 million U.S. or 70 percent of the program (FAI, 1985).

The subsequent water component planning of the UNDP/FAI Program was conducted within a priority area of some 150,000 km^2, where program representatives and NCDRWR officials performed reconnaissance surveys and actual site inspections of some 100 wateryards (out of an existing 131) and 50 haffirs and dams. Extensive data were collected on existing and abandoned boreholes and haffirs, both from NCDRWR files and from other sources. An integrated mapping system based upon the data collected was prepared by the consultant, together with information on geographic and other physical characteristics of the priority area. Despite the fact that "only sporadic and spot data have been found" (FAI, 1985, page 4) and that "no data exist for most of the boreholes examined" (page 5) in the site inspections, the consultant felt sufficiently confident to prepare an inventory of water sources, accompanying computerized maps for this area containing "about 1.4 million people, excluding urban areas, and about 3.7 million large and small animals" (page 1), and detailed reports and bills of quantities.

The resultant plan called for the drilling of 40 new boreholes to replace existing ones in wateryards, the drilling of 26 new boreholes to supplement existing ones in wateryards (twinning), the construction of 198 new wateryards, and the rehabilitation of 86 wateryards including borehole rehabilitation. The total plan cost estimate was approximately $14 million U.S. (19.6 billion Lira). Optional plans developed to rehabilitate 70 haffirs and 10 earth dams, and to construct 10 new haffirs, for a total cost of $26

million U.S. (36.0 billion Lira) were not pursued since this work was seen as "wholly self-defeating and anti-economical..." (page 22).

While the initial survey of some 100 wateryards attempted to determine water demand at each site, final site selection for inclusion in the program was done by the Darfur Regional Government, in consultation with NCDRWR and the Ministry of Agriculture. The siting decisions were based upon political feasibility to a considerable extent, and were only modified by hydrogeological conditions at the site (UNDP, 1989(d)). The wateryards included in the Program were distributed almost exclusively in the El Fasher and El Ait areas to the south of El Fasher. More needy and populous areas (DeWaal, 1989) west of the Jebel Marra Plateau, such as Kebkebiya and El Geneina areas, were almost totally excluded from the Program.

The plan to construct 198 new wateryards would represent a 150 percent increase in the number of wateryards in northern Darfur: from 131 to 329 (NCDRWR, 1989). Plans to combat desertification caused by the construction and utilization of this number of wateryards (Ibrahim, 1984; IES, 1982, 1987) were totally absent. Program plans were almost entirely concerned with the technical requirements of wateryard construction and rehabilitation. Neither was the problem of operating and maintaining such a large additional number of wateryards addressed in program plans, which is incongruous considering NCDRWR's inability to operate and maintain even the existing infrastructure (MFEP, 1990). Beyond supplying spare parts, supplies and equipment manuals, wateryard operation and maintenance was not considered (UNDP, 1989(d)).

Institutional Framework

Under UNDP management, implementation was contracted to Recchi S.p.A., an Italian engineering and construction company also implementing the road construction component of the Italy/Sudan Program. The planning consultant, Montedison

Servizi Agricoltura S.p.A., was retained to provide services during implementation as part of the overall Italy/Sudan Program.

An implementation agreement was signed between NCDRWR and the UNDP/FAI Program. However, with Recchi S.p.A. providing 30 expatriate technical experts (UNDP, 1989(d)) and UNDP providing expatriate management staff, NCDRWR was relegated to providing about 45 labourers and artisans for construction work and a counterpart project coordinator (NCDRWR, 1990). Once wateryard sites had been selected by the Regional Government, implementation proceeded by largely bypassing NCDRWR. For various reasons, NCDRWR was allowed almost exclusive domain over the relatively minor amount of haffir and earth dam rehabilitation funded by the program.

Sector Context

The UNDP/FAI Program represents a rather large, narrowly focused effort during the IDWSSD in Sudan, in which a large number of wateryards were constructed and rehabilitated, and little else happened. Northern Darfur contained less than 5 percent of the wateryards in Sudan prior to the implementation of the UNDP/FAI Program (NCDRWR, 1989) and most were in poor condition (FAI, 1985). The program therefore met the immediate need of providing more water in this drought-stricken and impoverished area. However, by concentrating solely upon water provision, and not addressing the needs of community participation and operation and maintenance, and by not integrating water provision activities with hygiene education and sanitation promotion, the program's efforts were largely wasted. Adding 50 percent to NCDRWR's stock of non-sustainable wateryards has little positive impact in the overall context of the sector in Sudan.

Technology Choice

Wateryards were constructed or rehabilitated to provide

an average of 3.3 L/S at each site. An approximate 80 percent success ratio was achieved in borehole drilling, to average depths of approximately 150m into Nubian Sandstones Formation or Weathered Basement Complex aquifers (UNDP, 1989(d)). Boreholes were screened in the bottom of the productive zone and cased with NCDRWR standard 6 5/8 inch diameter steel casing.

At 33 wateryards, 7 Teson deep well vertical turbine pumps coupled to 24 horsepower Lister diesel engines were installed on new boreholes. In most cases, pump capacity exceeded borehole yield so pumps were throttled back with gate valves. At other wateryards, including all rehabilitated borehole sites, Mono helical rotor pumps coupled to 12 horsepower Lister diesel engines were installed (Iskander, 1990).

Wateryard construction and wateryard rehbilitation was essentially the same activity, and consisted of the following equipment installation:

- galvanized sheet metal pumphouse and ancilliary building erection.
- erection of a elevated cylindrical steel water storage tank (nominal capacity 50m³).
- installation of a water distribution system, including tap stands for human consumption and troughs for livestock watering.
- erection of perimeter and internal cross fencing.

(UNDP, 1989(d)).

Sanitation/Hygiene Education Aspects

Unfortunatley, the UNDP/FAI Program did not integrate sanitation and hygiene education activities into either the planning or implementation of the program.

Under the Italy/Sudan Rehabilitation and Development Program - Darfur, rehabilitation of rural health clinics and dispensaries was undertaken, and some limited health education

via the rural health infrastructure (FAI, 1985). However, these activities were in no way coordinated with UNDP/FAI water provision activities.

Community Involvement

Unfortunately, the UNDP/FAI Program did not involve the beneficiary communities in the planning, construction or management of wateryards under the program. NCDRWR wateryard operating staff were retained at existing, rehabilitated wateryards and posted to newly-constructed ones. Upon completion of work at each site, the program handed over the wateryard to NCDRWR (UNDP, 1989(d)). Widespread reports of inoperative program wateryards and incidents of village vandalism to program equipment were reported soon after completion of the program (Iskander, 1990).

Operation and Maintenance Aspects

Operation and maintenance was not considered in program plans, beyond the provision of spare parts, supplies and equipment operation manuals. The contractor was required to provide a 12 month period of maintenance to boreholes drilled and wateryards constructed: beyond that maintenance was the responsibility of NCDRWR who legally owned each wateryard.

Of the 65 wateryards constructed or rehabilitated eventually under the UNDP/FAI Program, 27 (42 percent) were inoperative as of March 1990, about 6 months after the completion of the program (NCDRWR, 1990(b); Iskander, 1990). While most of the Mono pump installations were operative, 82 percent of the deep well vertical turbine pumps were broken down. In most cases, NCDRWR pump operators had un-throttled these pumps, and caused them to overpump the borehole, run dry, and subsequently burn out. In some cases, sand in the borehole had worn out the pump impellers (Iskander, 1990). UNDP's response was that perhaps a wateryard maintenance program was required for the future (UNDP, 1989(d)).

Financial and Cost-Recovery Aspects

The program budget of approximately $14 million U.S. was exceeded somewhat, and actual expenditures totalled about $17.7 million U.S. according to MFEP sources (MFEP, 1990). In the absence of more accurate financial information from the program, the above figures would appear to be realistic.

The program completed 65 wateryards (UNDP, 1989(d)) for a crude unit cost of $273,000 U.S. per wateryard: considerably above unit costs of about $80,000 U.S. reported by NCDRWR and USAID/CARE in Kordofan Region (see Section 5.3). Since Darfur is more isolated, it is reasonable to expect higher travel and transport costs to be incurred for wateryard construction and rehabilitation in Darfur as compared to Kordofan. However, the presence of 30 expatriates on the program team plus the expatriate managed UNDP input no doubt is responsible for the bulk of the costs and expenditures.

Aspects of cost-recovery related to capital or recurrent costs were not considered by the program.

Implementation/Construction

The construction and rehabilitation work proceeded rapidly once it was decided to downsize the original program to the drilling of 72 new boreholes and the rehabilitation of 21 boreholes, in a total of 65 wateryards. This "reassessment" (UNDP, 1989(e)) occurred by mutual consent between UNDP/FAI and the contractor once the difficulty of working in Darfur had been recognized, and in keeping with FAI legislation requiring "a rigid timeframe for the commitment of funds and completion of the [program]" (FAI, 1985, page 1). In fact, FAI was required to commit all its funds by September 1986, and have all funded programs completed "soon after" (page 1).

The crews worked 24 hours a day, seven days a week on a rotational basis. The two drilling crews totalled 24 expatriates, with laborers and assistants from NCDRWR.

Drilling commenced in April 1987, and 8 boreholes were drilled that year. In 1988, 41 boreholes were drilled, and in 1989, 23 boreholes, for a total of 72 by May 1989. In addition, 21 boreholes were rehabilitated. The drilling crews were also responsible for pump and engine installation (UNDP, 1989(e)).

Civil works crews consisted mostly of laborers and artisans from NCDRWR, with supervision by 6 expatriate staff. In total, 45 personnel from NCDRWR were employed on the program (UNDP, 1989(d)). Wateryard construction and rehabilitation commenced in February 1988 and was completed in September 1989. Average throughput of wateryards, initially slower, reached 8 to 10 wateryards per month by late 1988 and early 1989.

In order to speed implementation and to provide comfort for the expatriate workers, a considerable amount of program infrastructure was imported as part of the overall Italy/Sudan Program. In addition to heavy-duty equipment, vehicles and wateryard materials, the program constructed a large prefabricated compound on the outskirts of El Fasher, complete with offices, houses and hostel accommodation. A large generator provided air-conditioning and power for the entire compound of some 100 men. The contractor leased a light plane for transport of personnel and supplies to and from Khartoum. This was in addition to the UNDP light plane fleet that included El Fasher as a regularly scheduled stop.

Coordination

Relationships between the UNDP/FAI Program and NCDRWR Darfur Region were surprisingly good. The NCDRWR Regional Director was very supportive of the program and pleased with the results (NCDRWR, 1990(b)). In large part, this relatively harmonious relationship that existed, despite the obvious bypassing of NCDRWR by the program, was a result of shared philosophy. Both NCDRWR and the program emphasized the rapid construction of new facilities, and had little interest in

less tangible activities such as community development and hygiene education. Even in the area of operation and maintenance, both parties were in agreement: NCDRWR had long maintained that the problems with water system operation and maintenance in Sudan were the result of NCDRWR not having enough resources, equipment and spare parts (WHO, 1989; NCDRWR, 1987(b)).

Relationships between the UNDP/FAI program and the Darfur Regional Government were less than harmonious. The main reasons for this friction had little to do with actual program activities, but were peripheral and related to logistics, security and politics. With diesel fuel being scarce in Darfur, and the program's diesel needs being great, direct import of vast quantities of diesel was undertaken by the program contractor. Diesel is power in Darfur in more ways than one, and the program was in the position of controlling more fuel than all the government departments combined (Iskander, 1990). Rumours of black marketeering of diesel and corruption abounded.

The security situation in Darfur was very dangerous in the latter part of the IDWSSD, with widespread inter-tribal conflict. Frequent highway robbery and international conflicts with neighbouring Chad and Libya were all occurring simultaneously. Officially however, Darfur was safe and secure (GOS, 1988). The program was loud and long in its criticism of the lack of security in Darfur (see for example UNDP, 1989(e), page 12), which hardly endeared it to the Regional Governor. An added dimension to the problem of poor relations with the Government revolved around UNDP's coordination of Operation Lifeline in the latter part of the decade. Operation Lifeline, to provide food relief to southern victims of the civil war, ran counter to official Government civil war strategy employing starvation of the south as a weapon (UNDP, 1990) and generated acrimonious relations between the government and UNDP.

Beyond this, there was little interaction between the UNDP/FAI program and other players in the rural water sector. While the UNDP water sector staff based in Khartoum were relatively involved in general sector activities, they seemed generally unaware of and uninterested in program activities in Darfur (UNDP, 1989(f)). The UNDP Office of Execution staff in Darfur, whose main activity was managing the program, communicated infrequently with UNDP Water Sector staff (UNDP, 1989(d)). They communicated even less with other ESAs active in the sector, and did not participate in sector conferences and a workshop organized during the latter part of the IDWSSD. On a regional level, communication and collaboration with other sector projects being implemented concurrently were notable in their absence (Iskander, 1990).

Monitoring/Evaluation

UNDP Darfur provided monthly work progress reports, both quantitative and narrative to UNDP Khartoum headquarters. The reports essentially were construction progress reports, emphasizing dates, elapsed times and percent completions. Technical data related to borehole depths and yields were collated (UNDP, 1989(e)). The narrative, rarely more than one page long, likewise emphasized problems that impeded construction progress and forecasted program completion dates based upon current month progress. No formal evaluation was conducted of the water component, although FAI personnel and representatives of the Italian Government did visit the program site from time to time.

Outcomes

Specific outcomes of the UNDP/FAI Program (water component) included the drilling of 72 new boreholes and the rehabilitation of 21 existing boreholes, and the new construction or complete rehabilitation of 65 wateryards.

Major Issues

The UNDP/FAI Program failed to address any significant issues of the IDWSSD. However, the program did substantially (and probably temporarily) increase wateryard coverage and service levels in northern Darfur.

Major Constraints

Major constraints faced by the program included considerable friction and difficulty in relationships with the Darfur Regional Government, entire emphasis being upon the construction of new water supplies, combined with an "emergency" bias, being detrimental to sustainability, total lack of sector coordination and collaboration, and security difficulties posed to expatriate and local staff in some areas of operation.

Future Constraints

It appears that the UNDP/FAI effort in the rural water sector was a "one-off" event, and beyond some mention of a possible wateryard maintenance project in the future (UNDP, 1989(d)), the Italian Government has expressed no interest in future sector work in Darfur (Iskander, 1990).

Wateryards completed under the program are non-sustainable, and will require rehabilitation, apparently quite soon. UNDP's efforts with the World Bank in developing an effective sector policy for Sudan, if successful, may lead to the institutionalization of an appropriate wateryard operation and maintenance strategy (WHO, 1989). However at this point, the program's outcomes are in jeopardy.

Sector Implications

Beyond providing a recent example of a technology-driven program in the sector, in the style of the 1970s and early part of the IDWSSD (McGarry, 1991), the UNDP/FAI Program provides no positive implications for sector development in

Sudan or elsewhere.

5.6 CIDA/WUSC Project

The World University Service of Canada (WUSC) had been involved in Darfur Region as a sub-contractor during the 1985 and 1986 relief effort, responsible for the logistics of food aid transport and distribution. It had identified the need for improved water supplies in the area (WUSC, 1985(a)(b)) and sought support from various ESAs for a water supply program in the area. CIDA had not been involved in bilateral sector development in Sudan, but proceeded along with USAID in funding a water, sanitation and hygiene education project implemented by WUSC in northern Darfur.

Project plans called for the rehabilitation of 15 wateryards and the construction of 10 new wateryards (total 25) and the development and implementation of a community-managed wateryard operation and maintenance strategy on a pilot basis. Also, hygiene education, sanitation promotion and other human resource development activities were planned (WUSC, 1988). Funding for the Northern Darfur Water, Sanitation and Hygiene Education Project was provided by CIDA (80 percent), and USAID in local currency (20 percent). The total project budget was approximately $4 million U.S.

Project implementation by means of a WUSC/NCDRWR agreement commenced in September 1987 and concluded three years later in August 1990. By the end of the project, improved water supplies had been provided to 16 communities, through a combination of wateryards, waterpoints (borehole and pump only) and the upgrading of existing supply and storage systems (WUSC, 1990(a)). Implementation activities were considerably different than those planned, although wateryard rehabilitation or construction was still the main emphasis of the project.

The project was evaluated by CIDA in 1989 and, although concerns were expressed about the scope and nature of

construction progress, the project's efforts in developing and implementing a community-managed wateryard operation and maintenance strategy were seen as successful (CIDA, 1989). Hygiene education activites were generally successful but not completed (WUSC, 1990(b)), and sanitation promotion was a relative failure (WUSC, 1990(a)). At the completion of the project, both WUSC and CIDA withdrew from the rural water sector in Sudan, and to date have not attempted to replicate the project's activities.

Objectives

The long term objective of the CIDA/WUSC project was to improve the health and productivity of rural peasant farmers in northern Darfur, and to accommodate temporary influxes of nomadic pastoralists in this drought-prone area. This objective was to be partially achieved by the provision of potable water and adequate sanitation facilities through the project (WUSC, 1988, page 1).

Specific project objectives included the rehabilitation of 15 existing wateryards, the construction of 10 new wateryards, the development and implementation of a long-term operation and maintenance strategy for the 25 wateryards, formal and on-the-job training for water supply (NCDRWR) and hygiene education and community workers, and the construction of 100 VIP latrines in the villages served by the 25 wateryards. (WUSC, 1988, page 2)

Development/Evolution

WUSC's initial proposals included the rehabilitation of existing wateryards, the rehabilitation and construction of haffirs, shallow well rehabilitation and construction, and the devlelopment of a community-based operation and maintenance system (WUSC, 1985(a)(b)). Funding for these proposals, estimated to cost $5.4 million U.S. over a 24 month implementation period, was sought from USA For Africa, Band

Aid, Africa 2000, and various other emergency relief- oriented groups.

In 1986, CIDA expressed interest in supporting a sector effort in northern Darfur,and with subsequent substantial modifications accepted the WUSC proposal. Haffir and shallow well activities were dropped, and hygiene education and sanitation promotion components added. CIDA support was conditional upon supplementary funding being obtained for local operating costs. After considerable discussion, USAID agreed to provide approximately 20 percent of project budget in local currency.

Planning Undertaken

Pre-implementation planning by CIDA staff and a CIDA consultant resulted in the definition of project objectives with emphasis upon sustainability and maximizing health impact (CIDA, 1989). Based upon data collected exhaustively by WUSC in 1985 and 1986, and upon data supplied by IES staff (IES, 1990) the inevitable list of project sites was prepared and enshrined in the subsequent (1987) CIDA/WUSC contribution agreement. This list was to prove to be a bone of contention throughout the project.

The project began in September 1987, and immediately NCDRWR requested changes to the list of project sites. The subsequent WUSC/NCDRWR implementation agreement (October 1987) therefore lists different villages than project plans. The list was to change many more times during the period of implementation, and was still dynamic a few months before the end of the project (WUSC, 1990(c)). The result was that the villages actually served by the project bear little resemblance to those planned to be served. Criteria used in selecting (and deselecting) villages included political considerations by the Government of Sudan (NCDRWR, 1990(b)), technical considerations especially the quality and quantity of groundwater available (Iskander, 1990),and logistical and

security considerations (WUSC, 1990(c)). Community needs and willingness to participate were only minor considerations in site selection decisions.

Other, more positive examples of planning changes during implementation include:

- the expansion of formal and on-the-job training activities to include a comprehensive human resources development effort in cooperation with a Sudanese training institution (IES).
- the development of plans for an operation and maintenance strategy during implementation, based upon negotiation with all parties and modified by emerging conditions.
- enhanced localization and institutionalization of project activities and the de-emphasis of expatriate technical assistance.

(WUSC, 1990(a))

The above represented a continual source of confusion and suspicion to many individuals involved with the project (CIDA, 1989. WUSC, 1990(c)) but do reflect an adaptive and flexible approach to project planning on the part of project management. However, project management's role in planning was officially minimal but nevertheless tolerated (WUSC, 1990(c)).

Institutional Framework

The WUSC/NCDRWR implementation agreement states that "All work for the project is the responsibility of the WUSC Project Manager. Active cooperation with WUSC in all elements of the project work will be provided by NRWC [sic]" (WUSC, 1988, page 2). Despite this obvious attempt at bypassing NCDRWR, the CIDA/WUSC project actually integrated itself well within the Government of Sudan sector institutional framework.

Initially, 5 expatriate personnel were planned to assume key line management positions within the project's organizational structure. NCDRWR was to provide about 50

technical, artisan and support staff. Although initially 4 expatriates were briefly fielded, only one remained with the project for the duration. This "forced" localization which occurred during 1988 (WUSC, 1990(c)) proved to be very beneficial. More seconded NCDRWR staff assumed key line management positions, local consultants were retained to provide technical and administrative input, and the number of seconded NCDRWR artisan and support staff more than doubled as project activities accelerated. The lone expatriate project director assumed a motivational role, and retained overall responsibility for project activities (WUSC, 1990(c)). A project steering committee composed of representatives from USAID, MFPE, NCDRWR and WUSC met bi-annually, and the project participated in the inter-project committee meetings in Darfur, held several times a year.

The seconded NCDRWR project engineer supervised the borehole construction and rehabilitation crew, the wateryard construction crews (initially seconded from NCDRWR, later sub-contracted from NCDRWR), community development workers, and hygiene eduction and sanitation promotion crews. The project engineer reported to both the NCDRWR Regional Director in El Fasher, and to the CIDA/WUSC project director in Khartoum. Sudanese consultants were retained to assist the project engineer in community develoment, hygiene and sanitation, and borehole development (WUSC, 1990(a)).

Sector Context

The CIDA/WUSC project represents an attempt to balance the rehabilitation of existing water sources with the construction of new water sources, emphasizing the overriding need to develop a sustainable operation and maintenance strategy. By focusing upon the operation and maintenance of relatively high technology wateryards, the CIDA/WUSC project is unique in the context of the sector in Sudan during the IDWSSD.

Also, the CIDA/WUSC project attempted to integrate hygiene education and sanitation promotion with its water provision activities, the sanitation promotion being innovative in northern Darfur. By emphasizing human resources development, the project attempted to become and remain software-driven (CIDA, 1988(b)), despite relatively ambitious construction plans.

Technology Choice

Wateryard rehabilitation and construction were essentially the same technical activities at each site. New boreholes drilled by NCDRWR and older existing boreholes were developed, cleaned and repaired as required. Existing Edeco reciprocating piston pumps and Lister diesel engines were removed, and new Lister diesel engines (8 horsepower) and Mono helical rotor pumps installed at each site. New pumphouses, and elevated sectional steel storage tanks (nominal capacity 50m^3) were erected at each site, and a new water distribution system installed with separate areas of tap stands for human consumption and troughs for livestock watering. Perimeter and internal cross fencing of thorn bush or barbed wire was erected.

Boreholes in the project area were generally very deep, averaging 250 m (Iskander, 1990). Care was taken to select boreholes completed in either the Nubian Sandstones Formation or Um Ruwaba Series aquifers, avoiding the less productive Weathered Basement Complex aquifers. Borehole yield averaged 1.5 L/S, requiring the installation of second boreholes at more heavily used wateryards (4 sites) (WUSC, 1990(a)). At three sites, water demand was considered high enough to warrant the construction of second wateryards, some distance from the primary wateryard, in an attempt to reduce the congestion of people and animals.

Sanitation/Hygiene Education Aspects

Separate objectives for sanitation promotion and hygiene education were reflected in a fair degree of separation in the implementation of these two activities.

Four female and one male health extension workers were recruited, either by secondment from MOH and MOSW, or by contract employment, and given initial training in community mobilization and promotion. An in-service training course was held for these staff and other government personnel early in the project, conducted by IES and the Department of Community Medicine, University of Zimbabwe (WUSC, 1990(a), page 25). The major activites of the hygiene education team were to conduct a comprehensive health and hygiene survey at each village, conduct a hygiene education program at each village, help organize and train both formal and informal village health committees, and to measure the impact of hygiene education activities in each village.

Surveys and hygiene education programs were conducted at all project villages, and health committees were established at most sites. Due to delays in project implementation, these activities were on-going at the end of the project, so that a proper impact survey was not possible. IES did perform a limited impact survey in 3 project villages in 1990, and found "despite ... reservations there are clear indications of change of behaviour as a result of the health education campaigns" (WUSC, 1990(b), page 17).

Sanitation promotion was initiated during hygiene education activities, but the construction of demonstration VIP latrines and the training of village masons was undertaken by the community development and construction staff of the project. Logistical problems affecting project wateryard construction also affected VIP latrine construction (Iskander, 1990) and by the end of the project only 64 latrines out of a planned 100 had been completed (WUSC, 1990(a), page 48). Despite some interest by individual villages, the adoption of

latrines was less than enthusiastic, partially because of their high cost (WUSC, 1990(b)).

To support its sanitation promotion activities, the CIDA/WUSC project conducted a number of in-service training courses for government personnel, including:

- Low Cost Water Supply and Sanitation (1988).
- Water, Sanitation and Hygiene Promotion in Rural Communities (1989).
- Rural and Peri-urban Sanitation Planning and Implementation (1990).

The latter course was instructed by the Blair Research Institute, Zimbabwe, who had originally developed the VIP latrine. A comprehensive training manual was prepared (Blair Research Institute, 1990). In addition, a three month scholarship was provided to an MFEP sector planner to obtain training in sanitation program planning and appraisal (WUSC, 1990(c)).

Community Involvement

Individual villagers had no real input into the selection of their village for inclusion in or exclusion from the project. The scope of work and type of water system to be provided was likewise predetermined by the project. However, once project activities were underway in the village, community involvement was encouraged and usually materialized.

A community development worker aided by project management staff and a local consultant was responsible for forming a new (or strengthening an existing) village water committee at each site, providing administrative and financial training to the village water committee and wateryard clerk in their employ, providing technical training to the committee-employed wateryard operator (mechanic), and supervising the construction of demonstration VIP latrines at each site. (WUSC, 1990(a))

Despite being faced with a rather intimidating set of

duties, the community development worker was generally successful in accomplishing these tasks, the first three being the cornerstones of the project's community-managed operations and maintenance strategy (WUSC, 1989).

An assessment of the project's community develoment efforts conducted by IES in 1990 was generally flattering, but concluded that village water committee members needed more training, especially in financial management, women should be incorporated into the committee structure, and that NCDRWR will require further sensitization to accept the concept of community management of wateryards. (WUSC, 1990(b), page 23).

Operation and Maintenance Aspects

The overriding objective of the project was to ensure sustainability of the water supplies provided by the water provision work (CIDA, 1989). Initially, an operation and maintenance agreement was prepared by WUSC and signed by NCDRWR and MFEP to enable the implementation of an innovative strategy at project wateryards. The main articles of the agreement were:

- the establishment of a revolving fund into which all wateryard revenues are depositied and coded for each individual wateryard;
- the upward revision of water rates to realistic levels of 5 piastres per jerrycan (18L), equivalent to 2.77 Sudanese Pounds per cubic meter (subsequently raised to 10 piastres /5.56 Pounds per cubic meter);
- the joint management of the revolving fund (for operation and maintenance purposes only), by WUSC/NCDRWR and the community served. Surpluses in the fund are the sole property of the community;
- the establishment of effective and empowered community water committees at each wateryard;
- adequate record-keeping procedures for the collection, remittance and disbursement of wateryard revenues, and

for pump operation times, fuel consumption and water consumption;

- the regular provision of fuel, lubricants and spare parts on a cost-recovery basis by NCDRWR. WUSC would subsidize this cost for the duration of the project;
- emphasis upon preventive maintenance of wateryard equipment by training community pump operators and by the provision of regular preventive maintenance inspections by NCDRWR on a cost-recovery basis;
- regular reporting on the performance of wateryards and the revolving fund credits, debits and balances to the community water committees.

In essence, community management of wateryard operation and maintenance (WUSC, 1990(a)) was agreed to, with the community water committee taking the lead role and NCDRWR providing a strong supporting role. WUSC was to act as a facilitator, to assist both parties in effectively performing their respective roles and responsibilities.

Five comprehensive reports were prepared regarding the implementation and performance of the operation and maintenance agreement:

1. Operation and Maintenance Decision-Making at the Village Level.
2. Community-Based Operation and Maintenance of Wateryards in Northern Darfur, Sudan.
3. Institutional Analysis: Community and Government Roles in the Management of Rural Water Supplies.
4. Operation and Maintenance of Rural Wateryards in Northern Sudan.
5. Basic Issues for Sustainable Operation and Maintenance of Rural Water Supplies in Sudan.

(see WHO, 1989; IES, 1990)

These reports were presented at a conference and a workshop and widely circulated and discussed with GOS, multilateral, bilateral and non-government ESAs. A

conference on Sustainable Operation and Maintenance of Rural Water Supplies in Sudan was held in May 1989. This conference was organized by WUSC, IES and NCDRWR. The discussion centred around presentations on: experience in operation and maintenance vis a vis community participation, appropriate technology and cost-recovery systems (NCDRWR); case studies of operation and maintenance experiments and experiences in Sudan to-date (IES, UNICEF, WUSC, AMREF, WADS, KfW, MFEP); preparation and design of a national operation and maintenance action plan (WHO, RWSG/EA,IES). The conference concluded with the formation of an operation and maintenance working group to address the issues raised at the conference and to provide input into the current Government of Sudan-UNDP/World Bank sector policy review and formulation project. Conference proceedings were subsequently published by WHO as part of their comunity water supply and sanitation series (see WHO, 1989).

A workshop entitled Sustainable Operation and Maintenance of Rural Water Supplies in Sudan was held in May, 1990. This workshop was organized by WUSC and IES and designed as a follow-up to the May 1989 conference on the same topic. The workshop activities centred around discussing and resolving operation and maintenance issues related to: appropriate technology, standardization and local manufacture capabilities; cost recovery systems and financial management of rural water supplies; community and government roles in the planning and management of rural water supply operation and maintenance. The workshop proceedings were subsequently published by IES (see IES, 1990(b)).

An operation and maintenance service group was formed within the project to provide technical and administrative support to each community water committee and to provide preventive maintenance and repair services to each project wateryard. The operation and maintenance service group of seconded GOS personnel consisted of an operation and

maintenance coordinator, an operation and maintenance community development worker, and 4 tradesmen (2 based in El Fasher District, 2 based in El Ait District). The service group had 3 vehicles equipped with radios and spare parts stores/workshop facilties in both districts. The service group arranged for the supply of fuel, lubricants and fast-moving spare parts to each wateryard, at cost plus 30% overhead performed regular preventive maintenance work at each wateryard and repairs, as required, at cost plus 30% overhead; assisted each community water committee in the financial and technical management of their wateryards; and collected monthly wateryard revenues, presented monthly revolving fund balance statements and administered the revolving fund on behalf of the communities.

The cost of providing the management advisory services to each wateryard is charged at cost plus 30% overhead.

The institutionalization of the operation and maintenance strategy was to be completed near the end of the project by the signing of an operation and maintenance agreement between the community water committees of the project wateryards (as represented by the Assistant Governor, Development, Darfur Regional Government) and the Darfur Regional Office of NCDRWR. The agreement sets forth the following main articles:

- all revenues collected from the sale of water at the individual wateryards are the property of the individual comunity water committee;
- the established revolving fund is maintained, jointly administered by the community water committees and NCDRWR;
- the community is responsible for overall management of the wateryard;
- NCDRWR will provide fuel, lubricants, spare parts, maintenance and repair services to each wateryard as requested at cost plus 30% overhead.
- the operation and maintenance service group established

by WUSC will be incorporated within NCDRWR, to provide service to all project wateryards as above;

- full and accurate record-keeping is the responsibility of both the community water committee and NCDRWR, supervised by the operation and maintenance service group.

Data on wateryard technical and financial performance was collected and tabulated, commencing July 1989. Table #21 is a summary to May 1990 of the average technical and financial performance of a typical project wateryard. As can be seen from Table #21 average monthly operation and maintenance costs are considerably less than average wateryard revenues, reflecting the financial sustainabililty of the CIDA/WUSC strategy.

Financial and Cost-Recovery Aspects

Recurrent cost-recovery as specifically related to wateryard operation and maintenance is discussed in the preceeding section.

NCDRWR provided a significant contribution in kind in the form of seconded staff salaries, and office and workshop facilities, estimated to be equivalent to approximately $0.5 million U.S. (CIDA, 1989).

With the total project budget approximately equal to $4 million U.S. (taking into account various exchange rate fluctuations in both Canadian Dollars and Sudanese Pounds), and the actual number of wateryards completed being 13 (WUSC, 1990(a), page 4), then the unit cost per wateryard was some $308,000 U.S. This is considerably more than the $80,000 U.S. per wateryard reported by NCDRWR and USAID/CARE in Kordofan Region, and even more than the $273,000 U.S. per wateryard incurred by the UNDP/FAI Program in north Darfur. This was an expressed concern of CIDA (CIDA, 1989), but was not satisfactorily explained by WUSC. A partial explanation for the very high unit costs of the project may be the fact that procurement proceeded for 25 units but implementation failed

to construct this number: the balance of equipment and supplies being handed over to NCDRWR at the completion of the project (WUSC, 1990(c)).

Implementation/Construction

The CIDA/WUSC contribution agreement was signed in August 1987 and the WUSC/NCDRWR implementation agreement was signed in October 1987: it was agreed that the project life span of three years would extend from September 1987 until August 1990 (CIDA, 1989).

Logistical delays affected the project from the first stages: delays in port clearance of equipment and unreliable transportation of equipment to the field, combined with expatriate personnel problems and poor communications, resulted in a delay in the start of construction on a substantive scale until September 1988 (WUSC, 1990(a)). This "lost year" was of particular concern to CIDA (CIDA, 1989) and ultimately resulted in the reduction of the scope of project rehabilitation and construction work from 25 to 16 wateryards. During the first year of implementation, a hygiene education team was assembled and trained, and commenced work in the field. The team was initially responsible for community development also. A community development worker specifically for implementation of the operation and maintenance strategy was fielded in October 1988 (WUSC, 1990(c).

During 1988 and 1989, wateryard rehabilitation and construction was undertaken directly by the project, using seconded NCDRWR personnel. Progress was slow and by the end of the second year (August, 1989), only 3 wateryards had been rehabilitated (WUSC, 1990(d)). An experiment to use community labor for wateryard fencing proved to be counterproductive: progress was equally slow and usually payment of the community was required (Iskander, 1990). For the final year, wateryard rehabilitation and construction was sub-contracted to NCDRWR, and progress improved somewhat. By June 1990, 13 wateryards

and various ancilliary works (see "Outcomes" section) had been completed (WUSC, 1990(a)). Thus, only a little more than half the planned construction work had been implemented, while the project budget had remained essentially the same (WUSC, 1990(c)).

As mentioned, construction plans during implementation were very fluid, with various styles of wateryard being attempted (Iskander, 1990), and the list of project sites in a constant state of flux (CIDA, 1989).

Coordination

Project activities were well coordinated sectorally, with evidence of significant cooperation and collaboration with all major ESAs and NGOs active in the sector in Sudan during the project period (WUSC, 1990(a), pages 30, 31). Project personnel played a leading role in the promotion of sustainable wateryard operation and maintenance (WHO, 1989), organizing a sector conference and sector workshop, and collaborating with the UNDP/World Bank Sector Review Project (World Bank, 1989, (b)).

Relationships between the project and NCDRWR both Regionally and Nationally, and with MFEP, were excellent, and contributed to the areas of success in the project (MFEP, 1990). The localization of project management and the use of Sudanese experts as consultants no doubt contributed to the positive relationship with the Government of Sudan. This was recognized by other players in the sector and "bilateral and multilateral ESAs frequently consulted WUSC ... to guage current directions in the GOS water and sanitation sector in general and within NCDRWR and MFEP specifically" (WUSC, 1990(a), page 31).

USAID took an active interest in the project and attempted to persuade other NGOs implementing or planning similar projects (CARE and Save the Children U.S.), to consult with WUSC and adopt a similar model for operation and

maintenance of wateryards (USAID, 1989). Also, USAID was able to provide considerable input into the design of the CIDA/WUSC project, based upon its experience in the USAID/CARE (Kordofan) project of 1986 to 1988.

Monitoring/Evaluation

Periodic project monitoring was undertaken by both the USAID country engineering office and by CIDA (Ottawa Headquarters and Ethiopia Field Office). Monitoring visits by USAID and CIDA were made both separately and together, for a total of 5 visits during the project period (WUSC, 1990(c)). Reports were prepared and submitted to the project steering committee semi-annually, and quarterly and annual reports were prepared for CIDA and also circulated to USAID. Monthly progress reports on all project activities were prepared for NCDRWR, both Regionally and Nationally (WUSC, 1990(d)).

An "unofficial" process evaluation was conducted by CIDA in late 1989 (CIDA, 1989), with the main purposes of determining the likely outcomes of project wateryard rehabilitation and construction activities; gauging the effectiveness of project hygiene education, and community development activities related to wateryard operation and maintenance; and assessing the feasibility and desirabililty of proceeding with a second phase of the project, to be implemented in 1990 to 1991 and possibly beyond. (CIDA, 1989; WUSC, 1990(c)).

The results of this process evaluation were not distributed by CIDA, however the decision was made not to proceed with the project beyond the initial August 1990 completion date.

Outcomes

Specific outcomes of the CIDA/WUSC project included the rehabilitation or construction of 13 wateryards, four with second borehole supplies, the construction of 3 community

waterpoints (borehole and pump installation only), the upgrading of 3 small urban water supply systems (borehole or water storage rehabilitation), the development and implementation of a community-managed wateryard operation and maintenance strategy at the 13 wateryards, hygiene education training at 16 communities, and sanitation promotion at 16 communities.

Major Issues

The major issues addressed by the CIDA/WUSC project include: the feasibility of establishing a community-managed wateryard operation and maintenance strategy embodying recurrent cost-recovery on a pilot scale; the feasibility of integrating hygiene education, and to some extent sanitation promotion, with water provision activitie; the effectiveness of localization of project management and project implementation; and the utility of focussing most project activities upon human resources development.

Major Constraints

Constraints faced by the project included logistical and security problems currently endemic to Darfur Region, and over ambitious project plans considering the isolation of the project and the restricted implementation time frame.

Future Constraints

Community-managed wateryard operation and maintenance was established on a pilot scale in northern Darfur. Attempts were made to institutionalize this arrangement by concluding an enabling agreement between NCDRWR and the 13 village water committees, but this was not completed before the end of the project (WUSC, 1990(c)). Government of Sudan legislation passed in 1990, allowing the establishment of community revolving funds for wateryard operation and maintenance, will contribute to the viability of the project's achievements in

operation and maintenance, but will not ensure their continuation. Much depends upon the good will of all parties concerned in the arrangement.

If the project's operation and maintenance strategy proves to be administratively and financially sustainable, potential problems exist regarding technical sustainability. The wateryard systems rely upon imported diesel fuel and imported (relatively high technology) spare parts and equipment. Within the economic context of Sudan, import reliance on a large scale is of dubious wisdom. Alternative energy sources, such as solar energy and wind power, for wateryard pumping should be explored. Wateryard substitution with shallow wells or boreholes and handpumps should be considered whenever feasible, and may in fact be possible in many areas of northern Darfur (UNICEF, 1990(b)).

Sector Implications

The CIDA/WUSC project represents a fully integrated type of project in the rural water sector, concentrated upon operation and maintenance and human resources development. A small number of communities were ultimately served, at a relatively high cost and with a considerable amount of effort: this indicates that fully-integrated sector projects may tend to be more expensive and slower to implement than less-integrated projects.

With increasing emphasis in the sector on reducing unit service costs and providing "some for all" rather than "all for some" (UNDP, 1991), the CIDA/WUSC efforts in northern Darfur although generally successful may be too expensive to consider replicating.

6. Experiences and Initiatives of Other Relevant Programs and Projects

Various rural water provision initiatives have occurred in Sudan, both within the rural water sector and as part of multi-sectoral development efforts. These initiatives have taken place before and during the IDWSSD, and some are proposed for the post IDWSSD period. A brief examination of these initiatives is useful prior to the evaluation of the IDWSSD case studies presented in section 7.

Initiatives before and during the IDWSSD

Danish and Yugoslavian aid in the 1970s provided for the construction of more than 1,500 wateryards in Northern, Khartoum, Central and Kordofan Regions primarily. Implementation was done by NCDRWR almost exclusively, with little technical input from the ESAs (NCDRWR, 1987(b) (c)). Although various unofficial attempts were made by communities to independently operate and maintain these wateryards (IES, 1986) in the absence of this service from NCDRWR, most wateryards were in need of rehabilitation by the time of the IDWSSD (Sammani, 1989). By 1987, Yugoslavia had agreed to provide some $8 million U.S. for wateryard rehabilitation equipment (World Bank, 1988), and DANIDA were contemplating the provision of 59 million Danish Krona for the rehabilitation of 540 Danish-equipped wateryards (DANIDA, 1989, 1990). Both ESAs planned to fund only, with the NCDRWR doing the implementation.

Another interesting initiative involving wateryards is the Western Savanna Development Project (WSDP) implemented in southern Darfur commencing in the early 1980s, and funded by the United Kingdom Ministry of Overseas Development (ODA). The WSDP is primarily an agricultural development project focused upon environmentally compatible peasant agriculture and livestock production, emphasizing soil and water resource conservation. Within the WSDP area are some 233 NCDRWR

wateryards, nearly all of the provincial towns, in various states of disrepair (WSDP, 1987). The project turned some of its attention to wateryard rehabilitation, operation and maintenance, mounting a pilot project to establish the real cost of wateryard operation and maintenance in the project area and exploring the feasibility of substituting solar powered pumps for the existing diesel engine powered ones. This pilot project is on-going as part of the overall development activities of the WSDP, and has yet to produce any substantive results. However, various other research documents funded by ODA related to the rural water sector have been prepared (ODA, 1985, 1987).

UNICEF's water provision activities had commenced in Bahr el Ghazal Region in 1976, and by 1987 some 1,100 boreholes had been drilled and equipped with handpumps. In 1985, drilling operations commenced in Equatoria Region also, but by 1988 the rapidly escalating civil war in southern Sudan forced suspension of all UNICEF activities in these 2 regions (Dodge, 1988). The UNICEF program in the south had included hygiene education and sanitation promotion in the latter stages, but unfortunately nearly all of these initiatives have been lost with the massive social upheavals that have affected southern Sudan in the past five years. UNICEF also conducted a program in Eastern Region, Red Sea Province, commencing 1984 and on-going at the end of the IDWSSD. This program, serving primarily displaced peoples resettled into urban areas and government centres, was not integrated into UNICEF sector planning and programming as a development project, but was initiated and remains as an emergency response to a crisis occurring in the Red Sea Hill's area (IES, 1990(a)).

Similarly, UNHCR had been active in providing water supplies for Ethiopian refugees temporarily settled in the Eastern Region, primarily Kassala Province. In 1986 a comprehensive planning mission was conducted to examine water supply needs for urban and rural areas in Kassala Province,

primarily in response to a request of UNHCR (HARZA, 1986). Various additional water system schemes were proposed, including one of borehole drilling and water distribution for the main refugee camps. Subsequently, water provision to refugees by UNHCR was expanded.

The Islamic Development Bank provided NCDRWR with funds for wateryard borehole drilling in Eastern and Darfur Regions in the mid 1980s. Boreholes constructed were to either replace existing boreholes in wateryards, or to provide a second borehole source for more heavily used wateryards. Most of the drilling was done by private Sudanese contractors retained by the Islamic Development Bank (NCDRWR, 1988) and about 100 new boreholes resulted, mostly in Darfur Region.

The World Bank/IFAD funded Northern Stock Route Project in 1987/1988 constructed a series of wateryards from Nyala in southern Darfur to Khartoum, for the exclusive use of livestock herds being moved to market. The project was implemented by a German consulting company, Preussag. Although the stock route supplies were intended for a single purpose, pressure from local farmers and livestock owners along the stock route forced the widening of the intended supply envelope. The Government of Sudan, Livestock Production and Marketing Division, were responsible for wateryard operation and maintenance, but felt obliged after some time to involve NCDRWR in this activity (IES, 1990(a)).

Planned initiatives beyond the IDWSSD

The UNICEF Program in Kordofan Region is on-going at the present time, and attempts are being made to remodel the Red Sea Province Program along the same lines as the Kordofan Program. The U.K. ODA is planning at this point some additional technical assistance for wateryard rehabilitation, operation and maintenance within the WSDP (World Bank, 1988). The DANIDA wateryard rehabilitation funding proposal, delayed from its planned 1989 start, is now planned for 1991. In

addition, DANIDA funding to enable the expansion of UNICEF Kordofan Program Operations ($1.95 million U.S.) has been approved (DANIDA, 1989).

The UNDP/World Bank 3 year Water and Sanitation Sector Review and Action Plan Program commenced in late 1989. The program objectives are: establish a water and sanitation task force within the GOS water sector; prepare a sector policy framework paper; provide institutional strengthening and help establish more effective linkages between MFEP and related sector agencies; and promote local handpump manufacture. (UNDP, 1990(b)).

The program is funded primarily by the Nethlerlands and the African Development Bank, executed by the World Bank Regional Water and Sanitation Group (East Africa), and has a total budget of approximately $4 million U.S. One of the major expected outcomes from the program is the development of investment planning and program preparation systems, and the preparation of detailed sector project and program packages for subsequent ESA funding.

Concurrently, UNDP is undertaking an Economic Water Planning Model project with MFEP in an attempt to integrate water and land-use projects to optimize their socio-economic performance, produce a master plan for rural water development in Eastern Region, and develop sector institutional arrangements towards implementing the master plan. (UNDP, 1988(b)). With a project budget of about $666,000 U.S., the main thrust is the provision of a full-time expatriate water resources engineer, and part-time consultants (agriculture, computer applications, mathematical modelling). The GOS contribution of 416,000 Sudanese Pounds is primarily for a project director, counterpart water resources engineer, and various planners from MFEP. At the end of the IDWSSD, the project had not yet produced a workable model or master plan, and was on-going.

7. Results

7.1 Evaluation Framework

The analysis of case studies is a detailed evaluation of completed programs and projects conducted in Sudan during the IDWSSD. The analysis identifies the major lessons to be learned, with the goals of improving sector development management and improving the quality of future sector activities. The specific objectives are to:

1. Evaluate the approaches used by ESAs in planning and implementing sector programs and projects in Sudan during the IDWSSD.
2. Evaluate the appropriateness of the ESA programs and projects.
3. Evaluate the sustainability of the ESA programs and projects.
4. Outline an alternative strategy and approach to rural water sector program and project planning and implementation.
5. Evaluate the ability of GOS to contribute to and effectively manage completed programs and projects in the long term.

Each evaluation utilizes a modified version of a model initially developed by Cairncross et al (1980) for the evaluation of village water supply planning, and subsequently utilized by Therkildsen (1988) for the qualitative evaluation of sector program planning and implementation. The modified evaluation model used is a matrix where the programs and projects are assessed against a set of normative criteria established to allow quantification of program characteristics.

The evaluation of ESA approaches to planning and implementation employs a set of questions based upon normative criteria that reveal whether the approaches at various stages in the planning and implementation cycle tend to be control-oriented or adaptive. These criteria have been summarized

succinctly by Therkildsen (1988) and include long-term goals and objectives, shorter term plans and schedules, decision-making structure and procedures, information gathering and utilization procedures, beneficiary consultation and participation, and integration with local institutional framework.

The evaluation of program or project appropriateness employs a set of questions based upon normative criteria of appropriateness, as currently defined by sector ESAs. As evidenced by the 1990 New Delhi Statement and subsequent United Nations General Assembly Resolution, and as identified by most ESAs in various IDWSSD policy and planning documents, these appropriateness criteria include: integration of water, sanitation and hygiene education activities; human resources development; institutional capacity strengthening; community participation; low-cost technology; operations and maintenance strategy; enhanced role of women; and water resources considerations.

The evaluation of program or project sustainability employs a set of questions based upon normative criteria of technical, administrative and financial sustainability, as described in Cairncross et al (1980), and supplemented by sustainability criteria established by WHO (1989) and the UNDP/World Bank Water and Sanitation Program (1990). These criteria include: choice of technology including operating requirements; local manufacture of equipment and spares; training and institutional strengthening activities; community organization, training and empowerment activities; contribution to sector policy reform and sector linkage establishment; coordination and cooperation; capital and recurrent cost financial management; environmental compatibility; and local government commitment and sector capacity/capability.

7.2 Evaluation of ESA Approaches to Planning and Implementation

The evaluation model matrix shown in Table #23 utilizes the following normative questions and criteria:

A. Were long term objectives ambiguous and unclear?

B. Were long term objectives inconsistent?

C. Were detailed work schedules and production targets lacking?

D. Were both short and long term objectives subject to negotiated change?

E. Was planning and implementation authority decentralized between a number of agencies?

F. Were outside groups involved in decision-making?

G. Was decision-making within the agency(ies) made by planners, implementors and researchers?

H. Were pre-implementation data collected viewed as unreliable and suspect?

I. Was pre-implementation data collection kept to a limited amount?

J. Was monitoring during implementation used primarily as a means to gather more reliable data and contribute to a learning process?

K. Was uncertainty and unpredictability in the situation realized and the inherent risks posed by this accepted?

L. Was participatory planning encouraged?

M. Were effective communications established with beneficiary communities?

N. Did program/project plans evolve during implementation in response to emerging community needs and preferences?

O. Was technology used and water system type installed chosen by the community?

P. Was human resources development specifically identified as an objective?

Q. Were national government sector institutions fully involved in planning?

R. Were national government sector institutions fully involved in implementation?

S. Were expatriate technical assistance personnel primarily intended to advise and motivate local personnel?

T. Was emphasis placed upon national sector program and policy development issues?

Table 15 Evaluation of ESA Approaches to Planning and Implementation

Question or Criteria	Case Studies				
	UNICEF	USAID CARE	DGIS	UNDP/ FAI	CIDA/ WUSC
A	1	3	2	1	3
B	2	4	2	4	4
C	1	3	2	1	4
D	2	4	2	1	4
E	1	4	3	1	3
F	3	3	2	3	3
G	2	3	4	3	5
H	2	2	2	3	3
I	3	2	2	1	3
J	3	3	4	1	4
K	2	3	3	2	3
L	2	3	5	1	3
M	3	3	5	1	5
N	1	3	4	1	3
O	1	2	4	1	1
P	2	2	3	1	5
Q	3	3	3	2	3
R	3	3	4	2	4
S	3	2	4	1	5
T	3	3	2	1	4
Total	43	58	62	32	72

Score:
1 No
2 Generally No
3 Partly
4 Generally Yes
5 Yes

The results of the evaluation of ESA approaches to planning and implementation can be summarized within the context of a possible score ranging from 20 (control-oriented approach) to 100 (adaptive approach):

Most control-oriented	UNDP/FAI	32
	UNICEF	43
	USAID/CARE	58
	DGIS	62
Most adaptive	CIDA/WUSC	72

While none of the programs or projects showed strong adaptive approaches to planning and implementation, two programs (UNDP/FAI and UNICEF) exhibited relatively strong control-oriented approaches. The remaining three projects (USAID/CARE, DGIS, CIDA/WUSC) exhibited some adaptive and some control-oriented approaches to planning and implementation, with the CIDA/WUSC project being somewhat more adaptive than the other two.

The management approaches of the ESAs can also be analyzed in the context of their adherence to or divergence from key sectoral management concepts identified by the sector itself (for a discussion of the origins of the sector conceptual framework, see section 2.4). The key management concepts are:

- community participation and a full and effective role for women.
- institutionalization.
- human resources development.
- coordination and collaboration.

Community Participation/Gender Development

Community participation in program and project planning and implementation was encouraged to some degree by all of the case studies, except UNDP/FAI. Effort was generally put into establishing good communications with the beneficiary communities, usually after implementation plans had been substantially completed. Where identified as an objective, (UNICEF, DGIS, CIDA/WUSC) community management of completed water and sanitation systems was generally achieved, and a significant degree of community empowerment was also achieved. In two cases (UNICEF, DGIS), the key to empowerment lay in the use of VLOM technology, allowing community control over system operation and repair and essentially eclipsing the role of GOS in future operation and maintenance. In the other case (CIDA/WUSC), empowerment was achieved by political support and

legislative changes negotiated for the communities by project management personnel.

There is an apparent tendency for community participation to be incorporated into management activities when implementation is undertaken by either an NGO (WUSC, CARE) or by a relatively small contractor (IWACO in the case of the DGIS project). Large implementing ESAs (UNICEF, UNDP/FAI) tended to de-emphasize or limit community participation. In these latter two cases, program implementation emphasized the rapid construction of large numbers of systems.

Effective roles for community women in program or project activities can be identified in four cases (the UNDP/FAI Program being the exception). These roles centered around hygiene education and, to some extent where applicable, sanitation promotion activities. Women were the focus of this training and were organized into official or unofficial health committees in all four cases, thus receiving a degree of empowerment. In only one case (UNICEF) were women's roles extended into water system operation and maintenance and, hence, community management. The three other cases did not attempt to expand the role of community women into this area.

Within the context of rural Sudan, women's roles in community politics and decision-making are publically circumscribed, their influence being exerted privately within the context of the family (Mohamed, 1989, 1988). Community women however have the primary responsibility for family water provision, hygiene and sanitation practices. By providing a formal role for women in primarily hygiene education, four case studies involved women to some extent, but the more delicate issue of involving women in community management of the completed systems was largely neglected.

Institutionalization

Overall, implementation of program or project activities was institutionalized within GOS sector organizations, but

this was limited to the use of (primarily NCDRWR) technical, skilled and semi-skilled personnel for physical construction. In most cases, the management of implementation ranged from being generally to almost completely expatriate controlled and directed. Training provided during implementation was satisfactory, but again was limited to technical procedures in most cases. Only one example of institutionalized management (CIDA/WUSC) is in evidence, although the DGIS project was evolving towards this arrangement.

Considerable use was made of some GOS sector institutions and other local agencies in ensuring that water supplies (and sanitation facilities where applicable) were compatible with water resources and environmental conditions. The relative strength and experience of both IES and the NCDRWR Groundwater Research Department contributed to this degree of institutionalization. Weaker links in the GOS sector identified previously (Baldwin, 1988; UNDP, 1988(c)), were generally bypassed, and little effective attempt was made to strengthen these weak links and build institutional capacity within the GOS sector. However, both the CIDA/WUSC and DGIS projects made some attempt to build institutional capacity by expanding their training beyond a strictly technological base.

GOS showed a relatively strong degree of commitment to most of the programs and projects, especially where they felt an urgent sector need was being (at least in part) addressed. These needs were technologically-based however, and concerned the installation of handpumps (UNICEF) and the rehabilitation of wateryards (CIDA/WUSC). Evolving GOS commitment to sector policy reform was reflected in their committment to individual sector programs and projects, which increased during the IDWSSD. Political and bureaucratic disruptions in the latter part of the IDWSSD unfortunately placed this on-going and increasing commitment in jeopardy.

Human Resources Development

Increasingly, attention of sector ESAs is being placed upon human resources development, but debate over the definition and role of human resources development is not yet resolved (Livingstone and McPherson, 1991). Human resources development, encompassing training, institutional strengthening and sector linkage establishment was effectively absent from all of the case studies, with one exception.

The CIDA/WUSC project, in line with CIDA sector policy, attempted to focus upon human resources development, and in general the delivery of the project's training courses, scholarships and other human resources development activities was effective. The impact of these activities is difficult to evaluate, but it does appear that efforts to establish sector linkages had a beneficial impact.

The DGIS project concentrated upon a large number of fairly tightly-defined training courses, but did not expand their human resource development activities into other areas. Village-level training was provided by UNICEF in handpump operation and repair, and an attempt was made to conduct institutional strengthening by organizing a conference on rural water supply.

Overall, the attention paid to human resources development can be described as piecemeal, where it was addressed at all. The one attempt to focus project activities upon human resources development was constrained to a significant extent by the project construction implementation time frame.

Coordination and Collaboration

Sector activities in Sudan during the IDWSSD can best be described as being fragmented and isolated. Other development activities in Sudan have been noted as having the same appearance (Bennett, 1987, page 48). In part, the vastness of Sudan is responsible for the scattering of sector development

activities, but lack of coordination of activities regionally and nationally, and generally poor collaboration between sector ESAs active in Sudan, are the main reasons for this disjointed development.

Weakness within GOS sector planning agencies in part is responsible for the uncoordinated approach to sector development. Individual ESAs did little to ameliorate this situation, tending instead to promote their own programs and projects for their own ends. This is reflected in the emergency-relief emphasis of some programs and projects, and the pilot-project status of others. In the absence of an effective GOS sector policy, it is not unexpected to find a poorly-coordinated array of individual types of programs and projects.

With most major sector ESAs represented in Sudan, it could be expected that collaborative efforts would be relatively well advanced. However, the continuity of individual ESA involvements in Sudan tended to be sporadic, and in general their interest in the rural water sector was lacking. Other than preliminary efforts by the CIDA/WUSC project to establish a sector collaborative forum to address the issue of operation and maintenance, ESA sector collaboration was substantially lacking. Increased sector activities by the UNDP/World Bank Regional Water and Sanitation Group (based in Nairobi) towards the end of the IDWSSD appeared to be contributing to an increase in collaborative arrangements.

7.3 Evaluation of Program or Project Appropriateness

The evaluation model matrix shown in Table #24 utilizes the following normative questions and criteria:

A. Were water provision activities integrated with hygiene education and sanitation promotion activities?

B. Were human resource development activites emphasized in all program or project activities?

C. Did the program or project result in a identifiable strengthening of local government-institutional capacity?

D. Did beneficiary communities participate in all phases of program or project activities?

E. Was low-cost technology utilized?

F. Was system operation and maintenance adequately considered in water system construction activities?

G. Was community-managed operation and maintenance achieved?

H. Was environmental protection incorporated into program or project planning and implementation?

I. Did women plan a significant role in program or project activities?

J. Were water systems provided appropriate to available water resources?

Table 16 Evaluation of Program or Project Appropriateness

Question or Criteria	Case Studies				
	UNICEF	USAID/ CARE	DGIS	UNDP/ FAI	CIDA/ WUSC
A	4	3	3	1	5
B	3	2	4	1	5
C	3	1	3	1	4
D	3	2	5	1	3
E	5	3	5	1	1
F	4	2	5	2	5
G	4	2	5	1	4
H	3	4	2	1	2
I	4	5	4	1	3
J	4	5	5	3	3
Total	37	29	41	13	35

Score:
1 No
2 Generally No
3 Partly
4 Generally Yes
5 Yes

The results of the evaluation of program or project appropriateness can be summarized within the context of a possible score ranging from 10 (inappropriate) to 50 (appropriate):

Most inappropriate	UNDP/FAI	13
	USAID/CARE	29
	CIDA/WUSC	35
	UNICEF	37
Most appropriate	DGIS	41

One program was almost totally inappropriate (UNDP/FAI) and one project was very appropriate (DGIS). The remaining three projects and program (USAID/CARE, CIDA/WUSC and UNICEF) were partially to generally appropriate.

The appropriateness of the ESA programs and projects can also be analyzed regarding the degree to which they incorporated key elements of the appropriate conceptual framework currently held and expounded by the sector. These key elements are:

- the cost and appropriateness of the technology used.
- the degree of integration of hygiene education and sanitation promotion with water provision activities.

Technology

Only two case studies utilized low-cost VLOM technology: in the case of DGIS, an improved indigenous technology, and in the case of UNICEF, an imported technology. In the latter case, attempts were made (as yet unsuccessful) to establish local manufacturing capability and capacity. The remaining three case studies utilized the relatively sophisticated imported technology of wateryards. Although USAID/CARE was able to do this at relatively reasonable unit costs, by

emphasizing re-use of existing equipment, the other program and project incurred substantial and prohibitive unit costs.

While in some instances, wateryards with their deep boreholes were appropriate to the (only) available water resources, the initial choice of technology seems to have overridden the possibility that less complex alternatives may have been viable. The USAID/CARE project was the only one to pursue an array of technology alternatives, but did however concentrate upon wateryards in the final outcome.

Where non-VLOM technology was installed, only one project attempted to address sustainability by training the community and thus enabling them to perform some role in future operation and maintenance. No attention was paid to the main issue constraining wateryard technology: the chronic shortage (and resultant high price) of diesel fuel. Although both UNDP/FAI and CIDA/WUSC installed more diesel fuel efficient pumps and engines, no search for alternative energy sources was undertaken.

Where VLOM technology was installed, training in operation and maintenance was given to both NCDRWR and to the communities. Attention was also paid to the provision of spare parts on an on-going basis, with procurement and supply systems established. Thus, successful replication of these two initiatives from a technology perspective is probably attainable.

Integration

Integration ranged from being non-existent to virtually complete. All case studies except UNDP/FAI included a hygiene education component, all geared towards community women, but only the CIDA/WUSC project also attempted institutional strengthening in hygiene education within GOS sector agencies. Although the primary deliverers of hygiene education were seconded GOS field personnel, the linkage of their activities to NCDRWR implementation and MFEP planning/monitoring was

generally not attempted.

Only two case studies (UNICEF and CIDA/WUSC) attempted sanitation promotion in individual communities, beyond that provided via hygiene education. UNICEF's sanitation efforts were on a large scale and generally impressive, whereas CIDA/WUSC's sanitation efforts were more modest. In the former case, sanitation was a new component grafted into an on-going water provision exercise. In the latter, integration of sanitation was conceptualized in the design of the project as a demonstration activity. In neither case was the impact of sanitation promotion activities formally evaluated, so that the specific benefits of integration were not identified.

The integration of solid-waste management into water provision activities has been advocated by UNDP, the World Bank and other ESAs (UNDP, 1991), as another step towards maximizing health benefits from sector activities. Proper collection and disposal of solid waste was included in the hygiene education components of each of the two case studies undertaking this activity. It should be noted that the volumes and noxiousness of solid wastes in rural Sudan are low, so that management of these wastes is not a major issue in most rural situations. Solid waste management improvement in urban and peri-urban situations is a far more pressing need.

Environmental integration was evidenced to some degree by three case studies: the UNICEF Program where the establishment of tree seedling nurseries accompanied handpump installation in some communities; the USAID/CARE Project where similar initiatives were encouraged adjacent to rehabilitated wateryards; the CIDA/WUSC Project where shelterbelts were planted around some project wateryards. Documented desertification adjacent to water sources and supplies (Bennett, 1987; Ibrahim, 1984; IES, 1982) cannot be effectively mitigated by measures such as these, but these efforts served more as attempts at environmental education.

Low-cost (and hence low capacity) technology would be ethically more supportable in an environmentally integrated program or project.

7.4 Evaluation of Program or Project Sustainability

The evaluation model matrix shown in Table #25 utilizes the following normative questions and criteria:

A. Was the technology chosen VLOM?

B. Was the technology able to be operated using locally available supplies (ie: non-imported)?

C. Was local manufacture of technical components of the equipment achieved?

D. Were local government institutions adequately trained in the installation and maintenance of the equipment?

E. Were beneficiary communities adequately trained to manage the water supply systems?

F. Were beneficiary communities sufficiently empowered to undertake community management of the systems?

G. Did the program or project activities contribute to sector policy reform?

H. Were effective sector linkages established by the program or project?

I. Were program or project activities coordinated Regionally and Nationally with other sector initiatives?

J. Did program or project management collaborate with other development agencies in the sector and in other sectors?

K. Was some form of capital cost recovery attempted?

L. Were recurrent costs for operation and maintenance put on a cost-recovery basis?

M. Were unit service costs within reasonable and affordable limits?

N. Were program or project activities compatible with prevailing environmental conditions of the area?

O. Was the program or project replicable as implemented?

P. Was the GOS committed to the success of the program or

project?

Q. Was GOS provided with the resources (human, financial, managerial) required to continue to program or project?

Table 17 **Evaluation of Program or Project Sustainability**

Question or Criteria	Case Studies				
	UNICEF	USAID/ CARE	DGIS	UNDP/ FAI	CIDA/ WUSC
A	4	2	5	1	2
B	2	1	5	1	1
C	3	1	5	1	1
D	5	5	5	4	5
E	5	2	4	1	4
F	4	1	4	1	5
G	5	2	3	1	5
H	3	2	2	.	5
I	4	1	1	1	4
J	3	3	2	1	4
K	5	1	5	1	3
L	4	1	5	1	5
M	5	5	5	2	1
N	5	3	5	2	2
O	5	2	5	2	4
P	4	3	3	2	4
Q	3	2	3	1	4
Total	70	37	67	24	59

Score:
1 No
2 Generally No
3 Partly
4 Generally Yes
5 Yes

The results of the evaluation of program or project sustainability can be summarized within the context of a possible score ranging from 17 (non-sustainable) to 85 (sustainable):

Non-Sustainable	UNDP/FAI	24
	USAID/CARE	37
	CIDA/WUSC	59
	DGIS	67
Sustainable	UNICEF	70

Two programs/projects were clearly non-sustainable (UNDP/FAI and USAID/CARE). The remaining three projects and program (CIDA/WUSC, DGIS and UNICEF) are reasonably sustainable, especially the latter two.

The sustainability of the ESA sector efforts can also be analyzed from the point of view of their incorporation of fundamental concepts identified as enhancing sustainabililty. These concepts are:

- the need to build capacity within GOS sector institutions.
- the need to ensure satisfactory operation and maintenance of completed systems.

GOS Capacity

The capacity of GOS sector institutions requires considerable building in the areas of planning and policy formulation, management and administration, and technology choice and utilization. As previously mentioned (see section 6), the UNDP/World Bank Water and Sanitation Sector Review and Action Plan Program (1989 to 1991) is aimed at strengthening and building capacity within GOS sector institutions, but it is to be considered a preliminary step in this direction.

While all five case studies provided adequate technical training to NCDRWR personnel, employed on or involved in the

program or project, only three case studies (DGIS, UNICEF, CIDA/WUSC) extended training beyond the technical realm into the areas of management and administration. Only two case studies (UNICEF, CIDA/WUSC) were able to build GOS planning capacity and contribute to sector policy reform.

In both cases where capacity building was in evidence, GOS commitment to the program/project was relatively high, and relatively effective sector linkages were established between the implementing ESA, GOS and other ESAs. In the case of UNICEF, these linkages centered upon the issue of handpumps. In the case of CIDA/WUSC, the issue was operations and maintenance.

One project (DGIS) contributed to policy reform to some degree by addressing the issue of the utilization of low-cost indigenous technology. However, relatively weak linkages between this project and the sector as a whole resulted in poor diffusion of this initiative. While one GOS sector institution (Groundwater Research Department) showed a high degree of commitment to the DGIS efforts, the GOS sector as a whole was not involved in the project, and the project's contribution to policy reform was not substantive.

Operation and Maintenance

Case studies tended to either address the issue of operation and maintenance sustainability quite seriously, or ignore it. Three case studies (UNICEF, DGIS, CIDA/WUSC), employing three different kinds of technology, made relatively significant advances towards satisfactory operation and maintenance. The two other case studies (USAID/CARE, UNDP/FAI) constructed generally non-sustainable systems, as evidenced by the rate of failure after completion of construction.

The similarities and differences between the three approaches to operation and maintenance are illuminating. All emphasized community management of completed systems, and

provided technical and administrative training to that end. All embodied some form of capital and/or recurrent cost-recovery, with the communities managing the financial operations. In all three cases, a significant degree of community empowerment was achieved.

Both UNICEF and DGIS utilized VLOM technology, the former imported and the latter indigenous. Although the sustainability of UNICEF's handpumps may be impacted by the supply of spare parts, unless local manufacture can be established, both VLOM concepts can be integrated almost completely within the realm of community management. The more complex technology of the CIDA/WUSC project necessitated the establishment of what was termed cooperative operation and maintenance: the community played the lead role in management, but NCDRWR provided a strong supporting role. Therefore, the structure and strategy of the CIDA/WUSC operation and maintenance component was more complex and required more training at various levels. While this probably contributed to more operation and maintenance capacity and capability building within NCDRWR, the complex arrangement was more likely to fail than the simpler arrangements used in VLOM situations.

Partial capital cost recovery was employed in all three case studies. Both UNICEF and DGIS required up-front contributions from the community, while partial cost recovery was intended to be accomplished by wateryard revenue surpluses in the CIDA/WUSC project. These three case studies required full recurrent cost recovery. Money for operation and maintenance expenditures was collected as required by the communities with UNICEF handpumps. DGIS had a similar mechanism, but were encouraging communities to move towards a yearly fee mechanism. This would introduce a higher requirement for financial management in the communities, and additional training would be required. CIDA/WUSC, following established GOS practice, opted for a volumetric charge,

equivalent to about twice the standard GOS wateryard rate. By establishing a revolving fund with individual community accounts, the wateryard revenues covered the cost of operation and maintenance and leave a healthy surplus for both future repair and rehabilitation, and partial capital cost recovery.

7.5 Summary

UNICEF (Kordofan) Program

The approaches used by UNICEF in planning and implementing the Kordofan Program were relatively strongly control-oriented. Long term program objectives were generally expressed as detailed work schedules and production targets: the apparent goal being to optimize rural water coverage levels. Decision-making rested almost entirely with the UNICEF Sudan Country Office. Beneficiary communities did not effectively participate in the program, except in latter stages of system operation and maintenance and sanitation promotion.

The UNICEF (Kordofan) Program was generally appropriate, and was well-integrated, and relied solely on low-cost VLOM technology. Community management of the completed handpump installations was substantially achieved and village women played a significant role in this activity.

Primarily as a result of the program's emphasis on low-cost VLOM technology, its wide geographic scale, and the reasonable unit service costs achieved, a relatively high degree of sustainability was achieved. This could have been further enhanced by establishing local manufacture of the handpumps, which could eventually happen given the relatively strong GOS commitment to UNICEF sector activities.

USAID/CARE Project

The approaches used by CARE, and USAID to a lesser extent, in this project were both control-oriented and adaptive. While a considerable amount of pre-implementation

data collection and planning was conducted, largely without input from potential beneficiaries and in isolation from government sector planning institutions, the resultant plans and implementation activities were fluid and changed considerably. With no clear guiding long term project objectives, NCDRWR was able to increasingly influence project activities during implementation.

The USAID/CARE Project was somewhat inappropriate, primarily due to the lack of human resources development, institutional strengthening, and attention to operation and maintenance requirements. The degree of community participation in project activities was low, except in hygiene education.

The results of the project were generally non-sustainable also. The technology chosen for the majority of the project work was not VLOM and dependent upon imported supplies for operation and maintenance. The project did not address the need for community management of the completed water systems, or recurrent cost-recovery. With the exception of some initiatives by USAID, the project was not effectively coordinated with other sector initiatives, and collaboration between CARE and other sector ESAs was essentially non-existent. Little GOS commitment to the project was in evidence.

DGIS Project

The approach used by DGIS in planning this project was quite strongly control-oriented, but the subsequent approach used during implementation was quite strongly adaptive. Major weaknesses in the overall approach included the detailed pre-planning and data collection, and the belief that this information was reliable. Major strengths included the high degree of community participation in the project, and the significant human resources development and institutional strengthening that occurred.

The DGIS Project was very appropriate seeming almost "state of the art" in its overall conception. Lack of attention to environmental protection, and insensitivity to prevailing environmental degradation in south Darfur, reduced the project's appropriateness.

A relatively high degree of sustainability was achieved by the DGIS Project: primarily a result of the technology used and the implementation approach followed. Lack of coordination and collaboration with other sector ESAs detracted from the sustainability of this project to some degree, although capacity building within GOS by the project was relatively significant.

UNDP/FAI Program (water component)

The approach used to plan and implement the UNDP/FAI Program was strongly control-oriented: emphasis was placed on detailed and relatively rigid implementation schedules, and decision-making was strongly centralized. Monitoring was conducted to ensure conformable implementation, and considerable effort was expended to mitigate or eliminate factors that might negatively effect construction progress. Some adaptive tendencies were evidenced by the relative flexibility in overall program production targets, and although a considerable amount of pre-implementation data was collected, it was recognized to be of marginal utility and was not emphasized excessively in program plans.

Overall, the program was very inappropriate. In part, the inappropriateness stemmed from the sole reliance of deep boreholes and high-technology wateryards as water sources, but this reliance was necessitated to some degree by the hydrogeology of the program area. Conversely, it can be argued that the program area was selected because the use of this technology could then be justified. Aspects of integration, human resources development, community participation, etc., were ignored by the program.

The UNDP/FAI Program results were non-sustainable. Although the systems constructed were essentially modelled after the existing NCDRWR wateryards, and training was provided in the installation and maintenance of the new deep well turbine pump technology, the entire wateryard infrastructure in Darfur Region controlled by NCDRWR had repeatedly been demonstrated as being non-sustainable as it currently existed. The program made no effort to address this crucial issue, and made no attempt to build capacity within GOS sector agencies.

CIDA/WUSC Project

The approach used by the CIDA/WUSC Project was relatively adaptive. Although the technology utilized was not selected by the beneficiary communities, most project planning and implementation proceeded with a reasonable degree of sensitivity to community needs and government requirements. In part, the poor economic record and slow implementation progress may have been the result of the project attempting to satisfy too many conflicting and contradictory agendas.

Although utilizing high-technology, the project overall was relatively appropriate in its composition and delivery. Hydrogeological conditions restricted the choice of technology in the project area, but the frequent relocations of project area did not attempt to seek areas where a lower technology could be employed.

The results of the CIDA/WUSC Project are reasonably sustainable. Although the technology utilized was not VLOM, considerable attention was paid to enhancing the chances of success for community-managed operation and maintenance. Recurrent cost-recovery was particularly well addressed and strongly supported by GOS sector agencies. The high unit service costs incurred by the project may serve as a disincentive to the future replication or adoption of the project style.

A summarization can also be made of the conformity of the case studies to the current sector conceptual framework.

Regarding management approaches, community participation was generally encouraged but usually in the implementation rather than the planning stages. Community women were visibly involved in most of the programs and projects, but restricted generally to receivers of hygiene education and sanitation promotion. Implementation generally was institutionalized but the overall arrangements were for expatriate control and direction of NCDRWR, MOH and other GOS technical, skilled and semi-skilled personnel. Human resources development was embodied primarily by community-level training (hygiene, operation and maintenance), and technical training for NCDRWR personnel. In general, significant institutional strengthening and sector linkage establishment did not occur. ESAs tended not to collaborate with each other and individual programs and projects were isolated. Coordination of programs and projects by GOS was not achieved, and monitoring and evaluation by GOS was weak.

Regarding the appropriateness of the case studies, VLOM technology was employed in the minority of programs and projects, although this represented by far the greatest number of rural water supplies constructed. Emphasis, in part out of necessity, remained upon more complex technology. The degree of integration of sector activities was varible: most included a hygiene education component, but a minority included a sanitation component. A reasonable degree of environmental sensitivity was evidenced by the majority of programs or projects including an environmental rehabilitation or impact-mitigation component.

Regarding sustainability, capacity building for GOS sector institutions was not undertaken by most programs or projects. Training, institutional strengthening and sector linkage establishment was piecemeal and uncoordinated, and generally lacking. Operation and maintenance, centered upon

community management and cost-recovery, was addressed by three programs or projects. Conversely, the other two programs or projects effectively ignored the issue of operation and maintenance.

The study found that:

(i) management approaches

- none of the programs/projects were particularly adaptive but two were relatively strongly control-oriented.
- most programs/projects had both adaptive and control-oriented characteristics, depending upon the specific component.
- community particiation was generally encouraged, but only in the implementation stage.
- institutionalization was generally restricted to the employment of local sector staff.
- human resources development was effectively absent from most programs and projects.
- coordination and collaboration between donors was poor.

(ii) Appropriateness

- most programs/projects were somewhat appropriate, but there was a wide range.
- only two programs/projects utilized low-cost VLOM technology.
- only two programs/projects integrated sanitation promotion activities, but most delivered hygiene education.
- most programs/projects displayed an awareness of their environmental context.

(iii) Sustainability

- most programs/projects were somewhat sustainable, but two were clearly non-sustainable.
- government sector capacity building was absent from most programs/projects, and training when provided

concentrated [illegible] technical issues.
most programs, rojects addressed the issue of community management and cost recove:y in operation and maintenance, but two programs/projects made no attempt to do so.

8. Control-Oriented versus Adaptive Approaches

Researchers in rural development (for example: Chambers, 1974; Rondinelli, 1983) and in rural water sector development (for example: Therkildsen, 1988), have suggested that the type of management approaches followed are the main determinant of development effectiveness: control-oriented approaches resulting in ineffective outcomes and conversely adaptive approaches being more desirable and effective. The case studies in this analysis are evaluated with regards to their management approaches being control-oriented or adaptive, to determine the relative importance of management approach in controlling the effectiveness of the program or project outcomes.

Some general observations can be made from the evaluation of the case studies regarding the interrelationships between ESA approach, and program or project appropriateness and sustainabilitly:

- all programs or projects exhibit some combination of control-oriented and adaptive approaches to planning and implementation.
- the most control-oriented program (UNDP/FAI) was least appropriate and least sustainable.
- the most adaptive project (CIDA/WUSC) was only moderately appropriate and moderately sustainable.
- the most appropriate project (DGIS) used a generally adaptive approach to implementation, but used a relatively control-oriented approach to planning.
- the most sustainable program (UNICEF) used a generally control-oriented approach to both planning and implementation.

From these observations, some conclusions can be made:

- extreme control-orientation in planning and implementation results in ineffective outcomes.
- some degree of control-orientation is beneficial in

producing effective outcomes.

- adaptive approaches in planning and implementation do not necessarily ensure effective outcomes.

Evidently, there are both advantages and disadvantages associated with the use of a control-oriented approach to planning and implementation: some relatively obvious and some more subtle. Also, some factors related to appropriateness and sustainability are relatively independent of the approach used in planning and implementation: other factors are significantly affected depending upon approach used.

The control-oriented component of the approach commonly used in planning and implementing the case studies had four main characteristics:

i) planning and implementation decision-making was centralized within the ESA, and long term program or project objectives were detailed and relatively inflexible, with emphasis on work schedules and production targets.

ii) comprehensive pre-implementation data collection was conducted, in part to clearly define long term objectives, and in part to reduce perceived uncertainty regarding program or project implementation and outcomes.

iii) technology was pre-selected and the type of water source predetermined, with little or no community input.

iv) a relatively large number of expatriate personnel were utilized in both technical assistance and line management roles, with local sector personnel relegated to less key positions within the program or project.

From the above descriptions of the main control-oriented characteristics displayed in the case studies, it can be concluded that the fundamental manifestations of the control-oriented approach were:

- the preparation of and reliance upon <u>blueprint type plans</u>, with emphasis on construction activities.
- the <u>non-participatory</u> approach to both planning and

implementation, especially with regard to technology selection.

- the general bypassing of local sector institutions, or the token institutionalization practiced.

These three manifestations, present both in planning and during implementation, are a contributor to ineffective program and project outcomes.

Planning

Blueprint planning, and its reliance upon data and data collection, leads to a form of mental entrapment where dynamic and unpredictable situations can be made to appear to be relatively stable and predictable.[1] By emphasizing quantifiable components, such as numbers of boreholes, average depths, types of pumps, amounts of spare parts, even numbers of training courses and scholarships, the entire enterprise is moulded into a finite and neat package[2] that can subsequently be budgeted for and allocated a time frame for implementation. Less quantifiable components such as establishing effective community participation, institutionalizing implementation and conducting effective human resources development (training, institutional strengthening, sector linkage establishment) may be identified as program or project objectives, but rarely

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[1] The preparation of control-oriented plans assumes predictabililty, and knowledge and information concerning the cause-effect interrelationships between proposed activities. Developing country situations are rarely predictable, however this unpredictability is rarely taken into account by planners, but assumed to be able to be compensated for by the preparation of detailed plans. Knowledge and information in the developing world suffers from two main constraints:
- inaccurate or incomplete knowledge (see for example UNDP/FAI on page 71 or UNICEF on page 5).
- outdated or invalid knowledge (see for example USAID/CARE on page 19).

[2] This concept is discussed in more detail in Rondinelli, 1983.

materialize as hoped for since they cannot be incorporated into the blueprint planning mode.

Who can predict how long it will take to establish good communications with a beneficiary community, or whether this will be possible in all communities? How long will construction take if undertaken by the Water Corporation? What sector linkages already effectively exist, which ones need to be established, and how will this be done? To predetermine answers to these questions is impossible, and answers can only start to be apparent once the program or project is underway. In many cases, the emergent information may be quite different than what was anticipated. This will impact both budget and work schedules, therefore these components will often be ignored or only partially addressed.

Participation

Despite statements to the contrary, there is a tendency among ESAs to assume that they know what is needed and what will work best in rural communities. This opinion may be based upon the results of work elsewhere, upon the results of other ESAs, or upon the current concensus among ESAs of what is considered best.[3] While experience is in part a good teacher, replication of experiences is fraught with danger. Any new technology introduced to a rural community represents a change to that community, be it a handpump or a fully-motorized pumping system. Often, indigenous technology can be used as is, modified, or improved with far less negative impact upon the community. The key point is that the type of technology to be used should be negotiated with the community before a selection is finalized. Obviously, there are financial and administrative implications if the choice is

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[3] Frequently, expatriate technical assistance personnel are biased against the participatory approach. See for example UNDP/FAI on pages 73, 74, and Chambers, 1983 and Forss, 1988.

between a grass rope and goat skin bucket versus a pump and engine manufactured in Europe[4], but these implications should not compromise appropriateness and potential sustainability.

Community participation for community management of completed water systems is increasingly identified as a major objective by ESAs. However, there is a fundamental difference between operation and maintenance as a community obligation versus being a community right. A community may feel obliged to manage a water system installed by a program or project, or may be coerced into doing so, but this is rarely effective. A pre-packaged approach consisting, for example, of the installation of a new pump, provision of a box of spare parts, and a two day pump maintenance training course, can rarely accomplish community management[5]. In reality, the community may have been managing their traditional water source for a long time, and this initiative and experience can be built upon if the program or project can with sensitivity strengthen the community's administrative, financial management and legal capacities.

Bypassing

Institutionalized implementation is a stated objective of most ESAs, but in reality is rarely achieved and sometimes not even attempted. The benefits of institutional strengthening, sector coordination and collaboration, enhanced sustainability, etc., are frequently mentioned. Unfortunately, program and project plans calling for the relatively rapid and smooth construction of water facilities rarely take into account the relatively ponderous way in which

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[4] Most bilateral aid is tied to purchases of equipment and services in the donor country, often up to the 95 percent level.

[5] For an example see UNICEF on pages 10, 11 or UNDP/FAI on page 77.

most local sector institutions operate. The result, whether by design or by default, is the general bypassing of local sector institutions seen in most control-oriented programs and projects.[6]

Expatriate technical assistance personnel, whether labelled as advisors or not, assume a line management role to try and ensure that construction proceeds according to plan.[7] A local counterpart project manager is appointed, usually in a token capacity, and where significant technical expertise exists in a local sector institution, it may be utilized. The bulk of the project's labor force may be recruited from local government agencies: this also helps to keep project costs down, in much the same way as community labor is encouraged in some projects. Those losses to institutional strengthening caused by bypassing are compensated for (in project plans at least) by providing in-service training courses and scholarships, perhaps even a workshop or conference. These activites are rarely as effective as anticipated.

ESAs, despite fairly obvious disadvantages, choose to follow control-oriented approaches to sector development management for pragmatic reasons. This is frequently done contrary to stated ESA policies and philosophies, and is manifested in three main areas:

(i) Pragmatic Planning

Political, legal and administrative controls exist within

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[6] Bypassing may well result in the rapid implementation of large numbers of rural water systems (UNICEF on page 82, UNDP/FAI on page 135), but creates resentment and a sense of powerlessness among local sector institutions (MFEP, 1990(a), 1988; NCDRWR, 1988).

[7] Bypassing reinforces the ESA bias towards discrete sector projects rather than more open-ended programs, even though some efforts labelled "program" are in effect projects. One main reason for the ESA preference towards projects is that they effectively limit the donor's financial commitment to a specific country (CIDA, 1988. DANIDA, 1990, for example).

all ESAs regarding the provision of development aid. These controls require that individual development programs and projects be defined in terms of scope of work, time frame and, probably most importantly, cost.[8] Requirements of aid tying and the use of donor country technical assistance personnel and resources further restrict the nature of individual development efforts. The result is that as many program and project inputs as possible, preferably all of them, need to be identified and quantified before implementation begins. Hence the common emphasis on data, data collection and blueprint plans.

(ii) **Pragmatic Participation**

A major requirement of pragmatic planning is the elimination of uncertainty and the reduction of risk. In most cases, ESAs perceive that increasing the degree of community participation in program or project activities will also increase uncertainty and risk. One of the major attractions of the provision approach to sector development is that, if you assume that you know what the community wants and needs, then you really do not have to ask them. In this context, community participation is pragmatically defined as being the community cooperating with the project in activities which the project has determined they should be involved in. This is particularly attractive to ESAs in two areas: volunteer community labor during construction; community operation and maintenance of completed systems.[9]

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[8] The UNICEF and DGIS efforts were part of a broader program of sector development provided by the respective ESAs to Sudan. The USAID/CARE, UNDP/FAI and CIDA/WUSC efforts were of an obvious project-cycle emphasis.

[9] With continued emphasis on increasing sector coverage (UNICEF, 1991; UNDP, 1990) and growing realization that effective operations and maintenance is the key to sustainability (WHO, 1989, 1990), participatory approaches may become more attractive.

(iii) Pragmatic Bypassing

Detailed work schedules and production targets are frequently the main reason for bypassing of local sector institutions. It is determined, sometimes accurately, that the local water corporation or other sector implementing agency lacks the resources and possibly the motivation to fully undertake project activities.[10] An independent project management unit, the usual manifestation of bypassing, frequently has the resources and the motivation to implement more rapidly. Logistic bottlenecks, such as equipment, fuel, communications and transportation are also usually compensated for by the project management unit.

Other Pragmatic Aspects

Pilot projects, or projects involving the development of new techniques or technology, may require a relatively high degree of control-orientation in order to achieve immediate objectives. This may be applicable to the entire project, or only to certain components within the project.[11]

Faced with indecision, or lack of interest among local government sector institutions, or in the absence of an effective or clear sector policy, ESAs may determine that a predominantly control-oriented approach to rural water development is needed. This is particularly evident when the ESA has the stated objective of serving "the poorest of the

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[10] NCDRWR in Sudan for example was over-staffed (UNDP, 1988(c)), and lacked the financial resources and equipment (primarily vehicles) to undertake an effective construction and operation and maintenance program (MFEP, 1990(a)).

[11] The DGI and CIDA/WUSC projects were specifically identified as pilot projects, the USAID/CARE project was termed "interim" implying some degree of experimentation. Interestingly, all three projects followed more adaptive approaches than the non-pilot programs (implemented multilaterally).

poor", who may be quite neglected by their own government. Likewise, development for nomadic groups or emergency-type relief and development efforts may "have to" be done despite local government wishes to the contrary.[12]

On a less humanitarian level, it may be implicitly desired to give and to receive aid in a bilateral or multilteral context, but local sector institutions lack the capacity to undertake the development effort. There are obvious political benefits to both ESA and local government, but a control-oriented approach may be required (and mutually agreed to) in order to get the job done.[13]

The limitations caused by the control-orientation component of ESA approaches can be contrasted against the main characteristics that are evident in the adaptive approach followed in part by some case studies.

The Adaptive Approach

The adaptive approach is evidenced quite strongly by the DGIS and CIDA/WUSC projects, and forms a component of the approach followed in the UNICEF program and USAID/CARE project. The four main characteristics of the adaptive approach were:

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[12] The use of this justification to follow a control-oriented approach is used by most ESAs in various forms:
UNICEF: to improve health and child survival.
USAID/CARE: drought relief.
DGIS: drought relief and reduction of migration.
UNDP/FAI: drought mitigation and area rehabilitation.
CIDA/WUSC: community stabilization in a drought-affected area.

[13] For example, MFEP (1988 and 1990(a)) indicated that the volume of aid flows into Sudan were more important than their specific sectoral distribution. Water provision is a generally popular activity in rural areas, so rural water development projects were used politically by successive governments to reward their supporters.

i. planning and implementation decision-making was shared between the ESA, the implementing agency, local sector institutions and the communities. Long term program or project objectives were somewhat ambiguous and unclear, and changed through time.

ii. information collected during implementation was used to modify short and long term objectives, and effected implementation schedules.

iii. considerable effort was put into establishing and maintaining good communications with the communities.

iv. implementation was channelled through local sector institutions, with a minimal number of expatriates provided, to advise and motivate local personnel.

In his 1974 book Managing Rural Development, Robert Chambers identifies seven characteristics of an adaptive approach found effective in East Africa:

- a systems thinking approach is basic to adaptivity. Systems thinking:
  - accepts a very wide potential span of relevance.
  - seeks to identify interconnections between phenomena.
  - simplifies complex relationships.
- complexity and uncertainty dictate that planning and management should be empirical, not perfectionist.
- project resources and activities should be optimized rather than maximized, because of a frequent scarcity of resources, multiple objectives and anticipated multiple outcomes in most rural development situations.
- administrative capacity is a scarce resource, therefore project administrative requirements should be minimized.
- achieve simplicity, accepting imperfections and inaccuracies as the price of improved outcomes.
- has the experience and courage to know what is not worth knowing and to abstain from trying to find it out (optimal ignorance).

- the orientation towards opportunity, involving the seeking out of new possibilities, rather than a problem-solving orientation.

(Chambers, 1974, pages 150-155).

Rondinelli (1983) proposes an adaptive approach where development projects are viewed as experiments: planning is incremental, based upon a decision-making process linking results of implementation with future planning. Although of a basic problem-solving orientation, and therefore more static than dynamic, this experimental approach has been summarized effectively by Therkildsen as consisting of four stages:

- the experimental stage
  - to obtain knowledge about unknowns or problems.
- the pilot stage
  - to test the acceptability and feasibility of existing knowledge in specific contexts.
- the demonstration stage
  - to demonstrate that new technologies and techniques are better than existing ones.
- the replication stage
  - to expand implementation and management capacity to increase project coverage.

(Therkildsen, 1988, pages 192 and 193).

The degree of uncertainty and hence risk of failure is greatest in the experimental stage, and declines towards the replication stage. Hence, it is indicated that the experimental stage is more control-oriented, with adaptive approaches emerging towards the replication stage. However, large scale replication may resemble a control-oriented enterprise, and experimentation may appear adaptive (Therkildsen, 1988, page 209).

Korten (1980) proposes a program-oriented adaptive approach; a learning process approach. Arguing against the project cycle basis of development, which fragments and isolates development efforts, Korten emphasizes development s

an evolutionary process. The process consists of three learning stages:

- effectiveness
  - . developing a program that meets beneficiary needs.
- efficiency
  - . reducing costs and activities that are not needed to effectively deliver the program.
- expansion
  - . expanding administrative and organizational capacity, and continuing to refine program content and delivery.

(Therkildsen, 1988, pages 196 to 199).

Both Rondinelli and Korten caution against expanding a project or program too fast; both stress the relatively slow, evolutionary time frame from initial to latter stages.

While the categorization of overall management approaches as being either control-oriented or adaptive is a useful method for examining development programs and projects, the analysis of case studies from Sudan indicates that not only do most programs and projects fall somewhere in between these two categorizations in overall management style, but within each individual program or project, management approach can vary within various components of both planning and implementation. Therefore, categorization of management approach as being control-oriented or adaptive is valid only at a very general level.

Researchers have suggested that an adaptive approach to sector development management would improve effectiveness. This study concludes that the most effective management style combines adaptiveness with pragmatic control-orientation, and that an appropriate and sustainable conceptual framework for planning and implementation is more important than overall management style.

9. Conclusions

Rural development researchers (eg. Chambers 1974, 1983, Korten, 1980, Johnston and Clark, 1982, Rondinelli, 1983) have suggested a more participatory and adaptive approach to development planning and implementation. Within the rural water sector, researchers have suggested a change to a more flexible and community-based approach (eg. Feachem, 1978, Cairncross, 1980, Therkildsen, 1988).

Feachem and Cairncross advocate integration of monitoring and evaluation processes within the design and construction activities of sector programs. Based upon the observed effectiveness and impact of program activities, subsequent planning and implementation can be modified or adapted. Therkildsen advocates a similar approach, emphasizing increasing the capacity for village level planning and implementation, and emphasizing the need for clear sector policies to guide the overall process.

This study finds that although participatory planning and implementation can be effective, it does not guarantee success. A solid and relevant conceptual framework for planning and implementation is required if appropriateness and sustainability are to be achieved. It has been suggested also that adaptive approaches promote optimal outcomes and that control-oriented styles are ineffective and undesireable. This study indicates that, although in general adaptive management approaches may be successful, elements of control are necessary in management to achieve optimal efficiency and effectiveness.

The United Nations Water Conference in Mar del Plata in March 1977 identified a number of guidelines for sector activity (Biswas, 1978, page 154), and these guidelines were subsequently reiterated after the IDWSSD in the New Delhi Statement and United Nations General Assembly Resolution (UNDP, 1991; UN General Assembly Resolution A/RES/45/181).

These pre and post IDWSSD principles and objectives can be essentially distilled into two key guidelines:

i) coverage levels must be increased, and the only realistic way of doing so is to reduce unit service costs, and to require a larger share of the financial contribution to come from the beneficiary communities, or from the ESAs, who appear unwilling to do so.

ii) sustainability must be improved, and this can only be accomplished by:

- utilizing technology that is essentially indigenous to the area, nation or region, or can be readily locally-manufactured.
- accepting community management as the most acceptable means of system construction, operation and management.
- achieving capital and recurrent cost-recovery.
- integrating sector development within overall rural development activities, emphasising environmental protection and rehabilitation.

These two key guidelines for future sector activity are subject to the following controlling considerations:

Firstly, government sector institutions must take a leading role in project activities. ESAs should resist the temptation to bypass sector institutions, with the objective of rapidly expanding coverage, and assume a more passive supporting role. Certainly, ESA technical assistance and financial support will need to be significant, but it should be aimed at strengthening sector institutions through effective human resources development (see Livingstone and McPherson, 1991), and should provide tangible infrastructure support to the local institutions.

Secondly, financial arrangements for sector development need to be reoriented. ESA financial support to sector institutions as described above is one element of this reorientation, but beyond that financial support should be

program-based rather than project-based. Program financial resources, from various ESAs and from local government sources, should provide a revolving capital fund for sector development. Participating communities participate with an intitial cash contribution (down payment), financing the balance of their water and sanitation system from the revolving capital fund. If system operation and maintenance is on a cost-recovery basis, with a margin for capital cost loan repayment, the entire enterprise should be in the long run financially sustainable. Of course, there will still be occasions when capital cost subsidization or even free service is deemed politically or socially desirable: these instances should be exceptions rather than the rule.

Thirdly, the engineering and technological bias in sector decision-making should be reduced. Sewell (1971) and more recently Russell (1991) have indicated that engineers by nature and by training tend to be narrowly focused, insensitive to non-technological aspects, and problem-solving oriented; hardly the qualities needed for effective rural water development. Yet, engineers have and continue to dominate the planning and implementation decision-making within most ESAs and government sector institutions.

Fourthly, some attention needs to be paid to the time frame of individual sector programs and projects. Given that both control-oriented and adaptive approaches will be manifested during implementtion of most programs and projects, and that while construction may be more controllable, human resources development and community participation for example may need a more flexible timetable, then an expanded program or project cycle may be desirable.

The objectives of this analysis were: to evaluate ESA approaches to sector program and project management; to evaluate the appropriateness of ESA programs and projects; to

evaluate the sustainability of ESA programs and projects; to outline an alternative strategy and approach to sector program and project management; and to evaluate the ability of GOS to contribute to and effectively manage completed ESA programs and projects. The main theme of this analysis was to improve the management of implementation and to improve the quality of future sector efforts.

To these ends, five representative case studies were selected of programs and projects conducted by important ESAs in Sudan during the IDWSSD. The case studies were analyzed and a number of key points and lessons were identified. This information, obtained from sector activities in one of the least developed countries in the world, during a period of intensive and unprecedented attention upon the rural water sector by ESAs and the national government, has applicability to sector activities in other countries in Africa and elsewhere in the developing world.

Conclusions can now be made regarding: the characteristics of effective and successful sector programs and projects (section 9.1); effective approaches to planning and implementing sector programs and projects (section 9.2); guidelines for appropriateness (section 9.3); and guidelines for sustainability (section 9.4).

9.1 Characteristics of Effective and Successful Programs and Projects

Some general indication of the overall effectiveness of programs and projects evaluated can be obtained from examining table 18 and table 19.

The most effective project overall was the DGIS shallow well, traditional hand pump and hygiene education project implemented in southern Darfur. Almost equally effective overall was the CIDA/WUSC wateryard rehabilitation and construction, hygiene education and sanitation promotion project implemented in northern Darfur. The UNICEF (Kordofan)

Table 18 **Case Studies: Effectiveness**

Evaluation Criteria	UNICEF	USAID/ CARE	DGIS	UNDP/ FAI	CIDA/ WUSC
Approaches 20 = control oriented 100 = adaptive	43	58	62	32	72
Appropriateness 10 = inappropriate 50 = appropriate	37	29	41	13	35
Sustainability 17 = non-sustainable 85 = sustainable	70	37	67	24	59
Composite Score 47 = ineffective 235 = effective	150	124	170	69	166
% effective	64%	53%	72%	29%	71%

Table 19 **Case Studies: Rank**

Rank	UNICEF	USAID/ CARE	DGIS	UNDP/ FAI	CIDA/ WUSC
Approach	4	3	2	5	1
Appropriate	2	4	1	5	3
Sustainable	1	4	2	5	3
Composite Ranking	2.3	3.7	1.7	5	2.3
Overall Rank	2	4	1	5	2

borehole, handpump, hygiene education and sanitation program implemented in southern Kordofan achieved only slightly less effectiveness than the DGIS and CIDA/WUSC projects.

The USAID/CARE wateryard rehabilitation, shallow well and hygiene education project implemented in southern Darfur was only partially effective. The UNDP/FAI wateryard program implemented for northern Darfur was generally ineffective.

In examining the three more effective programs and projects, the following lessons can be learned:

i) a substantial degree of flexibility (especially during implementation) is desireable, but appropriate and sustainable concepts incorporated into program and project plans are more significant.

ii) effective programs and projects can exhibit a wide range of approach to management, from moderately control-oriented to moderately adaptive.

iii) in contrasting the most effective project (DGIS) with the least effective (UNDP/FAI), even if the latter's management approach was to become as adaptive as the former's, the resulting program would remain ineffective. This is due primarily to inadequate conceptual design of the latter program.

iv) Conversely, if the most effective project adopted a predominantly control-oriented approach to management as exhibited by UNDP/FAI, it would remain relatively effective.

It is apparent then that an effective program or project displays the following characteristics:

- the management approach will combine control with adaptation.
- the implementation of construction activities will be generally control-oriented.

- the implementation of human resource development and community participation activities will be generally adaptive.
- the project will be designed incorporating key concepts for appropriateness.
- the project will seriously address the issue of sustainability in planning and implementation.

9.2 Effective Approaches to Planning and Implementation

Some authors argue that an adaptive approach to planning and implementation will result in more effective development (see for example Chambers, 1974; Korten, 1980; Rondinelli, 1983; Therkildsen, 1988). Control-oriented approaches are followed by most ESAs for pragmatic reasons, especially in situations of uncertainty and logistical constraint as frequently found in the developing world (see for example pages 134 and 138).

From the analysis of the case studies it can be concluded that management approach, while a determinant of project effectiveness, is not an overriding factor. Both control-oriented and adaptively managed programs and projects yielded effective outcomes. Therefore the argument for increased adaptiveness in sector management is not completely valid.

In examining the three more effective case studies (DGIS, CIDA/WUSC, UNICEF), it can be seen that the most effective tended to have control-oriented planning but adaptive implementation. The two other programs and projects, which were somewhat less effective, had either control-oriented planning and implementation or adaptive planning and implementation. Therefore, it can be concluded that an effective management style:

- follows a more control-oriented approach in planning.
- follows an adaptive approach in implementation.

However, planning is thorough and realistic, rather than being blueprint type. Participatory planning is not excluded, but is encouraged. However, for reasons of efficiency and economy, a certain number of specific options are identified for subsequent implementation, rather than attempting to cover all options and all agendas. Planning is best accomplished by local sector personnel from various disciplines, strengthened where necessary by expatriate technical assistance. The planning process takes time, and is not a "parachute" exercise. Rather than relying excessively on quantitative data, the planning process obtains and utilizes representative qualitative data. The plans can be relatively detailed and structured regarding construction implementation and scheduling, but more flexible and fluid regarding human resource development, community participation and other non-technological activities.

Implementation of construction activities can be relatively control-oriented, and in fact may have to be to obtain efficiency and economy. This is particularly necessary if the scale of the activities is large. Construction may be guided by a project management unit or expatriates, but should be a commitment and undertaking of local sector agencies. Implementation of non-technological activities should be more adaptive. Guided by long term objectives, these activities should evolve as the project proceeds, based upon information gathered and lessons learned during implementation. Local personnel should lead in the implementation of non-technological activities, and specific activities should not be tied to activities in the construction schedules.

The first priority of governments should be to establish or reform existing sector policy so that it conforms with the accepted conceptual framework for appropriate and sustainable sector development. In any country, the focus of ESA attention should first be upon assisting the government to establish an effective sector policy framework.

Then, effective management of sector planning and implementation will depend upon both local government and ESA personnel exercising judgement on when to pursue these various approaches in the development process. Inherent is sensitivity on the part of the local government to the needs of the rural population and the capabilities of its own institutions, and sensitivity on the part of the ESA to the needs and capacity of the local government. Planners and implementors, both local and expatriate, must display qualities of judgement, interdisciplinarity, sensitivity and committment to know essentially when to push and when to bend.

9.3 Guidelines for Appropriateness

ESAs and local governments have generally agreed on the conceptual framework for appropriate sector development. The ten main criteria for appropriateness have been discussed and described repeatedly in the literature (see for example UNDP, 1991; WCED, 1987). However in practice they have rarely all been attempted.

From the analysis of the case studies it can be concluded that the major reasons for a program or project being apropriate were:

i) the integration of hygiene education and sanitation promotion with water provision activities, and the emphasis upon human resources development.

ii) the adequate attention given to operation and maintenance aspects.

iii) the significant role played by community women in program or project activities.

iv) the fact that water systems provided were appropriate to available water resources in the area.

The major reasons identified for inappropriateness were:

i) a general lack of community participation in program or project activities, especially with

regard to the selection of (VLOM) technology and the establishment of community-managed operation and maintenance of completed water systems.

ii) a lack of consideration of the environmental context of the program or project activities, and the general failure to effectively incorporate environmental protection and rehabilitation activities.

From these lessons, guidelines for program or project appropriateness can be developed that encompass two main areas of concern; human resources and environmental resources. The guidelines are non-technological implying that technology is not a significant determinant of appropriateness.

Human Resources

- Water, sanitation and hygiene education activities must be fully integrated into all sector programs and projects.
- Training, especially of women, at the community level is essential. Training encompasses extension, administrative, financial and technical training.
- Training of the local government sector institutions, especially in planning, management, operations and maintenance is essential.
- Local government policy should encourage community management of completed systems, with support as required from local sector institutions.
- Technology choice should be made on the basis of least-cost and VLOM capabilities.

Environmental Resources

- Water supplies and sanitation facilities installed must be appropriate to prevailing water resource and environmental conditions.

- The potential environmental impact of proposed program or project activities must be identified, and mitigation measures planned for.
- Environmental enhancement or rehabilitation components should be integrated into all sector programs and projects.

9.4 Guidelines for Sustainability

Increasingly, attention is being paid to enhancing the sustainability of sector development (see for example WHO, 1989; World Bank, 1990). Various criteria for sustainability are discussed in these documents and elsewhere. Local government sector policies are reorienting to incorporate some or all of these criteria.

From the analysis of the case studies it can be concluded that sustainability of program or project outcomes was enhanced somewhat by;

i) the involvement and training of local sector institutions in the installation and maintenance of the equipment.

ii) reasonable and affordable unit service costs.

The major reasons identified for lack of sustainability were:

i) the poor choices of technology, including the failure to consider locally available (indigenous) technology.

ii) the failure of individual programs or projects to coordinate their activities and collaborate with one another, and the general lack of effective linkages between sector groups.

From these lessons, guidelines for program or project sustainability can be developed that encompass two main areas of concern; human resources, and operation and maintenance.

The guidelines are partly non-technological, partly technological, implying that technology is a significant determinant of sustainability in combination with human resources development.

Human Resources

- Sector activities must proceed with collaboration between ESAs and local government institutions, with active cooperation and the establishment of effective linkages between all sector groups.
- Training of local government sector institutions is essential, concentrating upon capacity-building and linkage development.

Operation and Maintenance

- Technology choice should be made on the basis of least-cost and VLOM capabilities, emphasizing the utilization and improvement of indigenous technology whenever possible.
- Training is essential for effective operation and maintenance, and should encompass administrative, financial and technical training to both local government sector institutions and beneficiary communities.
- Least cost technology, full or partial capital cost-recovery and full recurrent cost-recovery are the financial base for sustainability.

* * *

In summary, the analysis of the case studies of programs and projects conducted in Darfur and Kordofan during the IDWSSD reveals that sector management can be improved and the success of future sector efforts enhanced by:

A. Following a broad management approach, encompassing both control and adaptation as needed, with the

divergent goals of increasing coverage and enhancing sustainability.

B. Seriously addressing human resource and environmental resource components for apropriateness in the program and project conceptual framework.

C. Seriously addressing human resource and operation and maintenance components for sustainability in the program and project conceptual framework.

D. Attending to the related sector issues constraining management and success, which are:

- the need for sound sector policies.
- the need for local sector institutions to take the lead role in sector management.
- the reorientation of sector financial arrangements.
- reduction of the technological bias in sector planning and implementation.
- consideration of expanding or segmenting program or project implementation time frames.

Based upon the foregoing analyses, I propose the following alternative program or project management model that combines the broad management approach recommended with the guidelines for enhanced appropriateness and sustainability. The model consists of three distinct phases:

A. Inception Phase

For a one or two year period, emphasis is placed upon community development and hygiene education, with the objectives of:

- gathering information from people in the proposed project area to prepare a baseline survey.
- identifying community needs related to water, and other development needs and aspirations.

- evaluating local water sources, technologies and practices that could be used or modified in the proposed project.
- explaining to potential beneficiaries the options and alternatives available, their costs, and financing and management requirements. The decision to participate and the design of the development would be in the hands of the community.
- identifying areas within community organizational structures where human resources development is needed.
- promoting the benefits of potable water and adequate sanitation by practical and interesting hygiene education sessions.
- encouraging community women to participate in decision-making and organizational structures.
- preparing a plan for the next phase of the project, negotiating with and obtaining approval from all parties to the plan.
- obtaining a firm and formal local government commitment to the program or project.

During the inception phase, project personnel required will be primarily community development and hygiene education workers. More specific input may be required periodically such as in evaluating water sources, gauging environmental conditions, estimating construction costs, etc. These activities should be coordinated by an interdisciplinary specialist within the national or regional sector planning agency, with or without an expatriate advisor as required.

B. Construction Phase

After the inception phase, once an implementation plan has been prepared cooperatively by all parties concerned, then implementation can proceed. Implementation could start in the designated project area, with individual communities joining

the implementation schedule as their financial and other contributions materialize.

The implementation phase could conceivably consist of experimental, pilot, demonstration and replication stages. The time frame could range from several to many years, and the following characteristics may apply.

- in areas of low existing coverage, or in problematic areas, an experimental and/or pilot stage is probably required initially. Based upon these results, demonstration and eventually replication stages may follow.
- in areas less problematic with a relatively well-developed coverage by traditional water sources (however inadequate), pilot and then demonstration stages may be appropriate.
- once technologies and techniques have been sufficiently demonstrated, wide scale replication may be possible throughout an area.

Some key considerations during the construction phase are:

- experimental and pilot stages will probably need to be more controlled than demonstration and replication stages.
- regular monitoring during implementation is essential to learn from experience and improve future implementation.
- construction should only proceed in a given community when that community has demonstrated its commitment to the enterprise.
- construction should be institutionalzied, with expatriate technical advice and motivation only when needed.
- the pace of construction may be slower than anticipated and may be sporadic.
- community labor should be utilized whenever it is practical and willingly offered. Community labor should

be taken into account when determining the cost of the completed system.

- it may not be possible to move through all construction stages in all areas. Some places may not get through the experimental stage.
- in moving from experimental to replication stages, be prepared for the project to evolve and even be substantially different than it started out being.

C. Consolidation Phase

At some point, a discrete consolidation phase is required: at the end of the construction phase, or between stages during construction if the situation warrants it. The consolidation phase is not just for the normal ex-post evaluation, although that may be included, but evaluation and monitoring should have been on-going during implementation. The main objectives of the consolidation phase are:

- to gather information from people in the project area to prepare an impact survey.
- to continue community development and hygiene education for human resources development reinforcement.
- monitor system operation, maintenance and performance.
- evaluate the project's performance and prepare guidelines and re-evaluate goals for future consideration in project planning activities.

With various consolidation phases occurring sequentially, simultaneously or otherwise, they represent a rich source of information for sector planning agencies and for ESAs: information that is currently not available, or if available, not disseminated.

D. Constraints

Adopting the proposed alternative strategy and approach to rural water sector development is constrained by some major considerations.

Politically, both ESAs and governments would be effected. Moving from a shorter-term aid commitment to a longer-term aid commitment would have significant repercussions in most donor countries where elections are held. Within recipient countries, governments used to dispensing development projects on the basis of political support from certain rural areas may have trouble accepting a more "democratic" base to sector development. Without substantial political will and support in both donor and recipient countries, the proposed strategy will not succeed.

Economically, the constraints may affect ESAs and donor countries the most. Ignoring the issue of increasing sector aid, increased coverage is likely to eventually result with current sector aid levels if the alternative strategy is adopted. However, the time taken to realize this coverage increase will be considerably longer. Given the desire for rapid results and rapid returns on investment, ESAs and their supporting governments and populace may be unwilling to support longer term sector investments. More immediately, adopting the alternative strategy could mean less employment for donor country engineering companies, equipment manufacturers and suppliers. Aid would have to be substantially un-tied, and trade objectives may not be realized. The sense of financial control over aid expenditures would lessen.

The immediate felt need remains as it was to increase coverage as rapidly as possible; the sense of impending disasters brought about by environmental degradation, resource depletion, population explosion, increased dislocations, droughts and famines all underline the urgency. A strategy proposed that may actually slow down implementation and

expansion of coverage levels is suspect, to say the least. Ignoring the observation that the headlong technological rush may be one of the root causes behind the impending disasters, a healthy dose of realism is required. This realism, inherent in the proposed alternative strategy, hinges upon the following:

- it will never be possible to achieve full coverage in the rural water sector.
- it is more sensible, and in the long term more humane, to develop a lesser number of water supplies that are appropriate and will last, than a large number that will substantially fail.
- that the impetus and resources for developing water supplies must come from the beneficiaries themselves: no one else in reality can do it for them, only assist temporarily in the process.

The sector dilemma of increasing coverage while enhancing sustainability may never be resolved; this alternative time frame to rural water sector development is a suggestion that quality is more important than quantity.

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11. Appendix

11.1 Descriptions of Basic Water Systems Installed in Sudan

. Shallow Well

- normally hand dug and of large diameter (up to 3 metres).
- constructed into water table or perched aquifers.
- traditionally unlined or lined with wood, with improved versions cased with concrete rings or blocks.

. Borehole

- constructed by drilling equipment and of small diameter (100 to 200 mm).
- constructed into water table, perched or artesian aquifers.
- normal depths in Darfur and Kordofan range from 50 to 300 metres.
- cased with steel pipe, equipped sometimes with a perforated or continuous-slot screen in the water bearing section.

. Handpump

- a relatively modern water-lifting device employing human power to pump water, usually by means of a lever, rod and piston/cylinder.
- numerous types exist, the most common in Sudan being the India Mark II installed in UNICEF Programs.

. Traditional Water-Lifting Device

- typically a leather bucket formed from goat skin attached to a rope made from woven crop residue or leather.
- raised by hand or by animal power.

. Windlass

- an improvement whereby the traditional water-lifting device is raised by turning the windlass

handle or wheel, which wraps the rope around the handle or wheel bearing shaft.

. Wateryard
  - a centralized water supply complex consisting of one or more boreholes, motorized pumping equipment, an elevated water storage tank, and outlets for container-filling and livestock watering.

. Haffir
  - an excavated reservoir constructed to catch and store periodic surface runoff.
  - nominal capacities range from 5,000 to 60,000 cubic metres.

. Earth Dam
  - a dam constructed across a wadi or other surface runoff channel, to catch and store periodic surface runoff in the reservoir created upstream of the earth dam.
  - nominal capacities range from 300,000 to 2,000,000 cubic metres.

. VIP Latrine
  - an excavated pit, normally 3 to 4 metres deep and 1 to 2 metres in diameter, covered with a ground level concrete slab, slab superstructure, and a vent pipe installed to remove noxious odors from the pit to the atmosphere above the superstructure.
  - when properly installed and maintained, is hygienic and virtually odor-free.

11.2 Data Collection Techniques

Data collection was by means of four main techniques:

- interviewing key government and ESA sector personnel.
- interviewing a sample of beneficiaries.
- conducting a comprehensive document and literature search.
- field observation of program and project implementation

and outcomes.

Interviews were conducted at several levels:

1. Semi-structured interviews with senior-level political representatives including:
   - department ministers (irrigation, energy, agriculture).
   - department heads (equivalent to deputy ministers).
   - regional governors (Kordofan, Darfur).
   - deputy regional governors (development).
   - salvation national committee heads (development), appointed by the current military government.
2. Unstructured interviews with senior and middle-level government section personnel:
   - MFEP water section.
   - MFEP development planning sector.
   - MFEP development financing section.
   - NCDRWR planning and management sections (Khartoum, Kordofan, Darfur).
   - NCDRWR construction, operation and maintenance sections (Khartoum, Kordofan, Darfur).
   - MOH management, sanitation and hygiene education sections.
   - MOSW community development and extension sections.
3. Unstructured interviews with senior and middle-level ESA sector personnel:
   - UNICEF country office and Kordofan regional staff.
   - USAID country office staff.
   - CARE country office and Kordofan regional staff.
   - DGIS country office and Darfur regional staff.
   - UNDP country office and Darfur regional staff.
   - FAI (Italian Fund Aid) Darfur regional staff.
   - CIDA Horn of Africa and country representative staff.
   - WUSC country office and Darfur regional staff.
4. Semi-structured interviews with senior-level development

personnel:

- UNICEF, New York.
- U.S. Embassy, Khartoum.
- The Royal Netherlands Embassy, Khartoum.
- UNDP, New York.
- The Italian Embassy, Khartoum.
- The Canadian Embassy, Cairo and Addis Ababa.
- CIDA, Ottawa.

5. Unstructured interviews with other ESA personnel, consultants and academic institutions as relevant.
6. Semi-structured interviews via an interpreter with beneficiaries at various locations in Kordofan and Darfur, including:
   - village councils.
   - district development committees.
   - district national salvation committees.
   - community water/health committees.
   - women's groups and organizations.
   - student's groups and organizations.

A comprehensive document and literature search included:

1. A review of all documents pertinent to the five case studies:
   - from ESA sources.
   - from government sources.
   - from independent sources such as evaluators and monitors.
2. A review of documents from various sources pertaining to related sector programs and projects conducted in Sudan prior to the IDWSSD, or planned for possible implementation after the IDWSSD.
3. A review of documents related to sector planning and financing:
   - from MFEP sources.
   - from World Bank/UNDP sources.

- from NCDRWR sources.
- from academic sources (University of Khartoum, University of Birmingham).

4. Baseline studies for Kordofan and Darfur produced by consultants and the government of Sudan.
5. Case studies of sector development in Africa, specifically sub-Saharan and the Horn of Africa.
6. General rural development analysis and case studies in the developing world, specifically Africa.
7. Archival documents in the Kordofan and Darfur Regional Libraries.

Field visits were made to each of the five case studies during the three year period from 1987 to 1990. In general, each was visited more than once, but security problems in Southern Kordofan and Southern Darfur in 1989 and 1990 curtailed further visits to programs located in those areas after those dates. In each case, during the field visits the author was accompanied by local Sudanese experts or officials knowledgeable with the area and population. Some visits were made accompanied by ESA personnel, other subsequent visits were made without the presence of ESA personnel.

Problems arise with the accuracy and reliability of data collected in the developing world in general, and in Sudan in particular, for a variety of reasons including:

- key person biases.
- oral/recollection biases.
- political biases and political discontinuities.
- poor communications.
- poor security situations.
- estimation and extrapolation in the absence of hard data.
- rapidly and unpredictably changing conditions.
- time inconsistencies in data recording.
- political, institutional or competitive sensitivity

of data.

Data collected included:

- description of the program or project
- program or project objectives
- program or project development/evolution
- planning undertaken
- institutional framework
- sector context
- technology choice
- sanitation/hygiene education aspects
- community involvement
- operation/maintenance aspects
- financial/cost-recovery aspects
- implementation/construction
- coordination
- monitoring/evaluation
- outcomes
- major issues
- major constraints
- future constraints
- sector implications

An attempt was made to validate data collected as far as possible by using multiple data sources, by cross-checking data between sources, and by evaluating data collected against data collected by secondary, independent sources. In all cases, quantitative data were supplemented by qualitative data collected via direct observation.

11.3 Examples of Questions Used in Semi-Structured Interviews

A. Interviews with senior-level political representatives of GOS

. Describe the achievements in the GOS ruralwater sector that have occurred nationally/regionally, especially during the IDWSSD.

- What areas require the most immediate attention for future sector development?
- What are the interrelationships you see between sector development and other national/regional development efforts and needs?
- The GOS is currently working to define an effective sector policy: what role have you played in this process, and what are the main issues you feel that sector policy should address?
- Has ESA involvement in sector development been beneficial? Where has it resulted in successful development, and where is improvement required?
- What roles do you see as appropriate for communities, GOS sector institutions, and ESAs for future sector development?
- How should development work in the sector be financed, both regarding capital cost and recurrent cost?
- Regarding (specific program/project) how would you assess its design and performance?
- Regarding (specific ESA), how would you assess their strengths and weaknesses?
- Regarding (specific local sector institution), how would you rate their capacity and capabilities?

B. Interviews with senior-level ESA representatives

- Describe your agency's involvement in the sector in Sudan, both in the past and currently.
- Compare your agency's sector activities in Sudan to your activities in other sub-Saharan African countries, and in the developing world in general.
- What are your agency's intentions regarding future sector involvement, both in the shorter and longer term?
- What are the main goals and objectives of your agency's sector development activities?
- What are the main issues you feel that GOS sector policy

should address?

- Has your agency's involvement in sector development in Sudan been successful? What have your efforts achieved, and where is more work required?
- What are the appropriate roles for communities, GOS sector institutions, and ESAs in future sector development?
- How should sector development work be financed, both regarding capital cost and recurrent cost?
- Regarding (specific program/project), describe how it was identified, designed and planned.
- Regarding (specific program/project), describe how implementation proceeded and assess the results and outcomes.
- Regarding (specific ESA), how do your agency's programs and projects complement theirs? In what areas do you see divergence?
- Regarding (specific local sector institution), how would you evaluate their performance, capacity, capability, and strengths and weaknesses?

C. Interviews with community beneficiaries (individuals and groups)

- Describe the historical development of water supplies in your community, and your interactions with the GOS.
- Regarding your current water supply, describe how it came to be constructed in your community.
- Who owns the current water supply in your community, and who is responsible for operating and maintaining it?
- Describe what you like about your current water supply, and what you do not like about it. Does it meet your needs? What needs to be improved?
- Looking to the future, what are the needs and goals for development in your community, and do you see the current water supply as being adequate?

- Regarding VIP latrines (where present), what do you like about them most, what are their drawbacks, and do you see more being built in your community?
- Regarding hygiene education (where presented), what are the major lessons you learned and what impact did these lessons have upon your family's hygiene practices and health?
- Regarding (specific local sector institutions and ESAs) who were involved in building your current water system, did you feel that they were interested in the community as a whole, or more interested in the water system construction only?

11.4 Examples of Questions Used in Unstructured Interviews

A. Interviews with GOS sector personnel

- Describe your institution's role in the sector and in sector development.
- Regarding your institution, describe:
  - organizational structure
  - career paths and promotional procedures
  - reporting and communication channels
  - decision-making procedures
  - procurement (where applicable)
  - transportation (where applicable)
  - work scheduling (where applicable)
  - monitoring
- What is your role and what are your responsibilities within this institution?
- In what areas have you been successful, and in what areas is your work constrained? What are the major constraints you face?
- Discuss (specific GOS sector policy issue) as it relates to your experience and to your institution's role and objectives in the sector.

- Discuss (specific ESA's approach to development management) as it relates to effective or ineffective program/project outcomes.
- Discuss (specific local sector institution's performance), and indicate where they have been effective and where weaknesses exist.
- Regarding identifying, designing and planning sector programs/projects, who should take the lead role and why?
- Regarding implementing, monitoring and evaluating sector programs/projects, who should do this and why?
- Regarding (specific program/project), evaluate its successes and failures.
- Which ESAs and other local sector institutions do you collaborate with, and why? Assess your relationships with these groups.
- What relationship should exist between communities and GOS in the ownership and management of rural water supplies?
- What immediate problems do you face in sector development, and what future difficulties will need to be addressed?
- What are your personal career goals and objectives?

B. Interviews with ESA sector personnel

- What is your role and what are your responsibilities within this ESA?
- Discuss (specific GOS sector policy issue) as it relates to your experience and your role in the sector.
- Regarding (specific program/project):
  - how was it identified?
  - who designed and planned it?
  - describe the implementation.
  - describe the outcomes.
  - describe the financial arrangements.
  - what successes did you have?

- what did not go as expected?
- what constraints did you face?
- if you were to do it again, what would you change and what would you keep the same within the program/project?

- Describe your relationships and interactions with:
  - national/regional GOS
  - specific GOS sector institutions
  - specific ESAs (planners, administrators)
  - specific ESAs (implementors, monitors)
  - consultants and advisors
  - academics and local training institutions
  - communities
- Regarding (specific local sector institution), how would you evaluate their performance, capacity, capability, and strengths and weaknesses.
- Regarding your in-country operations, describe:
  - other activities beyond the sector
  - organizational structure
  - reporting and communication channels
  - decision-making procedures
  - work scheduling
  - procurement
  - transportation
  - monitoring
  - commissioning
- What are your personal career goals and objectives?

C. Interviews with consultants, academics, etc.

- What specific roles have you played in the sector in Sudan? What roles do you feel you should play?
- Assess past sector performance in Sudan, especially during the IDWSSD. How does this compare to sector performance in other developing countries you have experience with?

- What are the main issues you feel GOS sector policy should address? Do you think these issues will be or are being seriously considered?
- Give some examples of successful and unsuccessful sector development activities. How would you rate the effectiveness and success of (specific program/project)?
- Describe your experiences in and inputs to sector planning, monitoring and evaluation.
- Rate the performance of (specific ESA or local sector institution) and (specific individuals) within that organization.
- What is meant by "appropriate" and "sustainable" and how are these concepts to be realized?
- What are your personal career goals and objectives?

11.5 Case Study Supplementary Information

Table 20 UNICEF Kordofan Program 1989 Budget

	U.S. Dollars
UNICEF	
Expatriate Staff	N/A
Vehicles, equipment, supplies	1,420,000
Cash production bonus/training incentives	196,000
UNICEF Contribution (not including staff or overhead)	$1,616,000
NCDRWR*	
Local staff	222,200
Stores, office, workshop facilities	44,400
Local supplies	106,000
Contingency	111,100
Transport of imported materials	222,200
Fuels and oils	125,100
NCDRWR Contribution	$831,000
Total 1989 Program Budget	$2,447,000

* Computed as U.S. Dollar equivalent at $1.00 = 4.50 Sudanese Pounds.

Source: UNICEF, 1988(a).

Table 21 **USAID/CARE and CARE/NCDRWR Project Agreements**

Item or Specific Objective	Planning Agreement (USAID/CARE)	Implementation Agreement (CARE/NCDRWR)
Communities to be included in project	30	26
Wateryard Rehabilitation	15	12
Shallow wells	13	13
Haffir Rehabilitation	2	1
Training for local private workshops	3	0
Community health and sanitary education sessions	30	26

Source: WASH, 1988, page 15.

Table 22 USAID/CARE Project Expenditures (U.S. Dollars or equivalent)

Item	USAID	CARE USA	CARE ITALY	CARE FRANCE	USA FOR AFRICA	TOTAL
Personnel	126,951	68,750	-	-	-	195,701
Materials/ Equipment	467,313	-	20,000	54,968	9,481	551,762
Vehicles	-	-	-	25,032	36,848	61,880
Vehicle Operation	71,428	856	-	-	-	72,284
Travel/Insurance	43,922	4,072	-	-	3,671	51,665
Office Operations/ Equipment	43,868	63,525	-	-	-	107,393
Miscellaneous	92	-	-	-	-	92
Overhead	63,129	-	-	-	-	63,129
Total	816,703	137,203	20,000	80,000	50,000	1,103,906

Source: WASH, 1988, page 14.

Table 23 **USAID/CARE Unit Costs For Various Project Activities**

	U.S. Dollars/Unit
- Borehole Rehabilitation	13,034/Borehole (1)
- Borehole Cleaning	4,750/Borehole (2)
- Borehole Drilling	25,080/Borehole (3)
- Engine, Pump, Pipe installation	22,088/Unit (4)
- Engine/Pump Overhaul	5,670/Unit (5)
- Shallow Well Rehabilitation	3,100/Well (6)
- Shallow Well Construction	10,010/Well (7)
- Handpump Installation	2,600/Installation (8)
- Community Development/ Hygiene Education	7,016/Community

Source: Modified from WASH, 1988, page 41.

(1) includes materials, labor, vehicle operation.
(2) includes materials, labor.
(3) includes materials (including casing/screen), labor, equipment operation.
- above based upon boreholes in the 120 to 135m depth range.
(4) includes Lister 8 h.p. engine, Edeco pump, rising main and associated materials, labor.
(5) estimate only.
(6) includes materials, labor, vehicle operation.
(7) includes materials, labor, vehicle operation.
- above based upon wells 45m deep.
(8) includes twin pumps, materials, labor, vehicle operation.

Table 24 DGIS Village Water Supply Construction Cost Forecast ('000 Sudanese Pounds*)

	Foreign Staff	Local Staff	Equipment	Materials/ Fuel	Vehicles	Total	#Wells
1986/87	5,500	290	2,000	492	4,750	13,032	
87/88	5,500	290		378		6,168	
88/89	4,800	290		703		5,793	110
89/90	3,200	413	1,225	889	3,565	9,292	
90/91	1,600	413		889		2,902	
91/92	900	413	750	703	4,750	7,516	190
92/93	900	413	500	492		2,305	
93/94	900	413		492		1,805	
94/95	900	413	725	492		2,530	105
Total	24,200	3,348	5,200	5,530	13,065	51,343	405

Source: Adapted from WADS, 1989(b).

* Assumes a shadow price of 11.5 Sudanese pounds to one U.S. Dollar, a more realistic estimate of the value of the currency.

Table 25 **UNDP Development Plans in Sudan**

Development Plan	Country Programme	Programme Value
1970/71 to 1974/75*	1972 to 1976	$20 million U.S.
1977 to 1981**	1977 to 1981**	$28.5 million U.S.
1982 to 1985	1983 to 1986***	$20.6 million U.S.
1987 to 1991	1988 to 1991	$33.9 million U.S.
		$103 million U.S.

Source: UNDP, 1987.

* extended to 1977
** extended to 1982
*** extended to 1987

Table 26 **CIDA/WUSC Project Typical Wateryard Performance**

Technical Performance:	
Water pumped	3,129.00 m^3/month
Hours operated	585.00 h/month
Average production	5.70 m^3/hour
Monthly fuel use	562.00 litres
Fuel Consumption	0.93 L/h
Fuel Consumption	0.17 L/m^3
Financial Performance: (Sudanese Pounds)	
Monthly Revenue	15,843
(A) Variable costs:	
Fuel	1,853
Oil	142
Spares/Supplies	251
(B) Fixed costs:	
Wateryard staff	2,873
Operation and Maintenance service unit cost	2,522
Total Costs	7,641
Balance	8,202

Source: WUSC (1990(a)).

Table 27 CIDA/WUSC Project Budget

CIDA Source	Canadian Dollars ('000)	USAID Source	Sudanese Pounds ('000)
Personnel	1,600	Personnel	2,331
Equipment/ Supplies	1,900	Equipment/ Supplies	554
Vehicles	150	Vehicle Operation	2,475
Office Support	150	Office Support	1,693
Training	300	Transport	2,143
Total	4,100	Total	9,196

Source: Compiled from WUSC, 1990(d) and WUSC, 1990(c).